Food Flavorings
Composition, Manufacture, and Use

by JOSEPH MERORY
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Dedicated to
MR. GEORGE L. SCHULTZ
President of Shulton, Inc.
for his vision and generosity
and to
MR. RICHARD E. BRAINARD
for they made possible the
independence of the author's firm,
Merory Flavors, Inc.
thus enabling him to publish this book

Dedicated to
MRS. SARAH MERORY
the author's wife
in gratitude
for her encouragement
Flavorings are of great importance to the palatability of all products which are prepared for human consumption. Bakery goods, meat products, gelatin desserts, confectionery, ice cream and ices, non-alcoholic and alcoholic beverages, tobacco, and pharmaceutical preparations require the addition of flavorings to make them acceptable and to satisfy continuously growing and changing demands. Nature has provided an abundant variety of flavoring substances, but in a limited quantity. As requirements grew, the chemical industry busied itself during the last half century and succeeded in supplementing nature by duplicating aromatic substances with even more powerful odor and taste than nature could produce. Thus flavorings have been made available in unlimited quantities which are economical to use.

Aromatic substances of natural or chemically manufactured origin are used mainly in mixtures to yield the proper flavorings for food and beverages. However, the literature with regard to food flavorings has been very meager during the last fifty years. Formulas and preparation of food flavorings have been kept under severest secrecy everywhere. Thus skilled flavor technologists are still very few.

This book is the first of its kind to be written for publication by a practicing flavor manufacturer. It is based on forty years of close contact with manufacturers who make or use food flavors, purchasers who order them, and chemists who utilize food flavorings in products for human consumption. From the inquiries concerning their needs and requirements as well as from information about their ingredients and manufacturing procedures the practical solution of flavoring problems has been made possible and are published in this book.

The book is divided into three sections: Natural Food Flavorings, Imitation Flavors, and Uses of Food Flavorings. Manufacturers and chemists who make or use food flavorings, students who want to learn about them, purchasers who buy and salesmen who offer them have been given consideration in the layout of this work so that it can serve all as a text and reference book.

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Although all sections of the manuscript have been carefully checked and thoroughly reviewed, some errors may remain. Any suggestions for improvement of the book or information indicating errors of omission or commission will be welcomed.

JOSEPH MERGY
Lake Hiawatha, New Jersey

March 15, 1960
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SECTION I

Natural Food Flavorings
CHAPTER 1

Fruit Flavors

DEFINITION OF FLAVOR

Flavor is a sensation which is derived from odor. Odor is created by aromatic substances which are present in every living matter grown in nature. Taste is perception which depends on odor. Thus, taste is the odor component of flavor.

The flavor manufacturer is interested in separating or duplicating and compounding the odorous substances of natural ingredients in order to create the various sensations which are called flavor.

Fruit and Their Characteristics

Basically, ripe fruit consists of skin or peels, fruit flesh, kernels and pits with fibers; also seeds with hulls and shells of various structure. The skin and the peels of fruit carry most of the flavor. The fruit flesh contains sugars such as dextrose, levulose and sucrose, along with enzymes, acids, coloring matter, and juice. Berry seeds, with proper treatment, yield a supporting flavor. Exposure of pitted seeds to hydrolysis forms benzaldehyde.

There is a correlation between sugar content, color, acidity, and flavor as fruit ripens. The flavor usually develops to its fullest aroma when the sugar content of the fruit is at its maximum and the color of skin or peels acquires the richest shade of brilliancy. When the fruit becomes overripe, the color turns dull, the sugar grows syrupy, and the flavor loses its volatile freshness.

Expressed juice does not contain the flavor of the whole fruit. The characteristic volatile aroma which carries the fresh flavor of expressed juice usually is less than 0.07 part per thousand. Only a compound mixture of extracted fruit, expressed juice, and aromatic constituents derived from the rest of the fruit will produce the flavor which can impart the full aroma and taste of the whole fruit.

Property of Fruit Flavor

Shade of color is often indicative of flavor strength of fruit. Evaluation of expressed juice, fruit extractive, and fruit flavors derived from a single fruit after which the particular yield is named, can be successfully made by flavor and color measurements. They consist mainly of the thresholds of perception and identification; the first showing faint color and the
second, distinct color. A true flavor which lacks the color shade of the fruit after which it is named can invariably be classified as a fortified product.

**Concentration by Vacuum Distillation**

Evaporation of water from expressed fruit juices and flavoring extracts by vacuum distillation yields concentrated soluble solids and extractive matter with little flavoring. The aromatic substances are stripped from the juice or flavoring extract during the vacuum distillation. They separate in form of vapor, part of which is recovered by condensation while the more volatile part is lost. Thus, the condensed material after vacuum distillation retains only a part of the original flavor. Coupled with the concentrated extractive matter, a flavor concentrate is obtained which is similar in character but weaker in volatile components to the flavor of the fruit from which it is made.

Fruit juices and extracts of cherry, raspberry, apple, and Concord grape will not be greatly changed by heating at boiling temperature of 212°F, for a short period of time.

Expressed juices and flavoring extracts of fruit containing 15 per cent alcohol will boil at 188.6°-197.2°F. Kept at this temperature for about ten or fifteen minutes, expressed fruit juices will retain extractive matter and color but lose volatile aroma by evaporation. Fruit flavors have been concentrated applying first the fractional distillation at atmospheric pressure to obtain an alcoholic flavor distillate with a yield of up to two per cent of the input of juice put into the still. The distillation is then interrupted and the juice cooled rapidly. The concentrate is then followed by a vacuum distillation. The condensates are fractionated to separate flavor and to recover alcohol. The flavor yield of the distillation at atmospheric pressure and the first flavor fraction of the vacuum distillation are then combined with the concentrate. The mixture is a flavor concentrate which contains the almost fully captured aroma of the fruit.

This type of manufacture of fruit flavor concentrate requires a steam heated water jacket covering about two-thirds of the still which can be used for heating as well as for cooling. The water jacket should contain a steam coil. Also required is a properly installed dephlegmator with a controlled reflux ratio along with three receivers and a condenser of suitable capacity. The vacuum pump must be capable of keeping a constant pressure. Juice and flavoring extract will be agitated vigorously during the flavor distillation at atmospheric pressure and during the concentration by vacuum distillation. The agitator should have its propellers fan out in a semi-circle along the walls of the still and reach up to the end of the heating jacket.
The vacuum in many of the stills which are used for concentration of fruit juice and flavoring extractives should be kept at about 28 inches for best results. The flavor strength of concentrated flavor is proportional to the degree of concentration. The peak of flavor strength is reached when expressed juice and fruit extractives are concentrated in conventional vacuum stills to a final yield of 25 lbs. of fruit per gallon of fruit flavor; that is, after concentrated juice and flavor distillates are combined. The temperature of the fruit juice and flavoring extract in the still rises with increased concentration and often reaches 176°F. and more, depending on the extractive matter and sugar content of the juice or fruit extractives. The agitation in conventional stills is not turbulent enough to prevent changes of aroma and taste resulting from the increased heat of the concentrated medium. Besides deterioration of flavor, the color may caramelize with growing concentration if the temperature is permitted to rise above 140°F. Formula MF 15 (p. 32) includes the procedure for a concentrated cherry fruit flavor.

Concentration by Freezing

Concentration by freezing will yield a superior fruit flavor provided that the expressed juice and flavoring extract has an alcohol content of about eight per cent. Alcohol absorbs the volatile aroma and with growing strength will increase with the concentration of the flavor and color of fruit juice and extractive matter. Fruit juices and flavoring extracts without alcohol usually do not yield a satisfactory fruit flavor concentrate by freezing. The freezing temperature during concentration varies from +10°F. to 0°F. Sugar added to fruit makes freezing of alcoholic fruit juices and flavoring extracts difficult. Formula MF 16 (p. 34) illustrates the concentration of fruit flavor by freezing.

The Essence Recovery Process and Full Flavor Concentrated Fruit Juice

The invention of the process of recovery of volatile aroma, the so-called "essence recovery process," from fruit juices in 1944 was followed by improvements in equipment and design in subsequent years afterward. It gradually made the manufacture of full flavor fruit juices in higher concentration possible. The first commercially successful process for the recovery of volatile aroma was developed for apple juice by the Eastern Regional Research Laboratory of the U.S. Department of Agriculture in 1944. The process was later modified to produce other full flavor fruit juice concentrates.

A feature of the process is operation at atmospheric pressure which minimizes aroma loss in the vent gases. Heat damage to the juice is avoided by high velocity, turbulent flow in the preheater. Essence re-
covery is effected by condensation of the fractionated vapors combined with scrubbing of the non-condensable gases before venting to the atmosphere. Production of full flavor juice from frozen and freshly picked cherries is illustrated in detail in formulas MF 17 and MF 18 (pp. 35 and 36).

Sugar-free Fruit Flavors

The author combined the essence recovery process with his own manufacturing procedures and succeeded in creating the sugar-free fruit flavors, which not only contain the fragrant freshness of the volatile aroma of the expressed fruit juice but also the full aroma of the whole fruit. The full aromatic fruit flavors also retain entirely the brilliant intensity of the fresh fruit color (Merory 1958).

Fruit Flavors With Other Natural Flavors

Food and Drug Administration Regulations.—The regulations of the Federal Food, Drug and Cosmetic Act specify that fruit flavors which are fortified with other natural flavors may be labeled as such provided that at least 51 per cent of the flavor strength is derived from the fruit after which they are named.

Fortification of fruit flavors with extractives, distillates of other fruit, or botanical ingredients and essential oils add taste and aroma as well as increased color.

However, it does not increase the strength of the original flavor of the fruit from which it is derived. With the exception of cherry, the fortification of fruit flavors with other natural flavors may add a more or less successful likeness but does not necessarily intensify the original aroma.

Measurements of Flavor Strength.—Expressed juice differs in flavor strength from an alcoholic flavoring extract derived from the same fruit. One gallon of juice and flavoring extract obtained from 10 lbs. of fruit and added alcohol is equal, in flavor strength, to about 1.5 gal. of juice which has been expressed from 10 to 12 lbs. of fruit.

Flavor evaluation by taste made every year after each harvest by using both expressed juices as well as alcoholic flavoring extracts of all types of fruit which are commonly processed in the manufacture of fruit flavors showed in general that 10 gal. of an alcoholic flavoring extract derived from 10 lbs. of fruit per gallon of yield are required in 100 gal. mixture with water to identify a fruit flavor, while about 15 gal. of juice are necessary to identify the type of fruit from which the juice has been expressed without the aid of an alcoholic extraction. Thus, the threshold of identification is to be considered basically the measure which specifies the flavor strength of an expressed juice or of a fruit flavoring extract.
In compliance with the regulations of the Federal Food, Drug and Cosmetic Act the specification of 51 per cent flavor strength which is derived from the fruit is equivalent to 5.1 gal. of alcoholic flavoring extract which is obtained from 51 lbs. of freshly picked or frozen fruit and is mixed with 94.9 gal. of water to a 100 gal. yield. It is also equivalent to 7.65 gal. of juice expressed from 76.5 to 91.8 lbs. of freshly picked or frozen fruit in a mixture with water to a 100 gal. yield.

APPLES

Property of Fruit

Average contents: water—84.37; sugar—8.85; malic acid—0.70; pectin—3.18; soluble solids—13.64; insoluble solids—1.99; fibre, peel, seeds—1.21.

Aromatic Constituents of Apples

The aromatic constituents of apples have been identified as being largely the amyl esters of formic, acetic, caproic, and caprylic acids. The esters increase in amount as apples ripen. Geraniol has been identified as another one of the odorous constituents of apples. Acetaldehyde and traces of ethyl alcohol have been found in normal apple tissue.

The physical and chemical changes in the apple prior to and during harvest proceed so slowly that it is almost impossible to select any measure or index of maturity. Apples are commonly sprayed with chemicals to control chewing insects such as the codling moth and apple maggot. Various types of machines and counteracting chemical ingredients are used in washing the fruit.

Most apples are graded before being sold. Most states have grading laws for apples which state that all apples sold in closed containers must be marked as to variety, grade, size range, or count of the fruit in the box, quantity of the contents or the net weight, and the name and address of the packer or repacker.

Apples Used for Drying, Canning, and Freezing

Apples possessing good cooking quality are most desirable for use in preparing dried, canned, and frozen products.

Grades of apples used for processing vary from field-run fruit to culls of an arbitrarily established minimum size. Apples purchased from packing houses will consist of definite grades.

The factors governing the quality of apples for fresh market use apply equally in determining the quality of this fruit for processing. The major portion of apples used in processing are obtained from fresh fruit pack-
ing houses and have therefore been washed to remove spray residue and are free from decay. Most apples prepared for preservation are peeled by machines that mechanically pare the fruit. Bits of skin, bruises, and defects remaining after the peeling operation are removed from the fruit by hand. The fruit is then sliced or cut to the desired form. From 25 to 45 per cent of the fruit is lost in the peeling, coring, and trimming operations, depending on the size and condition of the fruit.

### Apple Juice

Fresh apple juice is subject to rapid fermentation. In the United States the early distinction between the fresh and the fermented juice was made by simply terming the respective products as cider or fresh cider, and hard or fermented cider. At present the term cider is retained for the fresh or chemically preserved product and to the juice preserved by heat in hermetically sealed containers. Generally apple juice is the product which contains less than 0.5 per cent alcohol, by volume, regardless of its method of preservation. Products containing more than 0.5 per cent and less than 8 per cent alcohol, by volume, are termed ciders.

**Preparation.**—Apples to be used for juice are inspected. Decayed and badly damaged fruit are removed. The fruit is thoroughly washed to remove dirt and to reduce the micro-organisms on the surface. By thus reducing the initial inoculation of the juice with organisms, greater stability to fermentation is obtained during processing and the quality of the juice is improved. To obtain the maximum yield of juice it is necessary to disintegrate the apple tissues. Flavor constituents and vitamins concentrated directly beneath the skin are more completely expressed after thorough disintegration. Grating produces a juice richer in ascorbic acid than crushing.

**Maceration.**—Maceration consists of holding the milled fruit for a period of twelve or more hours before pressing but is not employed in the commercial manufacture of unfermented apple juice. The maceration results in a more fully flavored juice but leaves a harsh aftertaste. However the maceration for 24 hours of 35 to 40 lbs. of presscake per 100 gal. of juice yields an improved flavor.

**Pressing.**—Several types of presses are used to remove the juice from the pulp. With the exception of small home presses, which usually operate by means of a screw, practically all apple juice is pressed with power-driven hydraulic presses, which vary in size and style.

The most common procedure for pressing juice consists in making a single pressing, after which the cheeses are removed and the pomace separated from the cloths. In some cases it has been found economical...
to press, in two stages. The cheeses are first pressed in a large, low-pressure press which removes the greatest portion of the juice, after which the partly pressed cheeses are transferred to a smaller, high-pressure press to complete the operation. Under certain conditions it is advantageous to disintegrate and repress the pomace to effect an increase in yield of juice. This procedure is more common when low-pressure presses are used. To accomplish a second pressing the once-pressed pomace is disintegrated in a pomace picker and used in building new cheese. With normal operation, the average yield that can be expected with three pressings are 150, 20, and 3 gal. per ton of fruit. After the pressing is completed the racks and cheeses are removed from the press and the cloth stripped from the pomace. The pomace is usually passed through the pomace picker and transferred to storage bins for further processing.

Utmost cleanliness is required in operating a press room to assure that undesirable, off-flavors are not imparted to the juice. Besides frequent washing of the equipment to remove accumulated pulp and spilled juice, special attention is given to the cloths and racks. Unless it is periodically washed and aired this equipment tends to impart a musty, stale flavor to the juice.

Apple juice flows from the press as an amber fluid that may darken slightly within a few minutes after pressing. The change in color during pressing is caused by enzymatic oxidation of tannin compounds present in the juice. The nature of conventional apple presses and delays inherent in methods of pressing the pulped fruit make it impossible to retain the natural color of the apple juice unless special processes are used.

The natural apple color and flavor in the juice can be retained by the use of ascorbic acid. Chilled apples are rapidly ground and an apple juice solution of ascorbic acid is sprayed on the pomace during milling at a rate equivalent to from 6 to 12 gm. of ascorbic acid per bushel of apples (40-45 lbs.). After pressing the juice is deaerated, flash pasteurized, and sealed into containers as rapidly as possible to avoid darkening.

Beside soluble constituents responsible for its flavor, aroma, and color, freshly pressed juice also contains more or less suspended solids ranging in size from lumps through cellular pulp, to finely divided, dispersed colloidal material. The larger pieces are usually removed from the juice by screening at the press.

Removal of suspended solids by direct filtration is difficult because of mucilaginous, hydrophilic gums and pectinous materials contained in the freshly pressed juice. Much of the suspended solids are colloidal and retentive filters are required to produce a clear product.

A number of enzyme preparations have been employed to clarify apple
FIG. 1. THE FITZPATRICK COMMUNICATING MACHINE

Used to reduce fruit and vegetable plants to small particles in order to facilitate complete extraction of aromatic substances.

juice. Their action depends on their ability to hydrolyze collooidally suspended material into either more or less soluble substances.

Commercial preparations of enzymes, available in the United States as "Pectinol," are sufficiently potent to permit the rapid handling of large quantities of juice. Gelatin is usually added to these preparations to facilitate precipitation and stabilize the enzymes in solutions. The colloidal system of the juice is so completely broken down that the juice may be rapidly filtered without difficulty from clogging. The delicate, mild flavor of the juice makes clarification without change in flavor difficult.
The effect of enzyme treatment on apple juice varies with the preparations used. Off-flavors may be contributed to the juice unless the enzyme preparation is freed from such flavors during manufacture. Commercial preparations of pectin-decomposing enzymes are now available that do not contribute noticeable flavor and their principal effect on the juice is a reduction of viscosity, through decomposition of pectin substances.

FIG. 2. COMMINUTING CHAMBER

Comminuting blades with hammer-like carvings in the back are installed in the chamber which is reversible.

**Filtration.**—To effect complete removal of suspended material from clarified apple juice it is necessary to filter or centrifuge the juice. Filtration reduces the viscosity and alcohol-insoluble fractions of the juice. The loss in viscosity may be restored, if considered desirable, by replacing the pectin lost during clarification. Losses in other constituents that contribute to the flavor and properties of apple juice depend on the type of clarification treatment used, but in general these changes are not great. Filtration also has the effect of removing micro-organisms from juice.

**Carbonation.**—Clarified and filtered juice may be carbonated in equipment used for the carbonation of water by the carbonated beverage industry, provided corrosion-resistant metals have been used in those parts which come in contact with the juice. Use of about 2.5 volumes of carbon dioxide for each volume of apple juice has been suggested as suitable
for this beverage. A higher carbonation is desired for very sweet juice than for highly astringent juice.

Although carbonated apple juice has been described as comparable in flavor appeal to other carbonated beverages, commercial production of this product is limited.

**Blends With Other Fruit Juices.**—The fresh, but mild, fruit flavor of apple juice serves as an ideal base and is relatively inexpensive to produce in comparison with juices prepared from other fruits.

**Preservation.**—Apple juice not intended for immediate consumption must be subjected to some preservation process to prevent spoilage.

The most important commercial method of preservation is pasteurization. The most satisfactory method for preserving the fresh flavor of apple juice is by freezing. Juice preserved in this manner need not receive any heat treatment, and flavor changes which occur in canned juice during storage at higher temperatures are retarded. Chemicals used in the commercial preservation of apple juice are confined principally to sodium benzoate, sulfurous acid including its salts, and CO₂.

**Concentration**

The term juice concentrate is usually applied to fruit juices that have been condensed by the removal of water and which, when rediluted with water, resemble the original juice in composition. Concentrated juices are usually unpalatable because of their high acid content. The term syrup is generally applied to products prepared from juice with the addition of sugar, or in which the acid has been neutralized sufficiently to make it palatable in a concentrated form.
The press consists of a perforated, stainless steel cylinder with solid cast ends. Cylinder is reinforced with circular ribs, and contains a heavy, inner rubber tube (1 1/8 x 10 ft.) secured to both ends.

Pressing is accomplished by inflating the rubber tube to eight lbs. per sq. in. to squeeze pomace against cylinder wall. While there's still a flow of juice, tube is deflated and cylinder rotated 90 degrees then inflated again. Cycle is repeated until there's no longer any free run juice. Then pressure is increased in steps to a maximum of 80 lbs. per sq. in.

Upon completion of pressing, tube is deflated and cylinder doors are removed. Drum is now rotated to the open position, allowing pomace to drop out. The force of compressed air, working in all directions, controlled and guided, leads to an extraordinary pressing effect.

The perforated press drum reduces pressing time considerably, because of its large area which, unlike most other pressing systems, remains constant during pressing. The pliability of the rubber sleeve prevents stems, stones and seeds from being crushed and ground up.

The breaking up of the pressed cake, by rotation of the drum with further subsequent pressing, gives highest yields in the shortest time. The rotation of the drum causes the cake to discharge automatically.

Concentration by Vacuum Distillation.—To retain the natural flavor of fresh apple juice it is necessary to concentrate the juice by evaporation at temperatures sufficiently low to hold chemical changes to a minimum.

One of the principal problems encountered in the concentration of apple juice by evaporation is the loss of volatile, aromatic flavor constituents, and concentrates prepared by atmospheric or vacuum evaporation are practically devoid of the characteristic aroma of fresh apple juice. Among methods developed for recovering these flavor constituents one consists in passing the first vapors removed during the evaporation process through a cold concentrate obtained by previous evaporations, whereas another consists of stripping the juice of aromatic constituents by a pre-
liminary passage through a vacuum pan and condensing this first vapor for return to the final concentrate. In both methods it is necessary that the concentration of the juice be carried beyond that desired in the final product because of dilution by the aromatic fraction.

The most efficient process for recovering the volatile flavor constituents from apple juice is the process of stripping these substances from juice by heating in a rapid evaporator to obtain a 10 per cent flash vaporization which removes all of the volatile substances. The condensate is then treated in a fractionating column where the volatile flavoring constituents can be concentrated up to 150 times that of the original juice at atmospheric pressures.

The more complete removal of volatile constituents which is obtained by the rapid evaporation, and their subsequent enrichment through fractional distillation make it possible to prepare full-flavored apple juice concentrates which, when reconstituted with water, are indistinguishable in taste and aroma from fresh apple juice. This process for recovering and concentrating the volatile, aromatic components of apples also proved to be a practical method for the commercial preparation of volatile fruit concentrates from a variety of fruits.
In the United States apple essence manufacture is subject to regulation by the Bureau of Internal Revenue, Treasury Department, because minute traces of alcohol usually present in the juice are concentrated to above 0.5 per cent, by volume, of essence.

Concentration by Freezing.—The process of concentration by freezing avoids the danger of damaging the flavor of the juice by heat, and losses in volatile, aromatic constituents are held to a very low point.

Extensive commercial development of freezing concentration has been handicapped because of difficulties in practical application and the cost of the process.

FORMULAS FOR APPLE FLAVORS

Apple Fruit Flavor Essence MF 1

Mixture of:
- 850 gm. freshly recovered apple essence 100-fold
- 150 gm. ethyl alcohol 95 per cent
- 1000 gm.

Apple Syrup Flavor MF 2

Mixture of:
- 500 gm. full flavored concentrated juice 68° Brix
- 350 gm. recovered volatile apple essence
- 150 gm. ethyl alcohol 95 per cent
- 1000 gm.

Liquid Apple Flavor MF 3

Mixture of:
- 150 gm. full flavored apple concentrated juice 70° to 72° Brix
- 20 gm. recovered volatile apple essence
- 30 gm. citric acid 50 per cent
- 800 gm. sugar syrup 73.9° Brix
- 1000 gm.

APRICOT (Prunus armeniaca)

Property of Fruit

Average contents: moisture—82; soluble solids—11; acid—1; invert sugar (per cent) —2.6; sucrose—4.

Approximate yield: juice—60 to 65.

(per cent)

The apricot resembles the peach but is smaller and is higher in acid. Its flavor is also more distinctive and characteristic. Apricots grown in
California and in the northwestern region of the United States have the best flavor. The Royal, Tilton and Blenheim varieties are the most suitable for flavor production. One pound of the dried fruit is derived from 4 to 7.5 lbs. of fresh apricots. Dried apricots have extractive matter but no flavor value.

FORMULAS FOR APRICOT FRUIT FLAVORS

Apricot Flavor  MF 4

Ingredients

2500 lbs. frozen apricots—preferably Blenheim variety
510 lbs. or 75 gal. alcohol 95 per cent
415 lbs. or 50 gal. water

125 gal. menstruum of about 25 per cent alcohol content
10 lbs. enzyme Pectinol
FRUIT FLAVORS

Procedure

(a) 2500 lbs. frozen apricots are partly defrosted at room temperature and mixed with:
925 lbs. or 125 gal. menstruum of 25 per cent alcohol content. The mixture is run through a comminuting machine (Figs. 1 and 2) and then pressed (Fig. 8). The expressed juice and flavoring extract is mixed with:
10 lbs. enzyme "Peetolin"—and left to clear.

Yield is:
300 gal. expressed juice and flavoring extract of about 15 per cent alcohol content. The expressed portion of about 878 lbs. is processed in (g).

(b) 50 gal. of the clear juice and flavoring extract of (a) is put aside for use in (h).

(c) 150 gal. of the clear juice and flavoring extract of (a) is distilled, slowly, at atmospheric pressure to yield:
first fraction of: Five gallons flavor distillate of about 66.5 per cent alcohol content, which is used in (h);

(d) The distillation is immediately interrupted and the remaining juice and flavoring extract in the still is cooled to about 77°F.; to it is added approximately:
90 gal. remaining clear juice and flavoring extract of (a) for concentration. The rest of (a), about 10 gal., is used in the distillation of the pressed remains of (a), which is processed in (g).

(e) The concentration of (d) continues under vacuum distillation and yields the:
second fraction of 10 gal. flavor distillate, of about 62 per cent alcohol content, which is used in (h).

(f) The vacuum distillation continues to recover all the alcohol and yields the:
third fraction of 70 gal. distillate of about 30 per cent alcohol content, which is used in (g); the
fourth fraction is about 120 gal. of distillate, non-alcoholic, and is used in (g); the concentrate in the still is 31.25 gal. soluble solids which are used in (h).

(g) Distillation at atmospheric pressure of:
878 lbs. remains of (a), which are mixed with:
70 gal. distillate of 30 per cent alcohol content, of (f)
10 gal. juice and flavoring extract remaining after sedimentation of the juice of (a) and
120 gal. distillate, non-alcoholic, of (f) to yield:
fifth fraction of 3.75 gal. flavor distillate of 60 per cent alcohol content; it is used in (h).
sixth fraction of 120 gal. distillate of about 40 per cent alcohol content; it is redistilled if necessary and then used in the next production batch.

(h) Mixture of:
31.25 gal. concentrated soluble solids of (f)
50.00 gal. juice and flavoring extract of (b)
5.00 gal. first fraction—flavor distillate of (c) of 66.5 per cent alcohol content
10.00 gal. second fraction—flavor distillate of \((e)\) of 62 per cent alcohol content.

3.75 gal. sixth fraction—flavor distillate of \((g)\) of 60 per cent alcohol content.

100.00 gal. apricot fruit flavor of about 19 per cent alcohol content.

**Flavor Property.**—One gallon of apricot fruit flavor is derived from 25 lbs. of fruit.

**Apricot True Fruit Flavor, Concentrated Extract**  
\(MF\,5\)

\((a)\) Grind through comminuting machine:
- 400.0 lbs. partly defrosted apricots;
  - then mix with:
    - 40.8 lbs. (6 gal.) alcohol, 95 per cent
    - 1.0 lb. Pectinol enzyme (trade name); separate juice by centrifuge; use approximately 20 lbs. filter aid to facilitate faster separation of juice.

Yield:
- 234.0 lbs. or 26 gal. apricot flavoring extract of about 18 per cent alcohol content; the remains are to be used in \((c)\).

\((b)\) Extraction of:
- 100.0 lbs. dried apricots—comminuted into small pieces.
  - 26.0 gal. apricot flavoring extract of \((a)\) mixed with:
    - 5.0 gal. alcohol, 95 per cent;
  - agitate once daily for 5 days;

Yield:
- 25.0 gal. flavoring extract.

\((c)\) Mix remaining fruit with the pomace of \((a)\) and 5 gal. water, then distill at atmospheric pressure, slowly, to obtain:
- 5.0 gal. flavor distillate of 45 to 50 per cent alcohol content.

\((d)\) Mixture of:
- 25 gal. apricot flavoring extract of \((a)\) of approximately 18 per cent alcohol content.
  - 5 gal. flavor distillate of \((c)\) of 45 per cent alcohol content
  - 30 gal. apricot true fruit flavor of approximately 22 per cent alcohol content.

**BLACKBERRY** (*Rubus* *villosus*)

**Property of Fruit**

Average contents:
- moisture—85; soluble solids—7.5; acid—1.1; invert sugar—5.2; sucrose—0.45.

Approximate yield:
- expressed juice—80.

Blackberries grow in almost every section of the United States. The cultivated fruit is larger, has less seeds, and a better flavor than wild blackberries. However, a light fermentation of the wild blackberries
FIG. 7. STILL WITH TWO RECEIVERS

This still was used for the fractionated distillation of the wild cherry bark flavor distillate of formula MF 14 and of the genuine cherry pit flavor of formula MF 19.

brings out a finer flavor. The aroma resembles raspberry. Evergreen blackberries are preferred for production of fruit flavor.

BLACKBERRY FLAVORS

Blackberry Juice and Flavoring Extract MF 6

Ingredients

<table>
<thead>
<tr>
<th></th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000.0 lbs. frozen blackberries</td>
<td>115.9 lbs.</td>
</tr>
<tr>
<td>or 17.0 gal. alcohol 95 per cent</td>
<td>2.0 lbs. “Pectinol”</td>
</tr>
</tbody>
</table>

Yield:
100.0 gal. juice and flavoring extract
Procedure

(a) 1000.0 lbs. partly defrosted blackberries are mixed with:
    115.6 lbs.
    or
    17.0 gal. alcohol 95 per cent and left to thaw entirely; the fruit is
    pressed and yields:
    98.0 gal. juice and flavoring extract; it is used in (c).

(b) The pressed remains are mixed with:
    100.0 lbs. water and distilled at atmospheric pressure to obtain:
    2.0 gal. flavor distillate of about 50 per cent alcohol content; it is
    used in (c).

(c) Mixture of:
    98.0 gal. juice and flavoring extract of (a)
    2.0 gal. flavor distillate of (b)

Total:
    100.0 gal. juice and flavoring extract of about 15 per cent alcohol
    content.

Flavor Property.—One gallon of juice and flavoring extract is derived from 10 lbs. of fruit.

Blackberry Fruit Flavor MF 7

(a) Vacuum distillation of:
    300 gal. blackberry juice and flavoring extract manufactured accord­
    ing to Formula MF 6 to obtain:
    first fraction:
    25 gal. flavor distillate of about 62 per cent alcohol content; it is
    used in (b);
    second fraction:
    90 gal. distillate of about 30 per cent alcohol content; it is used in
    redistilled to higher proof alcohol and used in the next pro­
    duction batch;
    concentrate:
    75 gal. soluble solids; they are used in (b).

(b) Mixture of:
    75 gal. concentrated soluble solids of (a)
    25 gal. first fraction–flavor distillate of (a)

100 gal. blackberry fruit flavor of about 15.5 per cent alcohol content

Flavor Property.—One gallon of blackberry fruit flavor is derived from 30 lbs. of fruit.

BLACK CURRANT (CASSIS) Ribes rubrum

Property of Fruit

Average contents: moisture—82; soluble solids—10; acid—2.8; invert
    (per cent) sugar—6.3; sucrose—0.05.
Approximate yield: expressed juice—80.
    (per cent)
There are three varieties of currants—white, red, and black. The white currants are poorest in flavor and have no color. The red currants have a pleasant aroma, agreeable acidity, and a brilliant red color. Black currants, freshly harvested, do not have a pleasant odor and taste; however, after slight fermentation, the aroma changes and they develop a very fine flavor.

BLACK CURRANT FLAVORS

Black Currant Juice and Flavoring Extract  MF 8

(a) 1000.0 lbs. frozen black currants are left to defrost and to ferment until approximately 0.75 to 1 per cent alcohol content develops. The fruit is to be agitated three times daily during the fermentation.

(b) The partly fermented fruit is then mixed with:
- 136.0 lbs. or 20 gal. alcohol, 95 per cent, agitated, and immediately pressed just enough to yield:
  - 90.0 gal. expressed juice, and to leave a suitable fruit mash for flavor distillation.

(c) The remaining mash is distilled at atmospheric pressure to yield:
  - 10.0 gal. flavor distillate of about 50 per cent alcohol content; it is used in (d).

(d) Mixture of:
  - 90.0 gal. expressed juice of (b)
  - 10.0 gal. flavor distillate of (c)

Total:
- 100.0 gal. black currant juice and flavoring extract

Flavor Property.—One gallon of black currant juice and flavoring extract is derived from 10 lbs. of fruit.

Black Currant Fruit Flavor  MF 9

Ingredients:
- 3000.0 lbs. black currants
- 122.4 lbs. or 18.0 gal. alcohol, 95 per cent
- 4.0 lbs. Pectinol

Procedure:

(a) 3000.0 lbs. frozen black currants are allowed to thaw entirely, then are pressed. The expressed juice is mixed with enzyme Pectinol and allowed to stand for 24 hours to separate pectins. The clear juice is then concentrated by vacuum distillation to yield the concentrate:
  - 80.0 gal. soluble solids. It is used in (c).

(b) The pressed remains are mixed with:
  - 8.0 gal. alcohol, 95 per cent and
  - 20.0 gal. water.
The mixture is then distilled at atmospheric pressure to yield:
10.0 gal. flavor distillate of about 65 per cent alcohol content. It is
used in (c).

(c) Mixture of:
80.0 gal. concentrate of (a).
10.0 gal. flavor distillate of (b).
10.0 gal. alcohol, 95 per cent.
100.0 gal. black currant fruit flavor of about 16 per cent alcohol content.

Flavor Property.—One gallon black currant fruit flavor is derived from 30 lbs.
fruit.

CHERRY FRUIT (Prunus cerasus)

Property of Fruit
Average contents: moisture—80; soluble solids—13; acid—0.72; invert
(per cent) sugar—9; sucrose—0.5.
Approximate yield: expressed juice—70.

Growing on shrubs and trees of moderate size in temperate regions of
both hemispheres, cherries, both of the sweet and sour varieties, have be­
come the most commonly cultivated of all the tree fruits in North America.
The cherry is a well flavored sub-acid fruit and is used for the pre­
paration of preserves, syrups, in the manufacture of liqueurs, and to a
large extent in carbonated beverages.

English Morello Cherries.—In the manufacture of cherry flavor, prefer­
ence is given to the English Morello variety. Besides its pronounced fruity
note and extractive richness, Morello cherries yield a desirable shade of
red coloring characteristic of cherry. They are the last of the cherry fruit
to mature and are generally harvested about the first of August.

Montmorency Cherries.—Montmorency cherries yield a juice of bright
red color and a faint fruity flavor in the juice. The flavor and coloring of
cold expressed Montmorency cherry juice fade out after short period
storage. However, the expressed juice from preheated Montmorency
cherries retains an intensified aroma and color. The fruit is fully ripe
for harvest by the middle of July.

Sweet Cherries.—The West Coast produces large quantities of sweet,
cherries. Their aroma and taste do not have any of the characteristics of
the sour cherries which are useful in the manufacture of flavors. Sweet
cherries lack acidity. Their seeds develop little or no cherry or benzalde­
hyde flavor after hydrolysis.

Dalmatian Cherries.—Dalmatian cherries are named after their place
of origin, Dalmatia, which is a region of Yugoslavia. They are imported
in semi-dried form, packed in wooden kegs of 110 lbs. or 50 kg., net weight. Extractives of partly dried Dalmatian cherries are often used to blend with cherry flavors. However, Dalmatian cherries should be processed not later than three months after drying. They develop mold and become wormy on prolonged storage. Dalmatian cherries should be soaked and extracted with a mixture of cherry juice and alcohol to substitute for the juice which drains off and partly evaporates during drying.

After extraction, the exhausted Dalmatian cherries and pitted seeds are ground and subjected to hydrolysis to develop benzaldehyde. Alcohol is added and the mixture distilled at atmospheric pressure. The condensate is then fractionated and yields a very fine cherry and benzaldehyde flavor. Formula MF 13 describes the production of Dalmatian cherry flavoring extract.

Wild Cherry.—The wild cherry is a small fruit with a delicate aroma and a faintly bitter taste. The skins and kernels of wild cherries yield a more pronounced fruit- and benzaldehyde flavor than those of any other variety of cherry. By themselves, wild cherries have little or no nutritive value. Wild cherries are harvested in limited quantities to satisfy only advance orders. They are sold in dried form.

Wild cherries should be extracted with the juice of other cherries. They will yield a delicious flavor. Formula MF 12 (p. 29) describes the procedure of the flavor production.
Cherry and Benzaldehyde Flavor

Wild Cherry Bark.—Wild cherry bark is the dried stem bark derived from the wild, or black cherry tree, *Prunus serotina*, which grows throughout the northern and central United States. The chief constituent of the bark is *d*-mandelonitrile glucoside or prunasin \((C_{14}H_{15}NO_5)\), which has properties similar to the amygdalin of the almond seed. The other constituents are benzoic, trimethylgallic and *p*-coumaric acids, tannin, and volatile oil. If ground or pulverized wild cherry bark is treated with warm water of about 131°F., enzyme emulsin will hydrolyze prunasin to benzaldehyde, glucose, and hydrocyanic acid. The latter is removed chemically or is lost during the distillation. Distillation yields a flavor similar to Kirschwasser. Formula *MF 14* (p. 31) describes in detail the manufacture of wild cherry bark flavor distillate.

Bitter Almond (*Amygdalus amara*).—The volatile oil of cherry seed is identical with that of bitter almond. Both contain amygdalin. Oil of bitter almond is often used to substitute for benzaldehyde obtained by hydrolysis of cherry seeds.

The principal constituents of bitter almond are fixed oil, the glucoside amygdalin, and the enzyme emulsin. After removal of the fixed oil, the cake of the bitter almonds is mixed with warm water (131°F.) allowed
to hydrolyze and is then subjected to steam distillation. The distilled oil contains more than 80 per cent benzaldehyde, partly in free state but mainly in combination with a small amount of hydrocyanic acid. The latter is removed chemically by heating the distilled oil with a sulfite, or with slaked lime and an iron salt, and then the mass is redistilled. Oil of bitter almond is heavier than water.

Oil of bitter almond is also derived from the seeds of the apricot. The oil derived from the seeds of the almond tree is imported mainly from Southern France, Spain, and Italy. It is obtainable in two varieties; one containing hydrocyanic acid besides benzaldehyde, the other being free from Prussic (hydrocyanic) acid, often labeled in abbreviated form—FFPA.

The oil of bitter almond is colorless and will acquire a yellow color with storage. It will oxidize on exposure to air to form benzoic acid crystals, and should therefore be kept in tightly closed and completely filled containers.

Cherry Kernel Oil.—There is no production in the United States.

Cherry Pit Distillate.—This is a flavor which is obtained by subjecting the coarsely ground seeds of the cherry pits to hydrolysis, followed by its distillation with alcohol and water.
Kirschwasser.—Kirschwasser is made by fractional distillation of a fermented mash of cherries and crushed seeds. The increased temperature of the mash during the fermentation hydrolyzes the amygdalin of the seeds to benzaldehyde. A 50 to 55 per cent alcohol content of the distillate yields the best aroma of Kirschwasser.

Cherry-Laurel Leaves (Laurocerasi folia).—Cherry-laurel leaves are obtained from Prunus laurocerasus and are used in the fresh state. Its important constituents are the glucoside prulaurasin and the enzyme prunase. Prulaurasin is decomposed by the action of the prunase with the formation of benzaldehyde and hydrocyanic acid. The hydrocyanic acid is then removed and the oil redistilled.

Expressed Cherry Juice and Flavoring Extract

Cherry fruit flavors are made mainly from frozen pitted or unpitted fruit. The expressed juice of frozen cherries has the same natural aroma and bright color of the cold pressed juice of fresh fruit. Complete thawing of frozen cherries is to be avoided, since thawing subjects the frozen
FRUIT FLAVORS

fruit to oxidation, with resultant damage to both its fresh volatile aroma and its color. The proper procedure in the manufacture of cherry fruit flavor requires that alcohol be added to the partly defrosted cherries before further processing. It is also advisable to process fruit by treatment with a pectic enzyme prior to the addition of alcohol or by its addition to the expressed juice, in order to hydrolyze the pectins. The enzyme serves to convert the pectins partly into soluble sugars and also serves to precipitate pectic acid.

Expressed cherry juice should be stored in stainless steel containers to avoid exposure to air and to aid in the precipitation and settling of proteins, carbohydrates and other suspended matter. Formulas MF 10 and 11 (pp. 28 and 29) describe the manufacture of expressed juice from pitted and unpitted Morello cherries.

CENTRIFUGAL CLARIFICATION OF CHERRY JUICES AND FLAVORING EXTRACTS

The clarification of fruit juices and of flavoring extracts can be accomplished by settling or sedimentation, by filtration, and by centrifugal clarification. The centrifugal clarification is related to sedimentation methods. In the latter instance, the force of gravity is used to separate
the solid material from the lower specific gravity liquid in which it is dispersed or the heavier liquid from a lighter liquid, each type of material settling in accordance with its specific gravity.

In the case of centrifugal clarification, this action is speeded up by the centrifugal force developed by the rotation. This force when expressed in terms of gravity is many times greater than gravity. The solid will move horizontally fartherest from the center of rotation, the water will form a layer next to the solid, and finally the oil will form a third layer.

Westfalia KG clarifiers (Fig. 6) have been designed particularly for use in the flavoring extract industry. The KG clarifier bowl is divided into several annular chambers through which the liquid passes progressively, thus removing the solids in gradual stages governed by the size and specific gravity of the particles. As soon as the material to be clarified enters the bowl, it is subjected to centrifugal forces which remove the biggest and heaviest particle in the first chamber. Smaller and lighter particles are removed in each successive chamber, with the lightest and smallest being removed in the final, outer chamber, where the centrifugal force is greatest. In this way even the finest particles are trapped and removed.

**Expressed Juice of Pitted Morello Cherries**  
**MF 10**

**Procedure**

(a) 3000.00 lbs. frozen pitted Morello cherries (to which no sugar was added) are to be partly defrosted and mixed with:

- 170.00 lbs. or 25 gal. alcohol, 95 per cent, and then coarsely ground. The mixture is to be pressed and the expressed juice is to be mixed with:

- 170.00 lbs. or 25 gal. alcohol, 95 per cent. The yield should be about:

- 3036.25 lbs. or 347 gal. of about 15 per cent alcohol content.

(b) The pressed remains or pomace are to be mixed with an equal quantity of water and then distilled at atmospheric pressure to obtain a yield of:

- 22.50 lbs. or 3 gal. flavor distillate of about 55 per cent alcohol content. The distillation is to be stopped and the remains of the still discarded.

(c) The finished product is made by mixing:

- 3036.25 lbs. or 347 gal. of expressed juice of (a) with:

- 22.50 lbs. or 3 gal. flavor distillate of (b). The yield will be:

- 3058.75 lbs. or 350 gal. cherry juice and flavoring extract with an alcohol content of 15 per cent. Its weight per gallon is about 8.75 lbs.

**Flavor Property.**—One gallon of the finished cherry juice and flavoring extract of (a) is derived from 8.57 lbs. of pitted Morello cherries. If no alcohol were added to the fruit, about 9 lbs. of pitted cherries would yield one gallon of expressed juice.
Expressed Juice of Unpitted Morello Cherries  

**Procedure**

(a) 1000.00 lbs. of partly defrosted unpitted Morello cherries are to be mixed with:

61.20 lbs. or 9 gal. of 95 per cent alcohol, then coarsely ground and immediately pressed. The expressed juice is to be mixed with an additional:

61.20 lbs. or 9 gal. of alcohol. The yield will be about:

860.00 lbs. or 98 gal. of juice and extract, of about 14 per cent alcohol content.

(b) The pressed remains or pomace of (a) are to be mixed with:

166.00 lbs. or 20 gal. of water and heated up to about 131°F. The mixture is kept at this temperature for six hours during which time the seeds will hydrolyze and develop benzaldehyde. It is advisable to put the pressed remains and water into the still, which makes handling of the procedure easier. The distillation which follows the hydrolysis is performed at atmospheric pressure, and without fractionating. The yield will be about:

64.00 lbs. or 8 gal. distillate of about 20 per cent alcohol content. The remains of the still are then discarded, the still washed and cleaned. The distillate is then put back into the still and fractionally redistilled at atmospheric pressure. The main fraction will yield:

15.00 lbs. or 2 gal. of flavor distillate of 50-55 per cent alcohol content. The second fraction is distilled to recover the rest of the alcohol. The recovered alcohol is used in the distillation of the next batch.

The hydrocyanic acid which develops during the hydrolysis of the seeds is lost during the distillations.

(c) The finished product is made by mixing:

860.00 lbs. or 98 gal. of juice and extract of (a) with:

15.00 lbs. or 2 gal. of flavor distillate of (b), of 50-55 per cent alcohol content. The yield will be:

875.00 lbs. or 100 gal. of Morello cherry juice and flavoring extract with an alcohol content of 15 per cent. The weight of 1 gal. of juice is about 8.75 lbs.

*Flavor Property.*—One gallon of finished cherry juice and flavoring extract of (b) is derived from 10 lbs. of unpitted Morello cherries. If no alcohol were added to the fruit, about twelve pounds of unpitted cherries would yield 1 gal. of expressed juice.

Wild Cherry Fruit Flavoring Extract  

**Procedure**

(a) 600.00 lbs. of dried wild cherries are to be coarsely ground in a comminuting machine, then mixed with a menstruum of about 19 per cent alcohol content consisting of:
867.00 lbs. or 102 gal. cherry juice and:
170.00 lbs. or 25 gal. alcohol, 95 per cent. The total menstruum is:
1037.00 lbs. or 127 gal. It is to be circulated twice daily for 8 days in order to soak, soften, and extract the fruit. The extract is then drained off and the remaining fruit pressed to yield:
902.00 lbs. or 97.50 gal. of wild cherry extract.
The fruit remains are to be transferred into the still and mixed with:
(a) 332.00 lbs. or 40 gal. water, and then heated to about 131°F., kept at this temperature for about 6 hours to permit the seeds to hydrolyze to benzaldehyde. The distillation is performed at atmospheric pressure. The heat is applied gradually to allow a slow collection of the distillate. The yield is about:
18.70 lbs. or 2.50 gal. of distillate of about 65 per cent alcohol content. Hydrocyanic acid evaporates during the distillation.
(b) The finished product is made by mixing:
902.00 lbs. or 97.5 gal. wild cherry extract of (a) with:
18.70 lbs. or 2.50 gal. distillate of (b). The yield is:
920.70 lbs. or 100 gal. wild cherry fruit flavor of about 15 per cent alcohol content.

Flavor Property.—The analysis of the finished wild cherry flavoring extract shows a content of benzaldehyde.

Dalmatian Cherry Extract MF 13

Procedure
(a) 110.00 lbs. of semi-dried Dalmatian cherries are to be coarsely ground and mixed with:
217.50 lbs. or about 25 gal. of expressed cherry juice and flavoring extract of formulas MF 10 or MF 11. To it are also be added:
20.40 lbs. or 3 gal. of alcohol, 95 per cent, which adds up to a menstruum of about 28 gal. of approximately 23.5 per cent alcohol content. The menstruum is to be circulated twice daily through five days, to soak, soften, and extract the fruit. The extract is then taken off and expressed. The yield will be about:
216.00 lbs. or 24 gal. flavoring extract.
(b) The drained and pressed fruit remains are to be transferred to the still and mixed with:
83.00 lbs. or 10 gal. of water. The mixture is to be heated up to 131°F. and left at this temperature for six hours to hydrolyze the seeds to benzaldehyde. The distillation is then performed at atmospheric pressure without fractionating; the heat is applied gradually to allow a slow rate of distillation. The yield will be:
31.70 lbs. or 4 gal. of distillate, of about 25 per cent alcohol. The remains of the still are then discarded and the still cleaned. The distillate is then redistilled, to yield a middle fraction of:
7.65 lbs. or 1 gal. flavor distillate of about 50 per cent alcohol content. The tail fraction is to be used in the next production in place of alcohol.
The finished product is made by mixing:
216.00 lbs. or 24 gal. flavoring extract of (a) with:
7.65 lbs. or 1 gal. flavor distillate of (b). The total yield will be:
223.65 lbs. or 25 gal. Dalmatian cherry flavoring extract with about 15 per cent alcohol content. The weight of one gallon extract is about 9 lbs.

Flavor Property.—One pound of semi-dried Dalmatian cherries is equivalent to about 3.75 lbs. of freshly picked fruit without stems. Consequently, 1 gal. of finished Dalmatian cherry extract of (c) is derived from about 24 lbs. of cherries.

Wild Cherry Bark Flavor Distillate MF 14

Procedure
825.00 lbs. of pulverized wild cherry bark is mixed with:
1801.00 lbs. or about 217 gal. water, advisably in the still (Fig. 7), and heated to 131°F. The mixture is kept at this temperature for six hours to hydrolyze the prunasin of the bark, which is similar to the amygdalin of the almond seed. To the mixture is then added:
365.00 lbs. or about 53.68 gal. alcohol, 95 per cent. The total of the menstruum will be:
2166.00 lbs. or 270 gal. of about 19.25 per cent alcohol content; the weight of 1 gal. of this menstruum is about 8 lbs. The distillation is carried out at atmospheric pressure with the collection of fractions of 5 gal. each. The temperature is increased gradually to facilitate a slow flow of the condensate with a high alcohol content.

The yield of distillate is as follows:

<table>
<thead>
<tr>
<th>Middle Fraction</th>
<th>Quantity, Gal.</th>
<th>Alcohol Content, Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>5</td>
<td>85</td>
</tr>
<tr>
<td>(2)</td>
<td>5</td>
<td>72</td>
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<tr>
<td>(3)</td>
<td>5</td>
<td>69</td>
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<td>(4)</td>
<td>5</td>
<td>68</td>
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<td>(5')</td>
<td>5</td>
<td>64</td>
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<td>(6)</td>
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<td>64</td>
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<td>(7)</td>
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<td>(8)</td>
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<td>(9)</td>
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<td>58</td>
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<td>(10)</td>
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<td>56</td>
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<tr>
<td>(11)</td>
<td>5</td>
<td>56</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>55</strong></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Absolute Alcohol, Gal.</th>
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</thead>
<tbody>
<tr>
<td>4.25</td>
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<tr>
<td>3.60</td>
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<tr>
<td>3.45</td>
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<td>3.40</td>
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<td>3.20</td>
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<td>2.90</td>
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<tr>
<td>2.80</td>
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<tr>
<td>2.80</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

The total of the middle run fraction is: 55 gal. distillate of 65 per cent alcohol content.
When the fifth fraction showed an alcohol content of 64 per cent, dephlegmation was applied to the distilled vapors for reflux to keep the condensate at high alcoholic strength. Dephlegmation was intensified at the eighth fraction for the same purpose. With the eleventh fraction, the middle run was concluded and separation begun for the tail fraction.

**Flavor Property of the Middle Run.**—The eleven fractions carry the clean flavor of benzaldehyde and are mixed together. The chemical analysis of the total yield shows 0.09 per cent benzaldehyde and no hydrocyanic acid. One gallon flavor distillate is derived from 15 lbs. of wild cherry bark. Aroma and taste of this distillate resembles Kirschwasser.

<table>
<thead>
<tr>
<th>Tail Fraction</th>
<th>Quantity, Gal.</th>
<th>Alcohol Content, Per Cent</th>
<th>Absolute Alcohol, Gal.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(12)</td>
<td>5</td>
<td>53</td>
<td>2.65</td>
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<tr>
<td>(13)</td>
<td>5</td>
<td>52</td>
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<td>(14)</td>
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<td>47</td>
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</tr>
<tr>
<td>(15)</td>
<td>5</td>
<td>42</td>
<td>2.10</td>
</tr>
<tr>
<td>(16)</td>
<td>5</td>
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<td>1.75</td>
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<tr>
<td>(17)</td>
<td>5</td>
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<td>1.30</td>
</tr>
<tr>
<td>(18)</td>
<td>5</td>
<td>14</td>
<td>0.70</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>14</td>
<td>13.45</td>
</tr>
</tbody>
</table>

The total of the tail fractions is: 35 gal. distillate of 38.40 per cent alcohol content. At the end of the eighteenth fraction, the distillation is considered finished. The grassy odor of the condensate becomes too heavy to justify any continuation of the procedure.

The tail fractions are mixed together. To it is then added an equal quantity of water. The mixture turns cloudy and should be filtered. The filtrate is then redistilled to strip off the alcohol, which can be used in the next batch.

By deducting the absolute alcohol of all the fractions from the quantity of absolute alcohol which has been used in the distillation, the loss is about 2.79 gal. absolute alcohol.

**Concentration of Morello Cherry Fruit Flavor**

Cherry fruit flavors processed in conventional stills reach the highest peak of flavor strength when the concentration of juice and extract is made in the proportion of 2.3 lbs. of fruit and pits per one gallon of flavor. In this procedure the distillation at atmospheric pressure is applied to first separate the volatile essence without loss of aroma, followed by a vacuum distillation which serves to recover alcohol and to concentrate the soluble solids of the cherry juice to 30° Brix.

**Procedure**

(a) 2187.50 lbs. or 250 gal. expressed cherry juice and flavoring extract, containing about 15 per cent alcohol, of formula MF 11 (derived from 2500.00 lbs. of Morello cherries with pits) are loaded into the still. The juice is then rapidly heated and distilled at atmospheric pressure without dephlegmation and reflux.

1 The same formula applies to other cherry varieties.
The juice is to be agitated while heating and distillation is under way. The water in the condenser is kept at a fast flow to facilitate immediate condensation of the distillate without loss of alcohol and volatile aroma which are stripped from the heated juice in the form of vapors.

(b) The first fraction of this distillation yields within a short time: 35.50 lbs. or 5 gal. flavor distillate of about 70 to 75 per cent alcohol content. The distillation is immediately interrupted and the juice in the still rapidly cooled to about 77°F.

The vacuum pump is then put in operation to remove the air from the still. When 28 inches vacuum is reached the water jacket is heated gradually. Overheating must be avoided. The juice is kept constantly in agitation and the distillate collected at a slow rate to retain a high alcohol content in the distillate.

Flavor left in the juice is stripped together with the alcohol and yields:

(c) The second fraction consisting of about: 198.00 lbs. or 25 gal. flavor distillate of about 45 per cent alcohol content. The vacuum distillation continues under the same conditions as before until the end of the process.

(d) The third fraction should yield about: 577.00 lbs. or 75 gal. distillate of about 30 per cent alcohol content.

(e) The fourth fraction consists of:

(f) Concentrate consisting of:

Compound.—The mixture of the finished flavor is performed in the following succession:

679.00 lbs. or 70 gal. concentrate of 30° Brix of (f) are to be mixed first with:

198.00 lbs. or 25 gal. flavor distillate—second fraction of 45 per cent alcohol content—of (c), then with:

35.50 lbs. or 5 gal. flavor distillate—first fraction of 70 to 75 per cent alcohol content—of (f). The total is:

912.50 lbs. or 100 gal. Morello cherry flavor concentrate.

Flavor Property.—In this formula the expressed juice and flavoring extract of formula MF II is used to make a concentrated cherry flavor.

In the manufacture of the juice and flavoring extract of formula MF II the pomace containing the crushed pits has
been treated with warm water to hydrolyze the seeds. The distillation of pomace and pits then yields cherry flavor and benzaldehyde. Consequently, both are present in the concentrated cherry fruit flavor.

Flavor Measurements*
Threshold of perception: 2 per cent; color: faint.
Threshold of identification: 3 per cent; color: distinct.

Concentration by Freezing Expressed Juice and Flavoring Extract of Unpitted Morello Cherries MF 165

Ingredients
2500 lbs. frozen or freshly picked Morello cherries with pits
136 lbs. or 20 gal. alcohol, 95 per cent

Procedure
(a) 2500 lbs. partly defrosted frozen or freshly picked and cleaned Morello cherries are to be coarsely ground and mixed with:
20 gal. alcohol, 95 per cent, and then pressed to obtain an approximate yield of:
250 gal. expressed juice and flavoring extract of about 7 per cent alcohol content.
(b) The juice and flavoring extract of (a) is to be filled in open head stainless steel drums. If there are no refrigerating facilities on the premises, drums are to be tightly closed and sent to a refrigeration warehouse to be kept frozen at about 10°F to 0°F. A few days later the frozen extract is returned to place of manufacture and allowed to remain at room temperature for one or two days in order to defrost enough so that the icy product can be removed for chopping or grinding and concentration by centrifuge. If no centrifuge is available, then the frozen extract is put back into the drums in which spigots have been inserted near the bottom for drainage. As the frozen extract slowly melts the concentrated alcoholic flavoring material and soluble solids separate first and frozen water floats on top. The concentrate is continuously removed from the drums through the spigots. The remaining water is then allowed to defrost and is used in (d).
(c) The yield of the concentration of (b) is about:
95 gal. of fruit flavor of about 17 per cent alcohol content, which is then used in (e).
(d) The pressed remains of (a) are loaded into the still and there mixed with the water of (b), then heated to 131°F, and kept at this temperature for 6 hours to hydrolyze. Then:
2 gal. alcohol, 95 per cent is added to the mixture, and the mixture distilled slowly at atmospheric pressure to obtain:
5 gal. flavor distillate of about 50 per cent alcohol content, which is then used in (e).

*Test should be made in 100 parts water.
5This formula applies both to Morello and to other cherry fruit.
(e) Finished mixture of:

95 gal. concentrated flavoring extract of (e), of about 17 per cent alcohol content
5 gal. flavor distillate of (d), of about 50 per cent alcohol content.

Yield:
100 gal. concentrated Morello cherry fruit flavor of about 19 per cent content.

The yield of the concentration of Morello cherry juice and flavoring extract by the freezing method is best achieved at 25 lbs. of fruit per gallon concentrate. The use of Montmorency cherries may permit a higher proportion of fruit per gallon of concentrate. The proportion of fruit per gallon of concentrate by freezing depends on the density of the soluble solids of the juice and flavoring extract.

Concentration of Full Flavor Morello Cherry Juice MF 17
Partly defrosted Morello cherries (5,100 lbs. straight pack and 22,440 lbs. 5 + 1) are expressed with the use of large presses. The juice of both cherries, with and without sugar, is mixed together and to it added enough Pectinol to eliminate the pectins. The total of the expressed juice is about 2754 gallons. Thus, one gallon of juice is obtained from ten pounds of Morello cherries and pits. The addition of sugar to fruit increases the yield of juice and lowers the quantity of fruit needed per gallon expressed juice. Normally twelve pounds of cherries with pits yield one gallon of juice.

After six hours the juice is channeled into a still to strip the volatile aroma. The distillation is performed at atmospheric pressure at a temperature of 214°F. About 15 seconds are required to strip one gallon of volatile aroma and to concentrate it 100-fold. The juice is then immediately cooled down to about 100°F. The yield is 27 gal. 100-fold essence, each gallon stripped from 100 gal. of expressed juice. The distillate is filled in one gallon glass containers and stored at room temperature.

The juice is then piped directly to filter presses. From there it is channeled, without interruption, into the vacuum still. Concentration of the juice is carried out by distillation at a vacuum of about 27.12 inches and a temperature of 110°F. The yield is about 758 gal. of concentrated Morello cherry juice of 68° Brix. Considering the presence of added sugar to the fruit, each gallon of the concentrated Morello cherry juice is derived from 36.33 lbs. of fruit. The concentrated juice should be stored without the addition of volatile essence in stainless steel drums in a cold warehouse at 35°F. temperature.

Five years of tests and observation of the full flavor Morello cherry concentrated juice 68° Brix, indicate that it will remain stable indefinitely at 35°F.

Flavor Property.—One gallon of this full flavor concentrated Morello cherry juice is equal in flavor strength and natural fruit color to about four gallons of juice expressed from freshly picked fruit with pits. The characteristic cherry note is enhanced by the completely retained acids of the fruit and by the traces of benzaldehyde which is present in the juice.

Flavor Measurements.—
Threshold of perception: 1.50 per cent; color: faint.
Threshold of identification: 2.50 per cent; color: distinct.
Concentration of Full Flavor Morello Cherry Juice  MF 18

Procedure.—After inspection, the freshly picked fruit is transferred to a surge washer and then to a high spray wash. Cold water is used in both operations to chill the fruit quickly, remove dirt and impurities from the cherries. The use of cold water reduces the danger of fermentation and of bacterial changes.

The cleaned fruit is then transferred into stainless steel tanks where the cherries are heated to about 135°F, and then rapidly dropped down to the continuous presses. The juice is rapidly expressed and then filtered, with the use of filter aid, through plate and frame filter presses (Fig. 8).

The sparkling clear juice is piped directly from the filter to a feed tank of the still to separate volatile aroma and to concentrate the soluble solids of the juice. In this production the cherries are pressed hot. Its color is a deeper red than that of cold pressed cherry juice of formula MF 17.

One gallon of juice is obtained from about eleven pounds of fruit with pits. The juice is 14.5° to 15° Brix and has 1.89 per cent acidity.

SEPARATION OF VOLATILE AROMA AND CONCENTRATION OF JUICE

Filtered fruit juice, e.g., Morello cherry juice, is pumped from the feed tank (1) shown in Fig. 9, at rate controlled by the rotameter (2) into the preheater (3), where temperature of the juice is raised sufficiently to flash into vapor, in the vaporizer (4), a fraction containing all aromatics and volatiles.

In the centrifugal type separator (5) juice and essence-bearing vapor are separated, the former routed to the juice concentrating system, the latter to essence concentrating equipment. The vapor flowmeter (6) provides a gage for regulating steam to prevaporizer, thus regulating vapor volume. Vapor now enters 3-part fractionating column (7) with stripping rectifying and reboiling sections.

In the surface condenser (8) the aromatic-containing fraction is condensed and subcooled, a portion removed as 150-fold essence, and the remainder returned for refluxing to the top of the fractionating column. Essence concentration is determined by controlling the draw-off rate of essence in relationship to juice feed rate, as indicated on the rotameter (9).

The last 3-coil unit (10) in the essence recovery system is ammonia refrigerated. Here, essence is cooled before removal from the system, and non-condensable vent gases are cooled before they are back-washed in the scrubber, and “bottom” liquid is cooled before introduction to the top of scrubber.

Juice from the separator (5) is cooled to evaporator temperature in the flash tank (11) under relatively high vacuum aided by recirculation. The “falling film” type evaporator is designed for low operating volume and minimum juice-retention time. Evaporator level is instrument controlled.
From the evaporator, vapor and concentrate discharge into a separator (12), vapor then entering the barometric condenser (13) while the concentrate is recirculated by a pump (14) and a portion is withdrawn to finished product storage at desired density.

Cooling and flashing are aided by recirculation of a portion of the cooled juice. The unique recirculation method has the additional advantage of preventing foaming. The lower section of the flash chamber is extended to provide a feed surge-tank to supply the evaporator.

Retention time of juice in evaporator is reduced to a minimum by means of a unit of the “falling film” type. This type of evaporator not only removes any possibility of overheating the juice, but also reduces to a minimum the volume of juice in the system.

Minimum operating level in evaporator is automatically maintained by a pneumatic, differential-pressure type instrument that throttles an air-operated, diaphragm-type juice-feed valve at the inlet to the evaporator. Juice is recirculated in the unit by means of a pump, a portion of juice being withdrawn at desired product density and then delivered to storage.

Since the essence solution is stable and relatively free from deterioration under normal storage, the volatile aroma and flavor constituents may be added to the concentrate at the time of packaging.

In this production the volatile aroma is separated in two fractions, each of 100-fold strength representing 100 gal. of juice. The first fraction yielding 72 gal. has the composition indicated below:

- 0.9 per cent alcohol content and 0.036 per cent benzaldehyde.

A second fraction of 13 gal. of 100-fold essence is obtained; it contained no alcohol but 0.052 per cent benzaldehyde.

From previous experience, it can be shown that the benzaldehyde content is always higher in later fractions than at the beginning of the distillation.

The cherry juice concentrate produced indicated above has a soluble solids of 41° Brix. This concentrated juice of 41° Brix should be filled into stainless steel drums and stored at freezing temperature in a cold-storage warehouse.

Acids may separate on the bottom of the container of frozen 41° Brix concentrate. However, with the defrosting of the juice, the acid mixes well and dissolves easily. In using frozen concentrated cherry juice of 41° Brix it is advisable to add alcohol before complete thawing to avoid fermentation.

**Full Flavor Formula**—The compound of a full flavor concentrated Morello cherry juice consisting of concentrated soluble solids of 41° Brix
and additions of both fractions of the separated volatile aroma requires the following per one gallon of mixture:

- 3.55 per cent of the first fraction of the volatile essence,
- 0.43 per cent of the second fraction, and
- 96.02 per cent of the concentrated juice of 41° Brix.

**Flavor Property.**—One gallon of the full flavor concentrated juice is equivalent in aroma, flavor strength, natural color, solids, and acid, to about 4 gal. of hot expressed juice from 44 lbs. of Morello cherries.

**Flavor Measurements.**—A flavor test made in 100 parts water showed:

- Threshold of perception: 1.5 per cent; color: faint
- Threshold of identification: 2.5 per cent; color: distinct

**Concentration to 68° Brix**

The concentrated juice of 41° Brix can be treated with Pectinol and filtered. The filtered juice can then be further concentrated. Two gallons will yield one gallon of a 68° Brix concentrate. The concentrated juice can be filled in stainless steel drums and stored in cold storage at 35°F.

The taste of the concentrate of 68° Brix will not change in five years. Also, the color of this concentrate retains its dark red shade and brilliance. It can be assumed that this concentrate may remain stable indefinitely.

The concentrated Morello cherry juice of 68° Brix is more economical to use than the concentrate of 41° Brix of the same manufacture. No separation of acids occurs in the concentrate of 68° Brix if it is stored at room temperature.

The high concentration of the juice of 68° Brix also permits storage at room temperature and makes it possible to partially employ a storage drum without endangering the remainder of the contents.

**Full Flavor Formula.**—One gallon of full flavor concentrated juice made from the concentrated soluble solids of 68° Brix and the aromatic fractions requires:

- 5.24 parts of first fraction of the volatile aroma.
- 0.86 parts of second fraction of volatile aroma, and
- 93.90 parts of concentrated juice of 68° Brix.

**Flavor Profile.**—One gallon of the full aromatic concentrated Morello cherry juice is equivalent, in aroma, flavor strength, natural color, solids, and acid, to 8 gal. of hot expressed juice from 88 lbs. of Morello cherries.
Flavor Measurements.—A test made in 100 parts of water showed:

Threshold of perception: 0.75 per cent; color: faint
Threshold of identification: 1.25 per cent; color: distinct

The findings of the production of full flavor concentrated juice from hot expressed freshly picked cherries when compared with the use of frozen fruit, show that it is more economical to use the frozen product. Freshly picked Morello cherries are higher in cost at harvest time. Hot expressed juice, to some extent, helps to intensify the coloring matter; however, the heat largely inactivates enzymes in the seed in the kernel and destroys the volatile freshness of the flavor. Fruit should not be heated if it is used in the production of fruit flavors.

Genuine Cherry Pit Flavor MF 19

Flavor can be made from the pomace of the Morello cherries which have been used in the manufacture of full flavor concentrated cherry juice. Since the Morello cherries have been heated before the juice was extracted from the fruit, some of the enzyme emulsin of the seeds in the pits has been inactivated. Therefore, ground pits of freshly pressed unheated cherries are added as a source of the emulsin enzyme needed to hydrolyze the amygdalin of the seeds. The hydrolysis is represented by the following reaction:

\[ C_{20}H_{27}O_{11}N + 2H_2O \rightarrow C_7H_6O + HCN + 2C_6H_{12}O_6 \]

Amygdalin Water Benzaldehyde Hydrocyanic Glucose acid

Procedure

200.00 lbs. of pits of cold pressed cherries and
1900.00 lbs. of pomace of hot pressed Morello cherries and pits are mixed with:

2100.00 lbs. or 253 gal. water to produce a uniform mixture. The pomace and pits are then coarsely ground with the hammers of a comminuting machine. The mixture of the ground pomace and water is put into the still and heated to 131°F., with agitation, and kept at this temperature for six hours to hydrolyze the amygdalin of the cherry seeds to benzaldehyde. The hydrolysis is brought about by the emulsin enzyme which is present in the seeds. The mixture is then allowed to stand overnight. Then:

204.00 lbs. or about 30 gal. 95 per cent alcohol is added and the mixture agitated. Distillation at atmospheric pressure is conducted slowly until all the alcohol was recovered. The still is emptied and the distillate returned to the cleaned still for fractional distillation. Hydrocyanic acid, which is formed during the hydrolysis, is lost during the distillation. The
distillate is collected in 7 fractions, of 5 gal. each. The 1st fraction contained high aldehyde and very little flavor. The 2nd, 3rd, 4th, 5th, and 6th fractions have the clean aroma of cherry and benzaldehyde flavor. The 7th fraction has an alcohol content of 26 per cent, with little flavor and the distinct odor of the tails. The first six fractions are combined to yield:

213.00 lbs. or 30 gal. with an alcohol content of 76 per cent.

**Flavor Property.**—The mixture of the first six fractions has the characteristic flavor of the cherry fruit enhanced by the presence of benzaldehyde.

One gallon of the cherry pit flavor distillate is derived from 70 lbs. of pomace or expressed remains of Morello cherries with pits.

**Flavor Measurement**

Threshold of perception: 0.05 per cent.
Threshold of identification: 0.08 per cent.

**Full Aromatic Cherry Fruit Flavor MF 20**

Mixtures of full aromatic fruit flavors can be made in various strengths and adjusted to required needs. The compounding of full aromatic Morello cherry fruit flavors requires the use of full flavor concentrated juice and expressed cherry flavoring extract or fruit flavors. The following mixture is recommended for best flavor.

**Ingredients**

40 gal. full flavor Morello cherry concentrated juice made from soluble solids of 68° Brix to which is added the proportionate quantity of recovered volatile aroma, formula MF 17 or MF 18.

10 gal. genuine cherry pit flavor of 76 per cent alcohol content (formula MF 19).

50 gal. expressed Morello cherry juice and flavoring extract (Formula MF 10, or MF 11), or:

Morello cherry flavor concentrate—Formula MF 15
or:

Morello cherry flavor concentrated by freezing method—Formula MF 16
or:

all three products in proportions of individual choice. The total will be:

100 gal. Finished full aromatic fruit flavor of 15 per cent alcohol content.

---

*The test is made in 100 parts water.*
CRANBERRIES

Property of Fruit

Cranberries resemble cherries in appearance. The fruit is fleshy, firm, and matures late in the fall. It is extremely acid and thus is not commonly eaten raw. The principal varieties are Early Black, McFarlin, and Howes. Cranberries are cultivated in Massachusetts, New Jersey, and the Pacific Northwest.

Cranberries contain citric acid, benzoic acid, quinic acid, pectin, and have no characteristic volatile flavor.

Cranberry juice is prepared by heating the fruit with water. The heat softens the berries, the fruit is then comminuted and the juice is centrifuged or pressed out. A yield of about 100 gal. of red juice is obtained from 1250 lbs. of cranberries.

The presence of pectins in cranberry juice causes the extractive matter and soluble solids present to gel. Pectinol is added to the expressed juice to dissolve the pectins. Cranberries are seldom used in flavors.

Cranberry Substitute MF 21

Mix together

250.00 gm. concentrated red raspberry juice 68° Brix without recovered volatile essence.
250.00 gm. concentrated cherry juice 68° Brix without recovered volatile essence;
280.00 gm. desugared grape extract (for color) in which are dissolved:
  5.00 gm. quinic acid
  10.00 gm. malic acid
  22.00 gm. tartaric acid
  32.80 gm. citric acid;
130.00 gm. ethyl alcohol, 95 per cent in which are dissolved:
  0.95 gm. oil of wintergreen
  0.05 gm. oil of coriander
  0.10 gm. oil of petitgrain

Total:
1000.00 gm.

GRAPES

Property and Varieties

Grapes thrive in the middle belt of the north temperate climate of Europe and North America, France, Italy, Rumania, Greece, Spain, Germany, Russia, Switzerland, Austria, and other European countries. Grapes also grow in Asia Minor, Africa, Australia, and South America.

The grape varieties suitable in the manufacture of flavors are:
FIG. 12. COLD STORAGE TANKS FOR FRUIT JUICES

One million gallons of cold storage capacity is provided. Cedar tanks 16 feet high and 20 feet in diameter each hold about 35,000 gallons.

Grape juice is held in these tanks at a temperature of about 27°F. for approximately three months. The aging process clarifies the juice by allowing the crystals of tartaric acid to form and settle out.

Concord, a blue-black and round grape, which is pleasing in flavor when fully ripe;
Worden, a black grape, whose skin is sweet and the center of which is tart;
Catawba, a red grape of very good flavor;
Delaware, also a red grape which has a sweet flavor;
Muscat of Alexandria, a white, large grape with a thick tough skin, having a pleasing flavor, and used chiefly for raisins;
Sultana, also a white grape but seedless. It is also used for raisins.

Concord Grape Full Flavor Concentrated Juice  MF 22

Procedure.—Expressed juice of Concord grapes is mixed with Pectinol and stored at cold temperatures above the freezing point for some time to separate insoluble matter and dissolve pectins (Fig. 12 and 13). The pectin-free juice
is then concentrated and the volatile aroma stripped by means of essence recovery process. The aroma essence is separately packed. Often the grape juice is concentrated to 72 to 74° Brix and to it is then added the recovered essence aroma.

Commercial full flavor grape concentrated juices containing the recovered essence aroma are of 68° Brix and should be stored at 35°F. to preserve aroma, taste and color.

 Flavor Measurements of Full Flavor Concord Grape Concentrated Juice of 68° Brix.—A flavor test made in 100 parts of water showed:

Threshold of perception: 0.375 per cent; Color: faint
Threshold of identification: 0.5 per cent; Color: distinct
Threshold of consumers' flavor acceptance: 1.5 per cent; Color: sufficient
Threshold of full aromatic flavor: 2.0 per cent; Color: brilliant

PEACH (Prunus persica)

Property of Fruit

Average contents: moisture, 84; soluble solids, 10; peel, 1.5; acid, 0.8;
(per cent) invert sugar, 3.6; sucrose, 4.4.
Approximate yield: expressed juice, 65.
(per cent)

Fresh Fruit

The peach is a delectable fruit. It grows widely in the U.S.A. in California, Georgia, Maryland, New Jersey, Washington, Massachusetts, New York, and Florida. Other peach growing countries are Spain, France, Italy, Argentina, Australia, Chile, New Zealand, and South Africa.

There are two classes of peaches, clingstones and freestones, depending on whether the pulp adheres to the pit or may be separated freely. The ripe fruit is hand picked from the trees. Among the numerous varieties the freestone Elberta peach has an outstanding flavor.

Dried Peaches

Only ripe fruit is used for drying. Dried peaches darken in color more rapidly on storage in warm places which are free of moisture. Peach fruit color is often prepared by simple alcoholic extraction of dried peaches whose color is darkened by prolonged high-temperature storage. It saves concentration and caramelization of the extracted matter.

Peach Juice and Flavoring Extract\(^*\) MF 23

\((a)\) 1000 lbs of partially defrosted frozen freestone Elberta peaches (ascorbic acid is added before packing solely to retard discoloration) are mixed with:

\(^*\) Made from frozen fruit.
41 FOOD FLAVORS

200 lbs. 95 per cent alcohol, and
50 lbs. water, and
2 lbs. enzyme Pectinol

Agitate well and pass the mixture through the comminuting machine. Separate the juice from the fruit in the extractor by drainage after 24 hours extraction. Then press the remaining fruit. The yield is about:

945 lbs. juice and extractive matter of about 15 per cent alcohol content. It is used in (c).

(b) The pomace or pressed remains are mixed with 1.5 times its weight of water. The mixture is distilled at atmospheric pressure to obtain a yield of:

55 lbs. flavor distillate of about 15 per cent alcohol content; it is used in (c).

(c) Mixture of:

| 945 lbs. juice of (a) |
| 55 lbs. flavor distillate of (b) |
| 1000 lbs. peach juice and flavoring extract of about 15 per cent alcohol content |

Peach Fruit Flavoring Extract*  MF 24

Ingredients

500.0 lbs. dried peaches
1050.0 lbs. peach juice and flavoring extract of 15 per cent alcohol content, formula MF 23
150.0 lbs. alcohol 95 per cent

Procedure

(a) 500.0 lbs. dried peaches are mixed with
1050.0 lbs. peach juice and flavoring extract and allowed to soak until they soften so that the fruit can be comminuted. The comminuted mixture is then extracted with:

150.0 lbs. alcohol, 95 per cent, for five days; the menstruum is to be circulated twice daily over the fruit mash. The extracting menstruum is of about 30 per cent alcohol content.

(b) On the sixth day the liquid is drained off to yield:

1070.0 lbs. peach extract
600.0 lbs. of the extract is put aside for use in (f)
470.0 lbs. of the extract is used in (d)

(c) To the remaining mash in the extractor is added sufficient water to cover the fruit; additional liquid is then drained off to yield:

150.0 lbs. extracted matter; which is used in (d); the remaining mash is used in (e).

(d) 470.0 lbs. extract of (b) is mixed with
150.0 lbs. extract of (c) and then distilled at atmospheric pressure to recover the alcohol and to yield:

*Made from dried and frozen fruit.
first fraction:
40.0 lbs. flavor distillate of 60 per cent alcohol content; which is used in (f).

second fraction:
200.0 lbs. distillate of 25 per cent alcohol content is used in (e).

concentrate:
340.0 lbs. soluble solids, non-alcoholic, which are darkened in color by distillation at atmospheric pressure. This yield is used as color in (f).

(e) The remaining mash of (c) is mixed with
200.0 lbs. distillate— the second fraction of (d) and then distilled at atmospheric pressure to yield:

third fraction:
20.0 lbs. flavor distillate of 60 per cent alcohol content; which is used in (f);

fourth fraction: The rest of the alcohol is recovered and redistilled to higher proof for use in the next production batch.

(f) Mixture of:
600.0 lbs. peach extract of (b)
340.0 lbs. concentrated soluble solids—peach color, non-alcoholic, of (d)
40.0 lbs. first fraction—flavor distillate of 60 per cent alcohol content of (d)
20.0 lbs. third fraction—flavor distillate of 60 per cent alcohol content of (e)

1000.0 lbs. peach fruit flavoring extract of 15 to 18 per cent alcohol content.

POMEGRANATE (Punica granatum)

Property of Fruit

The juice of the fruit is in the pulpy mass surrounding the seeds. The outer shell, or husk, contains tannin, and the pulpy edible portion must therefore be removed without undue contact with the husk.

Fully ripe pomegranates yield a sweet deep colored juice of rich flavor. The juice is expressed from halved or quartered fruit. It is high in sugar and in citric acid. Pomegranate fruit flavor is used in preparing grenadine syrup for cocktails and other mixed drinks.

Grenadine Fruit Flavor MF25

Procedure
(a) Comminute (using a No. 5 sieve) the fresh edible pulp of:
1600.0 lbs. pomegranates, and mix with:
108.8 lbs. or 160.0 gal. alcohol, 95 per cent, then press. The yield is:
97.0 gal. juice and flavoring extract.
(b) The pressed remains are mixed with water and distilled at atmospheric pressure to yield:
3.0 gal. flavor distillate of 45 per cent alcohol content.
(c) Mix
\[ 97.0 \text{ gal. extract of (a)} \]
\[ 3.0 \text{ gal. flavor distillate of (b)} \]
\[ 100.0 \text{ gal. grenadine fruit flavor.} \]

**PRUNES**

Concentrated Prune Flavoring Extract\(^7\) MF 26

(a) Extract
250.0 lbs. dried prunes and
370.0 lbs. cold water
Duration, 12 hours. The menstruum is then circulated until the extract runs sparkling clear. Yield of extraction:
187.5 lbs. prune juice.

(b) The remaining fruit is covered with:
187.5 lbs. cold water; however, the menstruum is not circulated over the fruit. After two hours the extracted juice is drained off. Yield of extraction:
196.25 lbs. prune juice.

(c) Vacuum distillation of:
383.75 lbs. mixture of (a) and (b) extracted prune juices. Yields:
5.0 lbs. first fraction—flavor distillate, non-alcoholic; the other fractions are discarded.
95.0 lbs. soluble solids of 72° Brix remain in the still after the concentration by vacuum distillation.

(d) Both the 5 lbs. of flavor distillate and the 95 lbs. of concentrated soluble solids are mixed together and yield:
100.0 lbs. concentrated prune flavoring extract of approx. 68.4° Brix; it is pasteurized at 158°F., then cooled to 140°F. and bottled.

The manufacture of non-alcoholic concentrated extracts of dried St. John's Bread, dates, figs and plums are processed analogous to the prune in this formula.

**RAISINS**

*Property of Fruit*

About 85 per cent of the grapes dried are of the Thompson seedless variety, also known as the Sultanina; the seeded variety being known as the Muscat. The grapes are harvested when the juice has attained a Brix reading of between 24 and 25° at which time the grapes are dried.

Bleached raisins are prepared by dipping in a warm alkaline solution to check the skins. They are then rinsed and dried on trays in the sun. Raisins are also bleached with sulfur dioxide. Four pounds of fresh grapes are required to yield one pound of raisins.

\(^7\) non-alcoholic.
Raisin Oil

Raisin oil is obtained from the seeds of Muscat grapes, which are removed before drying the grapes for raisins. The oil is used primarily for coating raisins to prevent them from sticking together. The treatment with oil renders the raisins soft and pliable for a longer period of time, makes them less subject to insect infestation and improves their appearance.

Raisin True Fruit Concentrated Extract* MF 27

(a) First extraction: the unbleached seedless raisins are soaked with:
1025.00 lbs. water, and then comminuted using No. 4 screen; the mash is put into an extractor or tank and mixed with:
10.00 lbs. Pectinol enzyme; after 6 hours,
50.00 lbs. filter aid are added to the mixture.

(b) The soaked raisins and added ingredients of (a) are then mixed with:
3112.50 lbs. or 375.00 gal. hot water of 175° to 180°F., agitated, and kept at that temperature for one hour. The mixture is allowed to cool and then pressed.

(c) Second extraction: The pressed remains of (b) are mixed with:
2490.00 lbs. or 800 gal. hot water of 140 to 150°F., agitated, and kept at the same temperature for two hours; expressing follows without delay.

(d) Both extracts are then mixed, filtered, and concentrated under vacuum to approximately 68° Brix to yield the finished raisin true fruit concentrated extract, non-alcoholic.

RASPBERRY (Rubus strigosus)

Property of Fruit

Average contents: water, 85; soluble solids, 7; acid, 15; invert sugar, 3.3; sucrose, 0.9.
Approximate yield: expressed juice, 75.

Raspberries grow in New York, Northern Ohio, Michigan, Oregon, and Washington. Ripe raspberries should be processed immediately after picking. Since the period between ripeness and softening of the fruit is very short, picking is carried out rapidly and the harvested fruit is immediately washed with care. Leaves, stem, shriveled and badly bruised berries are removed by hand.

Red Raspberry Fruit Flavor° MF 28

Properties and Treatment of Fruits.—Red raspberries of the Cuthbert, Washington, and Newburgh varieties are of good use in flavors. Freshly picked full

*Non-alcoholic. Made from 1025 lbs. of unbleached seedless raisins.
°Manufactured from 25 lbs. of frozen red raspberries per gallon of concentrate.
ripe raspberries are cold washed and rapidly processed within a few hours after picking to cut down the exposure to air and oxidation. The use of frozen fruit permits operation through the year. Thawing of frozen fruit and exposure to air inevitably deteriorates the flavoring and coloring substances. The addition of alcohol to partially defrosted fruit eliminates the deterioration of flavor and preserves the brilliancy of color. After the juice is expressed from the fruit it is advisable immediately to process the pomace, which contains a significantly large amount of flavor and is successfully utilized in the production of raspberry flavor. Frozen raspberries which are used in fruit flavors are packed in barrels. The following formula refers to a large scale batch production.

**Ingredients.**—Twelve barrels of 375 lbs. each, totaling: 3500 lbs. frozen red raspberries, and 72 gal. alcohol, 95 per cent.

**Procedure.**—Consists of application of various manufacturing processes to obtain maximum recovery of aroma and taste from the fruit. The formula is divided into two batch procedures with the yield of each combined to make a finished fruit flavor.
FRUIT FLAVORS

Procedure Batch No. 1

(a) Four bbl. of 375 lbs. each, totaling 1500 lbs. of frozen red raspberries are allowed to defrost at room temperature for two days. To the partially defrosted fruit is added: 24 gal. 95 per cent alcohol.

The mixture is immediately charged into the comminuting machine with a one-quarter inch sieve and comminuted, then pressed. The addition of alcohol to partially defrosted fruit prevents loss of the volatile aroma and change of color. Comminuting the fruit mixed with alcohol also facilitates the instantaneous extraction of flavor from all parts of the raspberries including the slightly crushed seed. It is important to know that a similar treatment cannot be applied to seeds of heated fruit for tannin and seedy flavor may be extracted.

The expressed juice is stored in stainless steel containers at a room temperature of about 65°F. and allowed to clear in order to separate impurities. The juice can then be filtered. However, it is rather advisable to omit filtration in order to cut down exposure of fruit juices to air.

(b) The yield of expressed juice and flavoring extract is about 142 gal. The yield is then divided into two parts. 100 gal. of expressed juice and flavoring extract is put aside for use in the compound of the finished fruit flavor, while the remaining 42 gal. of the same yield is used in batch No. 2 (g).

(c) The fruit cake, also called pomace, which is the pressed remains of extracted skin, fruit flesh, and seeds is mixed with the pomace of batch No. 2 (f), and to it added the second fraction.

Procedure Batch No. 2

(a) Eight bbl. of 375 lbs. each totaling 3000 lbs. of frozen red raspberries are opened and the covers left on the barrels. The raspberries are stored at a room temperature of about 70°F. and allowed to defrost partially so that the fruit can then be coarsely ground. The ground fruit is left at room temperature to defrost completely. After thawing, natural fermentation sets in, during which it is necessary to agitate the fruit frequently. The fermentation is interrupted when the alcohol content is above one-half but below one per cent. The fermentation of red raspberries facilitates the change of acids to esters and thus increases the flavor strength of the fruit.

(b) The partly fermented fruit is then mixed with: 48 gal. alcohol 95 per cent and pressed, to yield approximately 429 gal. expressed juice and flavoring extract.

(c) The 42 gal. of expressed juice and flavoring extract which were put aside in batch No. 1 (b) are mixed with the 429 gal. of expressed juice of batch No. 2 (b) and left in stainless steel containers at room temperature for a few days during which time ester formation continues and sedimentation of pectins and other impurities takes place.
(d) The clear juice is taken off and transferred, for fractional distillation, into the still equipped with two receivers, a speedy agitator, a water jacket with built-in steam coil to facilitate both heating and cooling, and a reliable vacuum pump to assure uniform operation. The procedure begins with the removal of the flavor by a fractional distillation at atmospheric pressure. Heat is slowly applied to the water by means of a steam coil in the jacket of the still, and a slow flow of the first flavor fraction is collected which yields approximately 23 gal. of flavor distillate of about 50 to 55 per cent alcohol content. The first fraction contains all the volatile flavor of extracted fruit and expressed juice. The temperature during the distillation at atmospheric pressure may go up to 190°F for a short period of time without impairing the juice and flavoring extract in the still. The first flavor fraction of the distillation at atmospheric pressure is set aside for use in the compound of the finished flavor in (g).

(e) After the first fraction is collected, the heat to the steam coil is cut off and the hot water rapidly removed by the influx of cold water into the jacket of the still. After the contents of the still have cooled to about 77°F., vacuum is applied gradually, until 28 inches of pressure is reached. Then the water in the jacket is again slowly heated to start the vacuum distillation to recover additional flavor and the remainder of the alcohol as well as to remove the water from the juice and flavoring extract. The vacuum distillation continues until the concentrate in the still is reduced to a quantity of 40 gal. of about 65° to 70° Brix. The concentrate is then cooled and used in the compound mixture of the finished fruit flavor in (g). The yield will then be approximately 120 gal. distillate of about 26.5 per cent alcohol and is used in the distillation of the pomace in No. 2 (f).

(f) The pomace, consisting of the pressed remains of the first and second batch pressings, is mixed with the 120 gal. distillate of 26.5 per cent alcohol content of batch No. 2 (e) and 80 gal. water. The mixture is slowly distilled at atmospheric pressure. The distillate is collected in two fractions, the first with a yield of approximately 17 gal. flavor distillate of about 56 to 70 per cent alcohol content, containing all the flavor which was left in the pressed remains of the fruit. The second fraction with a yield of about 100 gal. distillate of about 29 per cent alcohol content is redistilled to obtain a higher alcohol proof. The rectified yield is used in a next production batch.

(g) To make finished red raspberry fruit flavor, mix

- 40 gal. concentrate of batch No. 2 (e);
- 100 gal. expressed flavoring extract juice of batch No. 1 (b);
- 23 gal. flavor distillate of 54 per cent alcohol content of batch No. 2 (d);
- 17 gal. flavor distillate of 69 per cent alcohol content of batch No. 2
Genuine Raspberry Flavor Distillate  

\( (a) \)

150.0 lbs. frozen red raspberries. Allow to defrost at room temperature, then comminute in a Fitzpatrick using No. 5 sieve. The ground mash is allowed to stand and ferment until its alcohol content is above 0.5 per cent and below 1 per cent strength. It takes 6 days from the time of thawing up to the height of fermentation. The mash is to be agitated three times daily to avoid accumulation of fruit on the surface.

\( (b) \)

At the height of fermentation add:

10.2 lbs. or 1.5 gal. alcohol 95 per cent are mixed with the partly fermented mash. The mixture is allowed to stand for extraction until the following day.

\( (c) \)

The partly fermented mash and flavoring extract is distilled at atmospheric pressure, very slowly, to yield:

20.0 lbs. raspberry flavor distillate of approximately 50 per cent alcohol content.

Black Raspberry Full Flavor Concentrated Juice  

**Procedure**

\( (a) \)

28,284 lbs. frozen black raspberries are allowed to defrost partially at room temperature for 24 hours. The partially defrosted fruit is then heated rapidly to 180°F., and immediately pressed. The yield of 2357 gal. expressed juice should be concentrated without further delay.

\( (b) \)

The 2357 gal. of black raspberry juice of 11.2 per cent Brix should yield in one single procedural batch concentration 285 gal. full flavor concentrated black raspberry juice of 70.5 per cent Brix. The concentrate should be filled into 5-gal. lacquered cans, vacuum sealed, and stored at room temperature. The 100-fold essence should be packed separately in glass containers.

The recovered volatile aroma of black raspberries does not have much flavor value. However, the soluble solids of the concentrated juice retains the full taste and color of the black raspberry fruit. The product should retain during at least six years of storage at room temperature, the aroma, taste, color, and consistency of full flavor black raspberry concentrated juice.

**Flavor Measurements.**—A test made in 100 parts water should indicate:

Threshold of perception: 0.075 per cent equivalent to 0.525 gal. concentrated juice mixed in 700 gal. water.
Color: faint.
Threshold of identification: 0.1 per cent equivalent to 0.7 gal. concentrated juice mixed in 700 gal. water.
Color: distinct.
Threshold of consumers' acceptance: 0.15 per cent equivalent to 1.05 gal. concentrated juice mixed in 700 gal. water.
Color: sufficient.
Threshold of full aromatic flavor: 0.5 per cent equivalent to 1.40 gal. concentrated juice in 700 gal. water.
Color: brilliant.

Flavor Property.—One gallon of full flavor black raspberry concentrated juice 8.15 fold of 70.5° Brix was obtained from 97 lbs. of fruit.

Sherry Type Flavor\textsuperscript{\textcopyright} MF 31
(a) Soak unbleached seedless raisins with:
1025.0 lbs. water, then grind through No. 4 screen in Fitzpatrick machine. Charge mash into extractor or tank and mix with:
10.0 lbs. Pectinal enzyme. After 6 hours add:
50.0 lbs. filter aid and extract as follows:
(b) First extraction: the soaked raisins and added ingredients of (a) are mixed with:
3112.5 lbs. or 375 gal. of hot water of 176°F. agitated and kept at that temperature for 1 hour. The mixture is allowed to cool and then pressed.
(c) Second extraction: the pressed remains of (b) are mixed with:
2490.0 lbs. or 300 gal. hot water at 140°F. agitated, and kept at that temperature for 2 hours; press and filter clear.
(d) The expressed extracts of (b) and (c) are put into a still and concentrated under vacuum to approximately 200 gal. yield.
(e) The distillation is stopped, the manhole on top of still opened, and heat slowly applied at atmospheric pressure to caramelize and concentrate to a yield of about 62 gal.; then add:
581.0 lbs. or 70 gal. cold water and filter; during the filtration of the diluted caramelized raisin concentrate, there is a separation of scorched caramel content which is to be discarded; the filtered product is mixed with:
136.0 lbs. or 20 gal. alcohol 95 per cent; if required, water is to be added to obtain a finished yield of:
125.0 gal. sherry-type flavor.

SLOE BERRY (Prunus spinosa)

Property of Fruit
Average contents
of fruit pulp:

<table>
<thead>
<tr>
<th></th>
<th>moisture</th>
<th>soluble solids</th>
<th>acid</th>
<th>kernel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sloe berry</td>
<td>80</td>
<td>14</td>
<td>3.5</td>
<td>25 (of the whole fruit)</td>
</tr>
</tbody>
</table>

Sloe berry is the wild sour plum of the blackthorn. The fruit ripens after the first frost in the late fall and is picked after its color turns bluish-red. Sloe berries are tart and sour. The berry is dried and used mainly in the extraction and manufacture of Sloe gin cordial.

\textsuperscript{\textcopyright} Made from 1025 lbs. of unbleached seedless raisins.
Sloe Flavoring Extract  MF 32

Ingredients
- 400.0 lbs. dried sloe berries
- 129.2 lbs. or 19 gal. alcohol 95 per cent
- 437.5 lbs. or 50 gal. expressed Morello cherry juice, non-alcoholic
- 415.0 lbs. or 50 gal. water.

Procedure
(a) 400.0 lbs. dried sloe berries are comminuted (using No. 4 sieve) and then mixed with:
- 50.0 gal. boiling water. After 24 hours a menstruum consisting of:
- 50.0 gal. Morello cherry juice and
- 19.0 gal. alcohol 95 per cent is added. The menstruum is circulated over the berries twice daily for three days. The extract is separated to yield:
- 95.0 gal. sloe extract

(b) The remaining mash is distilled at atmospheric pressure to yield:
- 5.0 gal. flavor distillate of about 60 per cent alcohol content.

(c) Mixture of:
- 95.0 gal. sloe extract
- 5.0 gal. flavor distillate
- 100.0 gal. sloe flavoring extract of about 15 per cent alcohol content.

Property of Fruit

STRAWBERRY (Fragaria virginiana)

Average contents: moisture—90; soluble solids—7; acid—1.3; invert sugar—4.7; sucrose—0.5.
Approximate yield: expressed juice—80.

Strawberries grow wild in forests and are also cultivated extensively. The so-called wild strawberries (Fragaria vesca and Fragaria semperflorens) which grow in wooded and mountainous areas are smaller, the color is darker, the aroma is more pronounced than that of the cultivated fruit (Fragaria chiloensis, Fragaria chiloensis of North America, Fragaria chiloensis of Chile).

Strawberries are extremely sensitive fruit and deteriorate easily. Juice which is designated for use in food flavors should be immediately mixed with alcohol of above 18 per cent content.

The addition of sugar at a ratio of 3 to 1 or 4 to 1 to freshly picked strawberries assists in preserving the flavor.

In the production of flavor, partially defrosted or fresh strawberries are speedily ground and their seeds slightly seared to yield a pronounced strawberry flavoring extract. The fruit is mixed with alcohol either be-
fore or immediately after grinding. The distillation at atmospheric pressure of pressed strawberry residue yields a very fine flavor in the first fraction at an alcohol content of 65 to 80 per cent.

Strawberry fruit flavors which are concentrated by the freezing method retain completely the freshness of volatile aroma and the brilliancy of color. The finished flavor should be kept in cool (not cold) storage.

Several varieties of strawberries are cultivated in Georgia, Tennessee, Maryland, Virginia, Florida, Louisiana, California, and the northwestern states, and are grown for different uses—some are used for preserving and freezing, others for flavor, and others for color. California now grows approximately one-half of the United States production.

The berries are picked in the early morning when the fruit is cool, the stems usually being pinched off in picking. The fruit is then rapidly washed to rid the berries of sand and to reduce the risk of mold growth and fermentation. The color and flavor of strawberries remain fresh when they are kept frozen or cold packed.

The Corvallis, Marshall, Clark Seedling, Redheart, and Ettersberg strawberries are used for freezing.

The flavor and ice cream industries use the Marshall, Blakemore, and Klondike varieties which have a high flavor and deep red color.

Strawberry Fruit Juice and Flavoring Extract MF 33

(a) 1000.0 lbs. frozen whole Marshall strawberries without, or with sugar (4 + 1), are defrosted; and to the partly defrosted fruit are added:

2.0 lbs. Pectisol and
163.2 lbs. or 24 gal. alcohol, 95 per cent. The mixture is comminuted with the Fitzpatrick machine using a No. 4 sieve; after which the fruit is pressed as rapidly as possible.

(b) The pressed remains are mixed with:

199.2 lbs. or 24 gal. water and distilled at atmospheric pressure to obtain a distillate of about 3 gal. of flavor distillate of approximately 60 per cent alcohol content. This flavor distillate is set aside for use in the finished mixture of (c).

(c) The expressed juice of (a) is mixed with the 3 gal. of flavor distillate of (b) to yield about 100 gal. with approximately 19 to 20 per cent alcohol content. Strawberry juice and flavoring extract are usually prepared with an alcohol content of above 18 per cent. Below this strength the juice ferments easily.

Flavor Property.—One gallon of expressed juice is derived on an average from

10 pounds of strawberries without sugar or eight and a half pounds strawberries with sugar.
Strawberry True Fruit Flavor \[ \text{MF 34} \]

The concentration of expressed strawberry juice by vacuum distillation yields an optimum flavor when derived from 20 lbs. of fruit per gallon of flavor. Strawberry true fruit flavor derived from more than 20 lbs. of fruit per gallon and concentrated by vacuum distillation yields an inferior product.

This formula is based on the strawberry juice being expressed from fruit without sugar according to formula \[ \text{MF 33}. \]

**Procedure**

\((a)\) 200 gal. strawberry juice and flavoring extract of formula \[ \text{MF 33} \], expressed from an average of ten pounds of fruit per gallon, with an alcohol content of 19 per cent, is loaded into the still and concentrated by vacuum distillation to obtain the first fraction of:

28 gal. or 210 lbs. distillate of about 50 per cent alcohol content to be used in \((b)\).

\((b)\) The second fraction of the vacuum distillation yields:

72 gal. or 568 lbs. distillate of about 30 per cent alcohol content which is redistilled to higher proof and is used in the next production of strawberry flavor.

\((c)\) The third fraction is non-alcoholic and can be used in the next production batch in place of water, where it is mixed with the pressed remains and to distill the flavor. This third fraction yields about:

64 gal. or 531 lbs. distillate. The yield of the concentrate in the still is:

36 gal. strawberry concentrated soluble solids. It is used in \((d)\).

\((d)\) The finished mixture consists of the cooled

36 gal. strawberry concentrated soluble solids of \((c)\) to which is added in the still, to avoid loss of concentrated juice by the transfer into another container:

36 gal. of expressed strawberry juice and flavoring extract of Formula \[ \text{MF 33} \] and

28 gal. of first fraction, flavor distillate of \((a)\). The total is:

100 gal. finished strawberry flavor true fruit concentrate of about 19 per cent alcohol content.

**Flavor Property.**—One gallon of this flavor concentrate is derived from 20 lbs. of strawberries without sugar.

Full Aromatic Strawberry Fruit Flavor\(^{11} \) \[ \text{MF 35} \]

**Ingredients**

3000 lbs. frozen, or freshly picked and cleaned, strawberries.

170 lbs. or 25 gal. 95 per cent alcohol.

**Procedure**

\((a)\) 3000 lbs. partially defrosted frozen or freshly picked and cleaned fruit are coarsely comminuted and mixed with:

\(^{11}\) Concentrated by freezing method.
170 lbs. 95 per cent alcohol and immediately pressed to obtain an approximate yield of:

265 gal. juice and flavoring extract of about 8 per cent alcohol content;

(b) It is filled into open head stainless steel drums whose covers are to be tightly closed and rapidly put into refrigeration for freezing. The frozen juice and flavoring extract is then taken out and left to stay at room temperature long enough so that the partially defrosted mash can be chopped and transferred into the centrifuge to yield approximately:

97 gal. concentrated flavoring extract of about 20 to 22 per cent alcohol content which is used in (d). The separated water of the concentrate is used in the distillation of the pressed remains in (c).

(c) The expressed remains or pomace of (a) is mixed with the water which has been separated from the concentrate in the centrifuge procedure (b). The mixture is then distilled at atmospheric pressure to yield approximately as a first fraction:

3 gal. flavor distillate of about 70 per cent alcohol content.

(d) The finished mixture consists of:

97 gal. concentrated flavoring extract of (b)
3 gal. flavor distillate of (c), to yield:
100 gal. full aromatic strawberry concentrated fruit flavor of about 22 per cent alcohol content.

Flavor Property.—The concentration of expressed strawberry juice and flavoring extract is derived from 30 lbs. fruit per gallon of concentrate made possible by the larger moisture content and lower sugar content of the fruit.
Citrus Fruit Flavors

The composition of citrus fruits are acids, carbohydrates, soluble solids, and volatile or essential oils. The most well-known citrus fruits are oranges, grapefruit, lemons, limes, tangerines or mandarins, and bergamots.

Essential Oil of Peels.—The essential oils are found in the peel of the fruit, in the blossoms, leaves, and twigs of the plant. The citrus oils are volatile substances which are made up of terpenes, sesquiterpenes, higher alcohols, aldehydes, ketones, acids, esters, and waxes.

Terpenes.—The essential oils consist mainly of terpenes \( (C_{10}H_{16}) \) and of small amounts of sesquiterpenes \( (C_{15}H_{24}) \). Both are the carriers of the oxygenated compounds of alcohols, aldehydes, ketones, acids, and esters. The terpenes of citrus oils resemble each other closely.

Among the terpenes is \( \delta \)-limonene, which is present in about ninety percent of the citrus oils. Purified, \( \delta \)-limonene has an agreeable lemon-like odor; pinene occurs in lemon oil; alpha pinene in neroli oil; camphene is found in the oils of orange, petitgrain, and sweet and orange blossom; terpinene, in form of gamma terpinene, is found in lemon oil and resembles dipentene; beta-phellandrene is found only in lemon oil.

Sesquiterpenes.—Sesquiterpenes \( (C_{15}H_{24}) \) have a boiling point of between 482° and 536°F. and are found in fractions of distilled essential oils. They have a faint odor.

Alcohols.—Alcohols in free state are seldom found in citrus oils. They combine with acids to form esters. However, of greater importance, because of their fragrance, are the unsaturated aliphatic alcohols of the terpene type \( (C_{10}H_{15}O) \) formula such as linalool, geraniol, and nerol. The last one has a roselike odor and resembles geraniol. Nerol is found in the oils of neroli, petitgrain, and bergamot. Citronellol \( (C_{10}H_{20}O) \), is also a widely distributed unsaturated aliphatic alcohol and has the odor of roses.

Aldehydes.—Aldehydes in essential oils occur only in small quantities. However, they possess a characteristic odor and are thus of importance. Among the aliphatic aldehydes are: n-octyl aldehyde \( (C_{7}H_{15}.CHO) \) which is found in lemon oil; n-nonyl aldehyde \( (C_{9}H_{17}.CHO) \) which is also found in lemon oil; n-decyl aldehyde \( (C_{9}H_{19}.CHO) \) which occurs up to 2.7 per cent in the oil of orange is also found in mandarin and neroli.
oils; citral (C_{10}H_{10}O) is a very important constituent of citrus oils. It is a yellow liquid and has a characteristic odor of lemon.

**Esters.**—Esters give distinctive and specific fragrance to essential oils although they occur in very small quantities. Among the esters of importance in citrus oils are linalyl acetate and geranyl acetate. Oranges which are kept in storage for a long time give off an odor of methyl anthranilate which is due to the increase of the methyl anthranilic methyl esters.

**Essential Oils of Flowers, Leaves, and Twigs.**—*Oil of Neroli.*—Oil of neroli is obtained by steam distillation from the blossoms of the bitter orange, *Citrus bigaradia Risso*. Neroli is produced mainly in the southern part of France, where the blossoms are picked by hand. It is also distilled in Spain, Italy, Venezuela, Paraguay, Syria, and Algeria.

Neroli oil has a yellowish color, is slightly fluorescent and has an intense odor of orange blossom. The taste is slightly bitter and aromatic.

**Oil of Petitgrain.**—Petitgrain oil is derived by steam distillation from the twigs and leaves of the bitter orange. The oil resembles neroli in odor; however, it is less fragrant. Petitgrain oil is often adulterated with lemon and orange oils and turpentine.

Other petitgrain oils are: petitgrain Portugal, which is distilled from the leaves of sweet orange; mandarin petitgrain oil, which is distilled from the leaves of the tangerine tree; lemon petitgrain, which resembles true petitgrain in odor, however, its aroma is distinctly like lemon; oil limette leaves resembles lime oil in odor.

**Citrus Fruits**

**Oranges.**—Oranges grow in the United States, Spain, Italy, Portugal, Israel, South Africa, the Azores, the Bahamas, Puerto Rico, and Australia.

California oranges are available the whole year round. Florida oranges are available from October to June. The oil of Valencia oranges has the best flavor. Oil of oranges is most extensively used in frozen ices. It is also the best source of pure d-limonene.

The varieties of oranges cultivated in Florida and neighboring states are Parson Brown, Hamlin, Seedlings, Pineapple, Valencia, and Leu Gim Gong. The Valencias are the late variety.

Oranges are picked before they are fully ripe. The maturity is determined by the ratio of total soluble solids, mainly sugars, to the acid content of the expressed juice (referred to as the Brix Acid Ratio). Certain varieties of oranges are green when ripe. Some have an orange color when the fruit is still immature. There seems to be no relationship between the color, flavor, and maturity of citrus fruits.
Sweet orange oil has a yellow to red-brown color and a distinctly characteristic aroma. The adulteration of orange oil is difficult because of its low specific gravity and its high angle of rotation. The oil of bitter oranges of the Citrus bigaradia Risso is bitter in taste and has a lower angle of rotation.

**Tangerines or Mandarins.**—Tangerines are small, flattened oranges with thin, somewhat dry skin. The oil of mandarins or tangerines, Citrus madurensis Loureiro, is produced in Italy by cold-expressing method and in Brazil by distillation.
Maltese.—The Maltese fruit is called blood orange because of the color of its pulp. The Seville is a sour orange.

Grapefruit.—The grapefruit has an acid and sometimes bitter taste. Grapefruit grows in Florida, California, Texas, Arizona, Puerto Rico, and the West Indies. The oil of the grapefruit, *Citrus decumana* Linnaeus, is produced in limited quantities for its use is still in the exploratory stage and the yield very poor.

Lemons.—Lemons grow in southern California, Spain, Portugal, Israel, Italy, and tropical and subtropical countries. Lemons are cut from the trees while still green and flavor is enhanced by ripening under controlled conditions. Lemon oil, which is derived from the peel of the fruit, is most extensively used in bakery products and widely applied in formulation of beverages and ice cream.

The principal constituent of lemon oil is d-limonene, with up to 90 per cent of the oil. The principal oxygenated constituent is citral, which represents about 2 to 6 per cent of the lemon oil. The other chemical components of lemon oil are geranyl acetate, linalyl acetate, methyl anthranilate, capric, caprylic, and acetic acids.

Lemon oil can be adulterated by the use of d-limonenes and a cheaper grade of citral which is made from oil of lemon grass. The detection of this adulteration is difficult either by chemical analysis or by examination with the use of a refractometer or polarimeter.

Limes.—Limes are oval, green to yellow colored fruit with more acid than lemons. Limes have a tart flavor. They are grown in Italy, Mexico, Jamaica, other Caribbean islands, and in Florida.

Oil of limes is derived from the rind of the fruit, *Citrus medica* Linnaeus, by cold-expressing procedure, or by distillation. The obtained oils differ greatly in their chemical composition.

Bergamot.—The bergamot tree, *Citrus aurantium* Linnaeus, grows mainly in Calabria, Italy. The fruit is used only for derivation of its volatile oil.

Bergamot oil has brownish-yellow color; is bitter in taste. Its fragrance is very pleasant.

Citrus Juices.—The juices of lemon, grapefruit, lime, and bergamot have a yellowish-green color, while orange and tangerine juice are orange to red in color.

The characteristic aroma of freshly expressed citrus juices is due in all probability to aromatic substances within the juice which are far different in composition from the essential oil of the peel. These flavoring constituents of freshly expressed citrus juices are present in such small quantities that it is difficult to investigate them. They change rapidly shortly after the juice has been removed from the fruit.
Lemon Essence Terpeneless  

(a) 20 lbs. oil of lemon, cold pressed, are mixed with
5 lbs. alcohol 95 per cent.

The mixture is then diluted with:
32 lbs. water, to facilitate the separation of terpenes.

The composition is allowed to stand for 24 hours in a
separator (Fig. 14) so that the separated terpenes can con­
tract and reduce in volume.

(b) The terpene-free essence is then taken off and yields approximately:
92 lbs. flavor compound, which is mixed with
8 lbs. alcohol, 95 per cent, to clear it. The finished yield is:
100 lbs. lemon essence, terpeneless.

This flavor is most useful in pastry and cakes. Four fluid ounces of lemon
essence, terpeneless, is sufficient to flavor 100 lbs. of bakery dough.

Concentrated Orange Oil Extract  

(a) 250.00 lbs. oil of orange, cold pressed is concentrated 10-fold by
vacuum distillation and the terpenes removed. The yield is:
25.00 lbs. oil of orange, cold pressed, 10-fold, which is used in (b).

(b) Mixture of:
25.00 lbs. concentrated 10-fold oil of orange, cold pressed, of (a) and
68.00 lbs. alcohol, 95 per cent, and to it added:
31.25 lbs. water. The mixture has to be well agitation and is then al­
lowed to stand in separator (Fig. 14) for 24 hours to effect
separation of terpenes and waxes. It yields:
86.25 lbs. terpeneless orange essence which is to be mixed with:
13.75 lbs. alcohol, 95 per cent;
100.00 lbs. concentrated orange oil extract.

A terpene separator designed by the author is shown in Fig. 14.

Orangeade Flavor Paste and Orangeade Syrup  

(a) The peels of fully ripe oranges, containing the volatile oil of the fruit, are
removed from the pulp. The expulpated peels are either ex­
pressed or distilled to separate the volatile oil.

(b) The remaining fruit is then halved or quartered and the juice expressed.
The expressed juice is either frozen or preserved by the
addition of 312 gm. formic acid (CH₂O₂), for each 100 kg.
of juice.

(c) The pulp of the expressed fruit is mixed with water and boiled until it is
soft enough to pass through the sieve of the comminuting
machine to form a fine mash. However, the water must be
removed from the softened pulp before comminution.

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1 Free of terpenes and waxes.
2 Continental formula.
(d) The mash is then preserved by the addition of 312 gm. formic acid for each 100 kilo of pulp.

(e) Preparation of Orangeade Flavor Paste (3 Kg. per Unit)

1.5 kg. mashed pulp is mixed with:
1.5 kg. powdered sugar, and to it is added:
250.0 gm. concentrated orange oil extract, free of terpenes and waxes—formula MF 37.
5 to 8 gm. certified orange color, which is required to finish the flavor composition.
The orangeade flavor paste is used in units of 3 kg. to flavor 100 kg. syrup.

(f) The syrup is prepared by dissolving:
65.0 kg. sugar in:
31.0 kg. water, to which is added:
925.0 gm. acid citric.
The mixture is brought to a boil and left to simmer for about five minutes, to facilitate the inversion of the sugar.
The syrup is then cooled and mixed with:
3.0 kg. orangeade flavor paste of (e).
Thorough agitation will contribute to complete dispersion of the paste.

(g) The product is orangeade syrup, which is then passed through a sieve to separate lumps which may have been in the mash of the orangeade flavor paste.

(h) The orangeade syrup is immediately filled into bottles or other non-metallic containers for distribution. The containers should be labeled “Shake well before use.”

(i) The expressed juice of (b) can be used in the preparation of syrup (f) with water in desired proportions. However, the sugar is to be dissolved in the mixture of water and juice without heating.

Tangerine Extract, Terpeneless  MF 39

Mixt.:

160.00 gm. oil of tangerine or mandarin
550.00 gm. alcohol, 95 per cent

Dilute mixture with:

290.00 gm. water:

1000.00 gm. after thorough agitation, allow to stand in separator (Fig. 14) for 24 hours;
145.00 gm. terpenes (approximately) will separate on the surface of the dissolved tangerine-alcohol-water mixture; the clear solution is taken off and will yield approximately:
855.00 gm. essence which is then mixed with:
145.00 gm. alcohol, 95 per cent to yield:

1000.00 gm. tangerine extract, terpeneless

Tangerine extract is used in sherbets and fruit ices.
Tropical Fruit Flavors

AVOCADOS (Persea americana)

Property of Fruit

Average contents: moisture, 65; fat up to 25.

(A per cent)

Avocados (alligator pears) grow in every country of tropical America. The cultivated varieties are Mexican, Guatemalan, and West Indian. Avocados have a nutlike flavor. The ripe fruit has a creamy to yellow color. The extraction of the juice and flavor is processed in a manner similar to banana.

BANANAS

Bananas belong to the genus *musa*. They grow in a tropical climate where rainfall is frequent and where the trees are protected from hot winds and hurricanes.

Bananas are grown in Florida, Mexico, Guatemala, Nicaragua, Costa Rica, Panama, Cuba, Dominican Republic, Haiti, Jamaica, Colombia, Brazil, Ecuador, Honduras, Canary Islands, Equatorial Africa, Formosa, Fiji Islands, Samou, Philippine Islands, and Australia.

The characteristic aroma and taste of banana is developed during ripening and is due to the presence of alcohols and esters. Amyl acetate is also a constituent of ripe bananas. The odorous constituents of the pulp consist of amyl esters of acetic and butyric acids, acetaldehyde, and very small quantities of ethyl and methyl alcohols. The essential oil of the fruit possesses in a small degree the odor of bananas.

During maturation of the banana, the fruit changes in color from green to yellow. The chlorophyll content of the peel decreases as the fruit ripens. The yellow pigments and carotene remain unchanged during ripening of bananas. The importance of the pigment is due to its content of ascorbic acid and of vitamin A. Oxidation of ascorbic acid takes place with browning and blackening of the fruit. Sliced, ripened fruit exposed to room temperature also loses ascorbic acid. Fruit cooked with the peel, however, retains ascorbic acid fairly well.

Products made from bananas are flakes, powder, flour, pastes, juice and flavors, wine, brandy, and vinegar. Banana wine and brandy flavor from ripe bananas is prepared from a mash consisting of the pulp with or with-
out peel. The mash is diluted with water and inoculated with a pure wine yeast culture and allowed to ferment at 68°F to 75.2°F for 20 days.

After fermentation the mash is filtered. Freezing of the clear juice and centrifugal separation of the water content in form of a snow mass yields a banana wine of 22 to 28 per cent alcohol content. By distilling the concentrated wine at atmospheric pressure and fractioning the distillate, banana brandy, the finest banana flavor is obtained.

BANANA FLAVORS

Property of Fruit

Average contents of fruit without peels:
- moisture, 75; invert sugar, sucrose, and soluble solids, 21.5; fruit, 60; peel, 40.

Banana Fruit Flavor MF 40

Ingredients
- 2500.0 lbs. bananas
- 166.0 lbs. or 20 gal. water
- 190.4 lbs. or 28 gal. alcohol, 95 per cent
- 3.0 lbs. enzyme Pectinol
- 50.0 lbs. filter aid.

Procedure

(a) Spread out 2500 lbs. bananas and allow them to become overripe, but not too soft, in order to permit easy peeling.

1500.0 lbs. peeled fruit (60 per cent yield of 2500 lbs. bananas) is run through the comminuting machine and mixed with:
- 20.0 gal. water and
- 3.0 lbs. Pectinol

The mixture is to be well agitated to form a uniform mash which is then allowed to stand for one day in order to thin its consistency and to dissolve the pectins.

28.0 gal. alcohol, 95 per cent is then added and thoroughly mixed with the banana mash.

(b) 50.0 lbs. filter aid is added to the mixture of (a) and the juice separated by draining and then by pressing; the yield is about:
- 95.0 gal. banana juice and flavoring extract; it is used in (d).

(c) The remaining mash is mixed with:
- 30.0 gal. water and distilled at atmospheric pressure to yield:

first fraction:
- 5.0 gal. flavor distillate of about 60 per cent alcohol content; it is used in (d);
second fraction:

5.0 gal. distillate of about 40 per cent alcohol content; it is used in the next production batch;

(d) Mixture of:

<table>
<thead>
<tr>
<th>95.0 gal. extract of (b)</th>
<th>5.0 gal. first fraction—flavor distillate of (c)</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>100.0 gal. banana fruit flavor of about 15 per cent alcohol content.</td>
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</tr>
</tbody>
</table>

Flavor Property.—One gallon banana fruit flavor is derived from 25 lbs. of fruit.

GUAVA

Property of Fruit

Guava is a tropical fruit with a pleasing flavor and has a balanced content of sugar and acid. The best varieties are the strawberry guava, the Costa Rican guava, Chamach, and Feijoa guava.

The juice is derived by slicing the fruit, mixing it with a small amount of water, and heating. The heated product is pressed and reheated by flash pasteurization. The juice is used in syrups and in beverages.

MANGO

Property of Fruit

Mango is a tropical fruit of plum-like form available in sizes up to a weight of five pounds. The fruit has a firm fiberless flesh with a color which varies from white to blood-red shades. The aroma is pleasant and often roselike. The taste is sweet.

Mango juice and fruit flavoring extract is prepared from fully ripe fruit by a procedure similar to that used to make banana fruit flavor.

PAPAYA OR PAPITA (Carica papaya)

Property of Fruit

Papaya is a tropical melon fruit which grows on trees. The natives call it the "fruit of the angels." Papaya is one of the few alkaline fruits known. The ripe melon contains vitamins A, B₁, B₂, and C, also iron, calcium, and phosphorus.

The unripe melon contains the enzyme, "papain," one of the most powerful digestants known, which is also the active ingredient of most meat tenderizers. Papain is absent from the ripe fruit and its juice.

Papaya requires rapid extraction of the juice and concentration of it by freezing in order to retain the vitamins and mineral as well as to preserve the freshness of the ripe fruit in the concentrate. Papaya and banana fruit flavor and apple essence make a good combination.
Papaya Fruit Flavor  

Prepare mixture of

- 12 fl. ozs. apple essence, 100-fold, of full flavor apple concentrated juice; or banana true fruit flavor
- 64 fl. ozs. papaya concentrated juice, five-fold
- 6 fl. ozs. caramel, acid proof
- 48 fl. ozs. syrup, 40° Baumé

128 fl. ozs. finished flavor

Papaya-Banana Nectar  

Prepare a mixture of

- 500 gm. papaya concentrated juice, five-fold
- 100 gm. caramel color
- 320 gm. banana fruit flavor—formula MF 40
- 80 gm. alcohol, 95 per cent

1000

Use 6.5 fl. ozs. per one gallon syrup and add 1 fl. oz. citric acid 50 per cent.

PASSION FRUIT (Passiflora edulis)

Property of Fruit

The passion fruit comes from South Brazil originally. It is cultivated in Australia, where the fruit is eaten fresh, as a dessert. In the United States passion fruit is grown in California. The ripe fruit is the size of a plum. Its color is dark purple. The passion fruit contains black seeds which are sheathed in a gelatinous orange-colored pulp. The flavor resembles that of a crab apple and is particularly suitable for ice cream and cake fillings.

The flavor is best separated from the fruit by alcoholic extraction, and the pressed remains distilled at atmospheric pressure to recover all the flavor of the fruit. These are combined to form the finished fruit flavor.

Passion fruit syrup and cordials are popular in Australia and South Africa. Carbonated beverages made from passion fruit flavor have a characteristic and attractive aroma.

PINEAPPLE (Ananas sativa)

Property of Fruit

Average contents:  moisture, 84; soluble solids, 13.5; acid 0.7; invert sugar, 3.9; sucrose, 7.5; pectin, 0.3; peel, 30.

Approximate yield:  expressed juice, 60, of fruit pulp.
The pineapple is cultivated throughout the tropical regions of the world. The fresh fruit is imported from Puerto Rico, Cuba, and the Hawaiian Islands. The largest part of the flavor is derived from the peel; some flavor is distributed in the pulp. The fruit contains bromelin which converts fruit pulp into peptone at 104°F.

Pineapple is heat-sensitive.

**Pineapple Fruit Flavor**  MF 43

**Ingredients**

- 400 lbs. unsweetened pineapple juice,
- 1200 lbs. fully ripe pineapple fruit,
- 180 lbs. or 25 gal. alcohol, 95 per cent
- 4 lbs. enzyme Pectinol

**Procedure**

(a) Mixture of:

- 400 lbs. unsweetened pineapple juice
- 180 lbs. or 25 gal. alcohol, 95 per cent

Total: 580 lbs. or approx. 72 gal. menstruum of about 33 per cent alcohol content.

(b) 1200 lbs. fully ripe pineapples—are to be cut into small slices and mixed with the menstruum of (a), then comminuted to smaller size. The juice and flavoring extract is to be separated by centrifuge to yield:

95 gal. flavoring extract; 4 lbs. Pectinol are added;

(c) the remaining fruit mash is distilled at atmospheric pressure to obtain:

first fraction: 5 gal. flavor distillate of about 50 per cent alcohol content; it is used in (d).

second fraction: is distilled to recover the alcohol, then redistilled to higher proof strength. It is used in the next production batch;

(d) mixture of:

- 95 gal. extract of (b)
- 5 gal. flavor distillate of (c)

Total: 100 gal. pineapple fruit flavor of about 18 per cent alcohol.

**Flavor Property.**—One gallon of flavor is derived from about 22 lbs. of fruit.
Apricot Fruit Color  MF 44

(a)  115 lbs. dried apricots are soaked in cold water, allowed to soften and then comminuted to facilitate extraction. The fruit is put into an extractor and sufficient cold water added to keep it covered. After two hours the liquid is drained off to yield, approximately:
   200 lbs. extract, which is used in (d).
(b) The remaining fruit is covered again with cold water in sufficient quantity to yield, after another two hours, approximately:
   150 lbs. extract; which is used in (d);
(c) the remaining fruit is allowed to drain and will yield additional extract of about:
   20 lbs. extract; which is used in (d).
   The fruit is then discarded;
(d) the extracts of (a), (b), and (c), are mixed and filtered. The filtered extract is concentrated by vacuum distillation to yield approximately:
   80 lbs. concentrated extract.
(e) The vacuum distillation is then interrupted and the residue distilled at atmospheric pressure to remove more water and to carmelize, the mass with continuous agitation so as to concentrate, but not burn the mass. The manhole of the still is opened and the degree of caramelization is continuously checked by a taste test required to detect the turning point from carmelization of the sugar of the fruit to actual burning. At the height of the procedure one-half gallon portions of cold water are forcefully poured into the boiling mixture twice in intervals of a few minutes, and then heating is interrupted. With it the caramelization process is finished. The yield is about:
   43 lbs. of caramelized concentrate which is used in (f).
(f) Mixture of:
   43 lbs. caramelized concentrate of (e)
   37 lbs. water
   15 lbs. alcohol, 95 per cent
   95 lbs. apricot fruit color of about 15 per cent alcohol content.

ELDERBERRIES

Property of Fruit

Dried elderberries are used for the coloring of blackberry, raspberry, currant, cherry, sloe, and other red fruit flavors in the United States. They are imported from European countries for this purpose.
Fruit Color Made From Dried Elderberries

(a) Extraction
25.0 kg. dried elderberries
42.0 kg. hot water 203°F.
500.0 gm. citric acid; after 24 hours, add:
8.0 kg. 95 per cent alcohol stir twice daily for five days, then draw off extract.

(b) Extraction
25.0 kg. water to remaining fruit which has been placed into percolator; remove the extract by gravity after one hour's stay;

(c) if the fruit still contains color, percolate with an additional portion of:
25.0 kg. water, and draw off extract;

(d) mix the yields of (a), (b), and (c), filter if not sparkling clear, then concentrate by vacuum distillation to obtain a yield of:
10.0 kg. concentrate of 70° Brix.

Fruit Color Made From Fresh Elderberries

If fresh elderberries are available, the following formula and procedure is applied:

(a) 100.0 kg. fresh elderberries, without stems or
120.0 kg. fresh elderberries, with stems; mixed with 500 grams, acid citric, are pressed; filter the juice; add alcohol up to 1.5 per cent strength.

(b) if no alcohol is added to prevent fermentation, the work must be carried out quickly to avert fermentation which will deteriorate the color making it bluish.

(c) put the juice into the vacuum still and concentrate by vacuum distillation to obtain a yield of:
10.0 kg. concentrate of about 70° Brix. The alcohol of both formulas is used in subsequent productions. The concentrates are free of alcohol. They are preserved by their own contents of soluble solids and sugars totaling 70° Brix.

True Red Fruit Color—Without Flavor

Ingredients
1200.00 lbs. black raspberries frozen or freshly picked and cleaned
500.00 lbs. dried elderberries
25.00 lbs. acid citric
272.00 lbs. or 40 gal. alcohol, 95 per cent; acid citric added to elderberries and black raspberries assists in removing coloring matter from the fruit. It is sufficient to add 3 pounds of citric acid to 100 lbs. of dried elderberries, huckleberries, black raspberries; 1 lb. to 100 lbs. fresh or frozen fruit used for the purpose of obtaining red coloring matter. The acid is dissolved in water or juice before it is added to the fruit to extract color;

1 For production in Europe.
yield: the finished product is approximately 115 gal., with about 15 per cent alcohol content.

Procedure

(a) 1200.0 lbs. of black raspberries are ground and pressed. The pulp is discarded. The juice is heated to 167°F, and mixed with 25 lbs. citric acid, then put into an extractor or tank with:

- 500.0 lbs. ground dried elderberries and after cooling mixed with:
- 142.8 lbs. or 21 gal. alcohol 95 per cent. After 24 hours the extracted color is drained off and pressed; the first extraction is temporarily put aside for use in (c);

(c) the pulp is returned to the extractor or tank and extracted twice more, after 24 hours using:
- 1245.0 lbs. or 150 gal. of warm water of 140°F each time, totaling:
- 2490.0 lbs. or 300 gal. water. The first, second and third extractions are combined and filtered through the press with filter aid.

(d) the filtered extract is loaded into the vacuum still to recover alcohol and to concentrate the extract. The yield of recovered alcohol is approximately 17.1 gal. absolute alcohol. The loss is 2.85 gal. absolute alcohol. The recovered alcohol is redistilled to higher proof and used in the subsequent procedure. The yield is approximately 96 gal. of concentrated soluble solids. It is allowed to cool and then mixed with:

- 108.8 lbs. or 19 gal. 95 per cent alcohol to yield: 115 gal. finished true fruit color.

Color Property.—One gallon of the fruit color is sufficient to give a distinct red berry shade to 700 gal. of water.

DESUGARED GRAPE EXTRACT—ENOCIANINA

"Enocianina" or desugared grape extract is used to add color of red shade to fruit flavors. The Enocianina is imported from Italy, where it is derived from the skin of red grapes with the aid of acidified menstruum. The extracted coloring matter is then neutralized by alkaline chemicals.

The lack of acid gives desugared grape extract a bluish shade of color which turns to red when an acidifying medium is added. Enocianina has no flavor. However, it acquires a peculiar odor after it is removed from its original wooden containers if it is kept for very long at room temperature. Desugared grape extract should be kept in its original containers and put in cold storage (not frozen). The extract should be filtered before use.

After use, the equipment should be washed with an acid solution and then rinsed with water to remove the bluish color traces of the extract.

Desugared grape extract is useful in juices, syrup, and carbonated beverages. However, the color changes to a gray shade in mixtures with milk products and ice cream.

Red fruit color.
Peach Syrup—68° Brix and Peach Fruit Color  

Ingredients

350 lbs. dried peaches
110 lbs. peach syrup of 68° to 70° Brix

Procedure

(a) 350 lbs. dried peaches are mixed with sufficient cold water to cover the fruit. The mixture is allowed to soak for 24 hours, is then comminuted and additional cold water is added to extract the fruit. The menstruum is circulated for about one hour and then drained off to yield:

600 lbs. extract; it is filtered and used in (c);

(b) to the remaining mash is added sufficient water to extract the fruit without circulation of the menstruum and to yield:

400 lbs. extract; it is filtered and used in (c); the extract remains are then discarded.

(c) Concentration by vacuum distillation of:

600 lbs. peach extract of (a)
400 lbs. peach extract of (b)

To yield 110 lbs. peach syrup of 68° to 70° Brix.

(d) The peach syrup can also be caramelized for use as a peach fruit color. The procedure is the same as for apricot fruit color of formula MF 44.
Sugar-free Fruit Flavors

The production of sugar-free fruit flavors is an invention of the author (U.S. Patent No. 2,865,756 issued December 23, 1958). Among the objects of the invention is the production of true fruit flavors free of the natural sugar content derived from the fruit. The invention is novel not only in that exact duplication of the fresh fruit flavor may be obtained but also by suitable compounding, new flavor types may be developed which have great interest from the commercial beverage and foodstuff flavoring point of view.

A variety of fruits may be used in the production of fruit flavors in accordance with the present invention. They may be raspberry, cherry, blackberry, grape, strawberry, peach, banana, pineapple, apple, pear, and the like.

The process desirably used in producing full aromatic fruit flavors free of sugar from the fruit source consists essentially in distilling off the aromatic essence from the fruit component leaving a residue which is then vacuum distilled to remove a substantial amount of water and concentrate the sugar content. This concentrated syrup is then added to a fresh fruit complement such as crushed fresh fruit or expressed juice and the fortified mixture is fermented to completely convert all of its sugar content. The fermented material is then pressed to yield a flavor concentrate which is blended with the aromatic essence which had previously been removed. In this manner, a concentrated authentic fruit flavor is produced containing no free sugar. It is essential to follow the steps of the process in the order in which they have been described above since any variation will result in either a wine type of product or a flat relatively tasteless juice concentrate.

Sugar-free Raspberry Fruit Flavor

2400 lbs. of black raspberries are mixed with 10 gal. of 95 per cent ethyl alcohol\(^1\) and comminuted. The fruit and alcohol mixture is then pressed to yield 200 gal. of black raspberry juice. The pressed remains are stored and designated as residue C-1. The black raspberry juice is distilled at atmospheric pressure to obtain one gallon of flavored distillate (Flavor distillate A) which contains the volatile aroma. Distillation is then stopped and the juice cooled to approximate 77°F. Vacuum is applied (28 to 30 in.) and 40-50 gal. distillate is removed until the juice is alcohol-free. This distillate is redistilled

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\(^1\) Raspberry brandy of equivalent alcohol content may be used.
without vacuum to obtain approximately 12 gal. of an alcoholic flavor distillate of higher proof (flavor distillate J). The vacuum distillation of the juice is then continued until there is obtained approximately 24 to 30 gal. of juice concentrate having a 36° to 38° Baumé sugar content (concentrate B).

1800 lbs. of red raspberries are mixed with 5 gal. of 95 per cent ethyl alcohol and 12 gal. of flavor distillate J. The fruit and alcohol mixture is then comminuted and pressed to yield approximately 200 gal. of a raspberry juice. Pressed remains are stored and designated as residue G2. For separation of volatile aroma, this juice is then distilled at atmospheric pressure to obtain three gallons of a flavor distillate (flavor distillate C). The distillation is then stopped and the juice cooled to 77°F. A vacuum of 28 in. is applied and distillation continued to obtain 50 gal. of distillate or until no more alcohol comes over from the juice in the still. This distillate is called flavor distillate D. The distillation is continued under vacuum in order to concentrate the juice to a volume of 18 to 20 gal. with a sugar concentration of 36° to 40° Baumé (concentrate E). 2200 lbs. of comminuted red raspberries or 2000 lbs. of a mixture of red and black raspberries, 28–30 gal. of concentrate B and 18–20 gal. of juice concentrate E are placed in a fermentation tank. A yeast culture is added and the mixture fermented until all of the sugar has been converted into alcohol. After fermentation, the mixture is pressed to yield approximately 225 gal. of concentrate (concentrate F). The pressed remains are designated as residue G3.

Residues G1, G2, G3, and 50 gal. of distillate D are mixed and the mixture distilled without vacuum to obtain 10 to 12 gal. of flavor distillate H.

In using the materials obtained from the various steps described above, a completely constituted sugar-free true fruit flavor of raspberry is compounded as follows:

| 225 gal. concentrate F | 12 gal. distillate H | 1 gal. distillate A | 3 gal. distillate C |

There is thus obtained 241 gal. of sugar-free fruit flavor concentrate containing approximately 17 per cent alcohol and being equivalent to approximately 26.6 lbs. of fresh raspberries per gallon of flavor concentrate.

The quantity of 26.6 lbs. of fresh raspberry fruit per gallon of concentrate is that concentration which can be considered the minimum of acceptable flavor strength for commercial use without the further addition of so-called natural flavorings. Other combinations and proportions of such concentrates and distillates may be made.

Sugar-free Cherry Fruit Flavor MF 49

200 lbs. of comminuted cherries are mixed with 4 gal. 95 per cent alcohol or cherry brandy of equivalent alcohol content and pressed. 20 to 22 gal. and 24 lbs. of press cake are set aside for future use (residue a). The pressed juice is distilled at atmospheric pressure to remove one-half gallon of aromatic essence (flavor distillate f) containing volatile flavor. The remaining juice is vacuum distilled until a cherry concentrate of 36° to 40° Baumé sugar content is obtained. The recovered alcohol of this fraction is put aside and called
distillate. The cherry concentrate is mixed with 200 lbs. of cherries, 110 lbs. of imported Dalmatian cherries and a yeast culture. The mixture is placed in a fermentation tank and fermented. After a period of time, a sample is taken out and analyzed to determine the alcohol and sugar content. When no more sugar can be detected, the fermentation is terminated and the contents of the tank pressed to yield approximately 22 gal. of concentrate (concentrate b). The press-cake is stored for future use (residue c). After comminution residue c, which contains the cherry pits, is mixed with 8 gal. of water, warmed, and agitated, and then left at 131°F. to stand for about 24 hours. The crushed pits of the residue develop an aromatic cherry essence (benzaldehyde) by enzymatic action. After a total of 24 hours have elapsed, the flavor distillate d and the 24 lbs. residue e are added and the mixture distilled to yield 2.5 gal. of distillate (flavor distillate e).

A fully constituted authentic sugar-free cherry fruit flavor is obtained by compounding 22 gal. of the concentrate b and 2.5 gal. of flavor distillate e and one-half gallon of flavor distillate f to yield 25 gal. of sugar-free fruit flavor with an alcohol content of approximately 20 per cent and being equivalent to 31.4 lbs. of fresh cherries per gallon of fruit flavor. One pound of dried cherries is the equivalent of 2.75 lbs. fresh cherries. The quantity of 30 lbs. of fresh cherries per gal. of flavor concentrate is that concentration which can be considered the minimum of acceptable flavor strength for commercial use without the further addition of so-called natural flavorings.

Dietary Fruit Flavors MF 50

These sugar-free fruit flavors are devoid of any sweet flavoring. In order to provide a flavoring material directly suitable for beverages, and especially dietary beverages and foods, the following compositions are suggested:

(a) One hundred gallons of the sugar-free raspberry flavor described in MF 48 should be mixed with 150 lbs. of sodium cyclohexylsulfamate and stirred until a clear product is obtained.

(b) One hundred gallons of the sugar-free cherry fruit flavor of MF 49 should be mixed with 160 lbs. of calcium cyclohexylsulfamate and stirred until a homogeneous solution is formed.

Dietary or Non-Calorific Beverages MF 51

These products are especially useful in the preparation of flavored food-stuffs and dietary or no-calorific beverages. The following composition illustrates the preparation of a suitable raspberry beverage:

- 40 gal. water
- 0.5 lb. sodium benzoate
- 12 lbs. sodium cyclohexylsulfamate
- 6 gal. sugar-free raspberry flavor of MF 48
- 100 oz. 50 per cent citric acid
- Color to suit
- Water to make 100 gal. of beverage

The beverage is bottled and carbonated with an appropriate amount of carbon dioxide gas.
Sugar-free Fruit Flavor with Other Natural Flavors  

The sugar-free fruit flavor of raspberry or cherry may be fortified with natural flavorings such as essential oils and botanical extracts to create a so-called “sugar-free fruit flavor with other natural flavors.” The following formula illustrates the preparation of a suitable “sugar-free cherry fruit flavor with other natural flavors” per gallon of finished mixture:

20 gm. oil of bitter almond (free from prussic acid)  
8 oz. alcohol distillate of wild cherry bark  
76.8 oz. sugar-free fruit flavor of MF 49 (in accordance with existing regulations of the FDA, this quantity corresponds to 51 per cent of natural cherry flavor in the total mixture).

Add the desugared grape extract, caramel color, or certified colors which are dissolved in water to obtain a total of one gallon of finished flavor.

Sugar-free Fruit Flavor and Imitation Flavor  

The sugar-free fruit flavor such as that of raspberry or cherry may be fortified with aldehydes, esters, ethers, ketones, and other food permissible aromatic chemicals, to produce a so-called “sugar-free cherry fruit flavor and imitation flavor.” The following composition illustrates the preparation of a suitable sugar-free cherry fruit flavor and imitation flavor:

2 oz. benzaldehyde  
1 oz. tolylaldehyde  
1 pt. 95 per cent ethyl alcohol  
Q. S. sugar-free cherry fruit flavor to obtain:  
1 gallon of finished sugar-free cherry fruit flavor and imitation flavor.
The botanicals from which flavors can be separated include herbs, roots, seeds, leaves, flowers, and other portions of plants, trees, and shrubs. The flavor is obtained from the botanicals by extraction methods, such as maceration, digestion, percolation as well as by various distillation procedures. The extracting menstruum is usually a mixture of alcohol and water. The botanical ingredients are reduced to small particles before use in the extraction and distillation procedures.

The application of all extraction and distillation methods requires a thorough knowledge of the botanical ingredients. Some contribute only aroma, while others yield both aroma and taste. For certain ones distillation is the best procedure, for others distillation and extraction, for some extraction alone is to be preferred.

Maceration

The botanicals are put in a cloth bag with ample space for expansion, and are then mixed with alcohol (approx. 40 to 60 per cent by volume). The extraction requires about 5 to 8 days, during which the herbs and menstruum are agitated twice daily. This maceration process soaks and softens the cells of the botanical ingredients. Some of the constituents of the botanicals are soluble in water, such as sugars, resins, and bitter materials, while others such as the aromatic components and essential oils are dissolved in the alcohol in the menstruum. The extract is then drawn off and the remains pressed to recover the rest of the flavoring extract. The extracted botanicals are mixed with water of equal weight and pressed again. The products of the extraction and pressing are combined and left to stand for a few days to clear. The final yield of the flavoring extract has about 30 per cent alcohol content and is of a well balanced aroma and taste.

Digestion

This is an extraction method accelerated with the aid of heat. The procedure requires that the menstruum of alcohol and water be kept at a temperature of about 140°F. in the digester during the extraction of the flavor. A digester is a closed apparatus in which substances may be heated under pressure usually by contact with a liquid menstruum to extract soluble ingredients. Digestion or heated extraction is accomplished within 24 hours. It is applied where an extraction over a short period of time is necessary to meet demands for a flavoring extract. Flavor material obtained by digestion is inferior to that of
maceration and percolation since heat often destroys the top bouquet of the aroma and taste.

**Percolation**

This is the most economical method of extraction. Percolation requires from 3 to 5 days to separate all the flavoring components from the botanicals without loss of aroma and taste. It also avoids pressing the remaining botanicals after extraction. Usually a menstruum of 40 to 50 per cent alcohol by volume is sufficient to percolate the botanical substances. The container used in this procedure usually has the shape of a cone. About 4 to 8 inches above the bottom outlet lies a perforated stainless steel plate which can be easily removed.

The botanicals are put into a thin linen bag which fits into the percolator. The bag is made slightly wider than the container to permit shrinkage at a later washing. The botanicals are first soaked briefly with the menstruum to avoid extensive swelling in the percolator. The bag with the botanicals is transferred into the percolator and placed on the perforated steel plate. A plunger is used to press them evenly and firmly in the percolator. The bag is tied up at the top, and covered with another perforated stainless steel plate, heavier in weight, to avoid expansion of the botanicals on the surface. The alcoholic menstruum is poured into the percolator and is continuously added to maintain a level above the botanicals. The menstruum is left to stand in the percolator for a period of three days to soften the plant cells, to penetrate into them, and to dissolve the aromatic substances; on the fourth day percolation begins. To facilitate flow of the alcoholic menstruum, a separate container is placed above the percolator and the flow coordinated to that of the drained extract. The extract is drawn off in a slow flow at about ten per cent of menstruum present in the percolator, per hour or about from two fluid ounces per minute up, depending on the size of the percolator. During the removal of the extract from the percolator the level of the menstruum is kept above the core of the botanicals until all the alcoholic menstruum of the container above the percolator is used up. The drainage from the percolator is continued until it slows down to drops. The balance of the extract is separated with water which is poured into the percolator until it reaches a level above the botanical ingredients.

After 24 hours the drain-off from the percolator is started at a flow of two fluid ounces per minute. During the draining the water is kept at the same level by influx from the container above the percolator. This aqueous extract is taken off and mixed with the previous alcoholic extract until the total equals the volume of the alcoholic menstruum initially used in the percolation.

**FLAVOR DISTILLATION OF BOTANICAL PLANTS**

**Distillation at Atmospheric Pressure**

In the manufacture of flavors distillation with alcohol at atmospheric pressure is widely used to separate volatile aroma and essential oil from the herbs, peels, roots, seeds, flowers, leaves, and other botanical substances. This distillation of botanicals, alcohol, and water enables vaporized volatile ingredients to mix with the alcoholic vapors immediately after their separation from the original substances. The presence of alcohol in the distillate not only prevents
any deterioration of volatile aroma, but also assists with its acid and ester content to mature and improve the distilled flavor.

Under no circumstances should vacuum be applied in the distillation of aromatic botanicals since the vacuum pump will remove part of volatile aroma. The botanicals are placed on a perforated stainless steel plate above the edge of the steam jacket in the still. This prevents scorching of the botanicals and burnt taste of the flavor as the distillation progresses. The distillation at atmospheric pressure is only started after mixing the botanicals with alcohol and water in the still and allowing 24 to 48 hours for extraction. The heating of the still should be under constant control and the flow of the condensate should be slow. The condensate is separated into fractions after refluxing for a short time until the exit pressure from the condenser carries the first whiff of aromatic air which can be sniffed without irritating the nostrils. The distillate is then left to flow through the condenser as middle or main fraction.

In the beginning the main fraction is distilled without dephlegmation. The condensate starts with about 90 per cent alcohol content, depending on the strength of the menstruum in the still, and reduces as the distillation progresses. The condensate is kept at a slow, clear flow. Sniffing and tasting of the flavor distillate at short intervals is required to detect oncoming changes in aroma and taste. Change of aroma is indicated by the air pressure of the flowing condensate. As distillation progresses, heat is carefully adjusted to maintain a steady flow of the condensate. At 65 per cent alcohol content dephlegmation is turned on to slow down the falling alcohol strength of the distillate. When the alcoholometer shows an alcohol strength of 55 per cent, this indicates the end of the main fraction and the beginning of the final or last fraction. Careful observation is necessary, sniffing and tasting should be more frequent. It is advisable not to wait until the change of taste becomes too obvious. The distillation of this last fraction continues until all the alcohol is recovered.

The main fraction is diluted with water to about 35 per cent alcohol content and allowed to stand about 48 hours for clarification and separation of terpenes. The terpenes accumulate on the surface of the mixture and are separated. The diluted main fraction is filtered to make it completely clear. It is then put back into the cleaned still for redistillation at atmospheric pressure using the same procedure and careful observation as in the first distillation. The main fraction will then yield the finished flavor distillate which has the finest aroma and taste.

The last fractions or tails of both distillations are mixed together, filtered, and redistilled to obtain a distillate of higher alcohol content. It is then used in the next production batch of the same flavor type.

Percolate and Macerate Distillation

The procedure of percolate or macerate distillation requires that the botanicals be first extracted by percolation or maceration. The extract containing the flavoring material is allowed to stand 2 or 3 days for the separation of insoluble matter. The clear extract is then put into the still and the distillation at atmospheric pressure is performed in the same manner as the alcoholic distillation of botanicals. By not heating the solid botanicals, this percolate or macerate distillation yields a product with a keener aroma than the distillation of the botanicals with alcohol and water.
<table>
<thead>
<tr>
<th>Pronounced Bitter</th>
<th>Bitter</th>
<th>Mild Bitter</th>
<th>Pronounced Aromatic</th>
<th>Aromatic</th>
<th>Sweet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agaric</td>
<td>Centaury herb</td>
<td>Angostura bark</td>
<td>Angelica root</td>
<td>Abelmoschus (musk seed)</td>
<td>Anis</td>
</tr>
<tr>
<td>Aloe</td>
<td>Colomba root</td>
<td>Cascarilla bark</td>
<td>Balm mint</td>
<td>Azaica flowers</td>
<td>Carob</td>
</tr>
<tr>
<td>Chiretta</td>
<td>Gentian root</td>
<td>Caracao peel</td>
<td>Calamus root</td>
<td>Balm leaves</td>
<td>Coriander</td>
</tr>
<tr>
<td>Quassia wood</td>
<td>Holy thistle</td>
<td>Hop</td>
<td>Caraway</td>
<td>Celery seed</td>
<td>Fennel</td>
</tr>
<tr>
<td>Wormwood</td>
<td>Chinchona bark</td>
<td>Iva herb</td>
<td>Chamomile, Roman</td>
<td>Chamomile</td>
<td>Licorice root</td>
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<tr>
<td></td>
<td>Simaruba bark</td>
<td>Orange peel, bitter</td>
<td>Calabash</td>
<td>Elder flowers</td>
<td>Manna</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oranges, unripe</td>
<td>Elecampane root</td>
<td>Galanga root</td>
<td>Orange peel, sweet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yarrow</td>
<td>Juniper berry</td>
<td>Guaiac wood</td>
<td>Tangerine peel</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Laurel berry</td>
<td>Lavender flowers</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Laurel leaf</td>
<td>Oris root</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lemon peel</td>
<td>Pyrethrum root</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lovage root</td>
<td>Sassafras wood</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Marjoram</td>
<td>Tansy</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Origanum</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Peppermint</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pepperwort</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pimpinella root</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Rosemary</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sage</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thyme</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Valerian</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Zedoary root</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OLEORESINS

Oleoresins are prepared by extraction of comminuted seeds, roots, barks, leaves, and fruit of botanical plants with a solvent of high chemical purity and low boiling temperature. The extraction is performed either by maceration or percolation immediately after the pulverization of the botanical material to reduce loss of volatile aroma. Part of the extracting menstruum is mixed with the spices while they pass through the rotating blades or hammers of the comminuting machine to avoid loss of essential oil by heat and evaporation during the process.

The use of the menstruum as a cooling aid during the comminution also facilitates an instantaneous extraction. Spice materials in general are extracted with solvents which are not water soluble such as ethylene dichloride. Non-aqueous solvents avoid extraction of undesirable material such as starch, sugars, resinous matter, and gums. Water soluble solvents such as alcohol and acetone are used in extractions where it is required that the oleoresin be soluble in aqueous solutions.

The extraction of the botanical material is repeated each time with a fresh menstruum until all the extractive matter is removed. Each extract is concentrated first by distillation at atmospheric pressure, then by vacuum distillation at low pressure. The solvent is recovered and used in the following extractions of the same material. The finished oleoresin is then separated from any water which may be present and freed of remaining traces of solvent by addition of ethyl alcohol and subsequent distillation. After manufacture, oleoresins often require the addition of essential oil, glycerin or propylene glycol to retain sufficient flow characteristics for their use. Oleoresins which are prepared from seeds are assisted by the presence of fixed oils for fluidity.

Oleoresins impart the taste of the spices from which they are separated. The addition of essential oils gives them aroma. Oleoresins are suitable in compounds with essential oils, distillates, and extracts of botanical plants as well as in combination with chemical flavoring material for use in food products, bakery goods, confections, beverages, pharmaceuticals, and tobacco.

VOLATILE FLAVOR OF VEGETABLE PLANTS

Essential Oils

Volatile oils derived from plants, and usually carrying the essential odor or flavor of the plant are called essential oils. They are as a rule insoluble in water. The yield of essential oil usually is not high. Methods of separating the essential oils include expression, steam distillation, enfleurage, extraction, and adsorption.
Expression or pressing is used for fruit rinds rich in oils, such as those of the orange, lemon, lime, and bergamot. The whole fruit is washed then crushed between rollers, sprayed with water, and the oil separated by means of a centrifuge.

Steam distillation is used to separate the volatile substances from many odiferous plants and flowers. Steam is passed through a bed of the plants and volatilizes the essential oils which then separate as an upper layer in the condensate. The water layer will have an odor and may be used as flower water.

<table>
<thead>
<tr>
<th>Blue</th>
<th>Brown</th>
<th>Red</th>
<th>Yellow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campeachy wood</td>
<td>Catechu</td>
<td>Alkanet root</td>
<td>Buckthorn berry</td>
</tr>
<tr>
<td>(logwood)</td>
<td></td>
<td>Black huckleberry</td>
<td>Curcuma root</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pernambuco wood</td>
<td>Safflower</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poke berry</td>
<td>Saffron</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kino</td>
<td>Santal wood</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mallow flowers</td>
<td>Yellow wood</td>
</tr>
</tbody>
</table>

Enfluerage is the solution and adsorption of the essential oils of flowers in fat. This process is employed for those very delicate oils whose odors are destroyed by even moderate heat. The odorous fat is extracted with a solvent to obtain the essential oil. The fat which remains is used in making scented soaps.

Solvent extraction involves the treating of flowers placed in tiers on perforated plates with a solvent such as petroleum-ether. The solvent is then distilled and reused. The residue from the distillation contains the essential oil.

Maceration of flowers or leaves is the extraction of volatile aroma with or in a fat and then treating the fat to obtain the essential oil.

Adsorption is the method of passing air or an inert gas over flowers and then through active carbon. The essential oil from the air is then steamed out of the carbon. This method is used where flowers are decomposed by normal distillation methods.

Concrete

After the enfluerage, the fat is extracted with a solvent. After removal of the solvent there remains a semi-solid mixture of essential oil and fatty waxy material. This semi-solid mixture is called a concrete.
Absolute

If the concrete is dissolved in alcohol, chilled, and filtered, most of the wax is left behind. When the alcohol is distilled off, the residue is nearly pure essential oil, and this is known as a floral absolute.

Isolate

An isolate is a pure substance separated from natural products such as eugenol from clove leaf oil.

The Aromatic Compounds of Essential Oils

Chemical constituents of essential oils are chiefly esters, alcohols, aldehydes, ketones, and hydrocarbons. The hydrocarbons are cyclic, dicyclic, and open-chain terpenes, having the formula \( \text{C}_{10}\text{H}_{16} \) and the sesquiterpenes, \( \text{C}_{15}\text{H}_{21} \).

Composition of Botanical Flavoring Materials

The composition and properties of botanical flavoring materials are summarized in Table 3.

RESINS

Balsam of Peru is a dark brown, viscid, non-glutinous liquid which has a vanilla-like odor. It originates from *Myroxylon pereirae*, a tree which grows in Central America. Balsam secretion is induced by beating the bark and scourging it with burning faggots. The balsam exudes and is soaked up by rags applied to the wounded places, then recovered from the pieces of cloth by immersing them in vats of hot water. The immiscible balsam separates at the bottom. Balsam of Peru contains about 53 per cent of an oily ester, cinnamcin, which consists mainly of benzyl cinnamate.

Balsam of Tolu is obtained from an evergreen tree, *Myroxylon toluifera* and is collected by cutting in the bark deep notches ending in an angle. The balsam is a soft, brown resinous substance, which becomes brittle in cold weather. It contains balsamic acids of similar structure as benzoin. Balsam of tolu has a hyacinth odor.

Benzoin is a balsam derived from *styrax* benzoin. It has an agreeable aroma. Benzoin contains a mixture of free benzoic, free cinnamic acids, and esters.

Chicle gum is the thickened latex from *Achras sapota*, indigenous to Mexico, Central America, and the northern part of South America. It is similar to gutta percha and is used for the preparation of chewing-gum.

Copaiba is an oleo-resin, obtained from *copaifera*, growing in Brazil.
<table>
<thead>
<tr>
<th>English</th>
<th>Nomenclature</th>
<th>Flavor Property</th>
<th>Extractive Taste</th>
<th>Yield of Volatile Oil</th>
<th>Organic Substances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agrimony</td>
<td>Herba argimoniae</td>
<td>Aromatic</td>
<td>Bitter</td>
<td>4.0</td>
<td>55 per cent Thymol</td>
</tr>
<tr>
<td>Ajava seed</td>
<td>Carum ajowan</td>
<td></td>
<td>Hay</td>
<td></td>
<td>Alcannin, anehusin</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>Medicago sativa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alkanna (ankanet)</td>
<td>Alkana tinctoria</td>
<td>Garlic odor when</td>
<td>Coloring principle</td>
<td>4.5</td>
<td>Alcannin, anehusin</td>
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<tr>
<td>Allerman's root</td>
<td>Allium victorialis</td>
<td>fresh</td>
<td>Burning</td>
<td></td>
<td></td>
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<tr>
<td>Allspice</td>
<td>Pimenta officinalis</td>
<td>Clove-like</td>
<td>Pungent, nutmeg-,</td>
<td>0.7</td>
<td>80% Eugenol, cineol</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>pepper-, cinnamon-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>burning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Almond, bitter</td>
<td>Amygdalae amarae</td>
<td>Benzaldehyde,</td>
<td>Bitter, burning</td>
<td></td>
<td>3.5 per cent Amygdalin, benzaldehyde,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>aromatic</td>
<td></td>
<td></td>
<td>cyanhydrine, Aloin, barbaloin</td>
</tr>
<tr>
<td>Aloe</td>
<td>Aloe spicata</td>
<td>Unpleasant</td>
<td>Strongly bitter,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>purgative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Althea root</td>
<td>Radix althaeae</td>
<td>Characteristic</td>
<td>Sweet</td>
<td></td>
<td>Althein (Asparagus)</td>
</tr>
<tr>
<td>(Marshmallow)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambergris</td>
<td>Ambra</td>
<td>Benzoin-like</td>
<td>None</td>
<td></td>
<td>Amyrol, amyroloin, carinene, caryopphylene</td>
</tr>
<tr>
<td>Amyris (Sandalwood oil)</td>
<td></td>
<td>Faint, unpleasant</td>
<td></td>
<td></td>
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<tr>
<td>Angelica herb</td>
<td>Herba angelicae</td>
<td>Aromatic, musky</td>
<td>Aromatic</td>
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<td>Angelica, malic, valeric-acids, phellandrene,</td>
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<tr>
<td>Angelica root</td>
<td>Radix angelicae</td>
<td>Strongly aromatic,</td>
<td>Pungent, bitter,</td>
<td></td>
<td>agelica-in</td>
</tr>
<tr>
<td>Angelica seed</td>
<td>Semen angelicae</td>
<td>ecelery, iris, helmin</td>
<td>spicy</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Finc, aromatic</td>
<td>Bitter, celery, perfume</td>
<td>1.2</td>
<td>Phellandrene, exaltolide, valeric acid, hexadeecenol-actone</td>
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<tr>
<td>Angostura bark</td>
<td>Cortex angosturae</td>
<td>Aromatic</td>
<td>Bitter</td>
<td></td>
<td>Galipol, cadinene, pinene, galipene, cusparin</td>
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<tr>
<td>Anise</td>
<td>Fructus anisi bulgaris</td>
<td>Aromatic, spicy</td>
<td>Sweet, licorice</td>
<td>3.5</td>
<td>90 per cent Anethole</td>
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<tr>
<td>Annatto seed</td>
<td>Bixa orellana-annata</td>
<td></td>
<td>Coloring principle(Bixin) butter color</td>
<td></td>
<td>Annotta, annotta, bixin</td>
</tr>
</tbody>
</table>

1 The data presented in this table are summarized from the source listed at the end of table.
<table>
<thead>
<tr>
<th>English</th>
<th>Nomenclature</th>
<th>Latin</th>
<th>Flavor Property</th>
<th>Extractive Taste</th>
<th>Yield of Volatile Oil Per Cent</th>
<th>Organic Substances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apricot kernel</td>
<td>Semen armeniacae</td>
<td>Genus pinacea</td>
<td>Benzaldehyde</td>
<td>Bitter</td>
<td>1.0</td>
<td>Amygdalin</td>
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<td>Araucaria (Tree</td>
<td>Flores arnica</td>
<td>Radix arnicae</td>
<td>Strong, aromatic, borneol, cineol</td>
<td>Aromatic, slightly bitter, Thujon Pungent, aromatic, bitter, biting Starch (baking, confectionery)</td>
<td>1.0</td>
<td>Arnicin, tannin, inulin</td>
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<tr>
<td>Arica flowers</td>
<td>Radix arnicae</td>
<td>Genus manara</td>
<td>Radish, oris, celery</td>
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<td>Starch</td>
<td>Starch</td>
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<td>Arica root</td>
<td>Rhizoma aric</td>
<td>Herba menthae balsamic</td>
<td>None</td>
<td>Pepper</td>
<td>0.75</td>
<td>Carvone</td>
</tr>
<tr>
<td>Asafeitda gum</td>
<td>Resin of ferula narthex</td>
<td>Oleoresin of myroxylon balsaminum</td>
<td>Peppermint, camphoraceous</td>
<td>Mint, aromatic</td>
<td>Turpentine</td>
<td>Beyazl benzoate, beyazl cinnamate</td>
</tr>
<tr>
<td>Ash bark</td>
<td></td>
<td>Balsam copaiba</td>
<td>Aromatic</td>
<td>Spicy</td>
<td></td>
<td>Beyazl benzoate, beyazl cinnamate, farnesol</td>
</tr>
<tr>
<td>Asparagus root</td>
<td></td>
<td>Balsam of fir (Canada balsam)</td>
<td>Aromatic</td>
<td>Refreshing, sharp</td>
<td></td>
<td>Beyazl benzoate, beyazl cinnamate</td>
</tr>
<tr>
<td>Avens root</td>
<td></td>
<td>Balsam herb</td>
<td>Peculiar</td>
<td>Fixative</td>
<td></td>
<td>Beyazl benzoate, beyazl cinnamate, farnesol</td>
</tr>
<tr>
<td>Balm mint</td>
<td></td>
<td>Balsam of Peru</td>
<td>Agreeable, pine</td>
<td>Slightly bitter, acid</td>
<td></td>
<td>Beyazl benzoate, beyazl cinnamate</td>
</tr>
<tr>
<td>Balsam copaiba</td>
<td></td>
<td>Balsam of Tolu</td>
<td>Sweet</td>
<td>Mint</td>
<td>1.5</td>
<td>Beyazl benzoate, beyazl cinnamate</td>
</tr>
<tr>
<td>Balsam of fir (Canada balsam)</td>
<td></td>
<td>Banana</td>
<td>Aromatic</td>
<td>Sweet, nourishing</td>
<td></td>
<td>Beyazl benzoate, beyazl cinnamate, farnesol</td>
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<tr>
<td>Basil herb</td>
<td></td>
<td>Basil herb</td>
<td>Mild, aromatic</td>
<td>Clove-like, cool, aromatic</td>
<td></td>
<td>Beyazl benzoate, beyazl cinnamate</td>
</tr>
<tr>
<td>Bay leaves</td>
<td></td>
<td>Bay leaves</td>
<td>Spicy</td>
<td>Bitter-sweet</td>
<td></td>
<td>Beyazl benzoate, beyazl cinnamate, farnesol</td>
</tr>
<tr>
<td>Bearsewort root</td>
<td></td>
<td>Balsam of Peru</td>
<td>Lowage-like</td>
<td>Toxic, irritating</td>
<td></td>
<td>Beyazl benzoate, beyazl cinnamate</td>
</tr>
<tr>
<td>Beechwood</td>
<td></td>
<td>Beechwood</td>
<td>Characteristic</td>
<td>Clove, delicate</td>
<td>0.5</td>
<td>Beyazl benzoate, beyazl cinnamate</td>
</tr>
<tr>
<td>Benet herb</td>
<td></td>
<td>Benet herb</td>
<td>Spicy</td>
<td>Spicy</td>
<td></td>
<td>Beyazl benzoate, beyazl cinnamate</td>
</tr>
<tr>
<td>Benzoin gum</td>
<td></td>
<td>Benzoin gum</td>
<td>Lemon, orange, amyl acetate</td>
<td>Bitter</td>
<td></td>
<td>Beyazl benzoate, beyazl cinnamate</td>
</tr>
</tbody>
</table>

34 to 45 per cent Limonene, pinene, terpinene, linalyl acetate, linalool, bisabolene
<table>
<thead>
<tr>
<th>Plant Type</th>
<th>Species Name</th>
<th>Flavor Characteristics</th>
<th>Flavor Profile</th>
<th>Chemical Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bibernel root</td>
<td>Radix pinninellae</td>
<td>Unpleasant</td>
<td>Biting</td>
<td>Phenols, guaiacol, cresol, cresol, xylenol</td>
</tr>
<tr>
<td>Birch tar (oil)</td>
<td>Betula alba</td>
<td>Characteristic, smoky</td>
<td>Toxic</td>
<td>Tannin</td>
</tr>
<tr>
<td>Blackberry bark</td>
<td>Rubus idaeus</td>
<td>Aromatic, faint rose</td>
<td>Tea</td>
<td>Resin, tannin</td>
</tr>
<tr>
<td>Blackberry leaves</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blessed thistle herb</td>
<td>Herba cardui benedicti</td>
<td>Aromatic</td>
<td>Pungent, bitter</td>
<td>Beta ionone, ethyl formate</td>
</tr>
<tr>
<td>Borage herb</td>
<td>Herba boraginis</td>
<td>Insignificant</td>
<td>Bitter, sweet</td>
<td>Diosphenol, menthone, limonene, dipentene</td>
</tr>
<tr>
<td>Boronia flowers</td>
<td>Boronia megastigmaanes</td>
<td>Aromatic</td>
<td>Cucumber-like</td>
<td>Menyanthin</td>
</tr>
<tr>
<td>Bucku leaves (Bucku, buco)</td>
<td>Folia buco</td>
<td>Sweet, mint-like</td>
<td>Bitter, cooling</td>
<td></td>
</tr>
<tr>
<td>Buckbean leaves</td>
<td>Folia trifoli iibrini</td>
<td>camphoraceous</td>
<td>Bitter, no aroma</td>
<td></td>
</tr>
<tr>
<td>Buckthorn bark, dried</td>
<td>Cortex rhamni catharticae</td>
<td>Insignificant</td>
<td>Brown-red color principle</td>
<td></td>
</tr>
<tr>
<td>Buckthorn berries, dried</td>
<td>Fruites rhamni catharticae</td>
<td>Unpleasant</td>
<td>Bitter, purgative, green</td>
<td></td>
</tr>
<tr>
<td>Cabreuva (cabreiba)</td>
<td>Microcarpus frondosus</td>
<td></td>
<td>green coloring principle</td>
<td></td>
</tr>
<tr>
<td>Cade oil (Juniper tar)</td>
<td>Juniperus oxycedorum</td>
<td>Tarry</td>
<td>Burning, bitter</td>
<td></td>
</tr>
<tr>
<td>Cajuput leaves</td>
<td>Melaleuca leucadendron</td>
<td>Camphor-like</td>
<td>Aromatic, burning, cooling</td>
<td></td>
</tr>
<tr>
<td>Calamus root</td>
<td>Rhizoma calami</td>
<td>Characteristic</td>
<td>Sharp, burning</td>
<td>1.5-5.0</td>
</tr>
<tr>
<td>Calumba root (Colombo)</td>
<td>Jateorrhiza palmata</td>
<td></td>
<td>spicy, characteristic</td>
<td></td>
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<tr>
<td>Camphor twigs</td>
<td>Cinnamomum camphor</td>
<td>Camphor</td>
<td>Pharmaceutical principle</td>
<td></td>
</tr>
<tr>
<td>Cananga flowers</td>
<td>Cananga odorata</td>
<td>Ylang-ylang</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canella bark</td>
<td>Cortex canellae albae</td>
<td>Cinnamon</td>
<td>Cinnamon</td>
<td>1.25</td>
</tr>
<tr>
<td>Capers</td>
<td>Capparis spinosa</td>
<td>Spicy</td>
<td></td>
<td></td>
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</table>

**NATURAL FLAVORINGS FROM VEGETABLE PLANTS**
<table>
<thead>
<tr>
<th>English</th>
<th>Nomenclature</th>
<th>Latin</th>
<th>Flavor Property</th>
<th>Extractive Taste</th>
<th>Yield of Volatile Oil Per Cent</th>
<th>Organic Substances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capsicum (cayenne pepper chilies)</td>
<td>Capsicum frutescens</td>
<td>Ginger, pleasant</td>
<td>Spicy, pungent</td>
<td>7.0</td>
<td>60 per cent carvone, carvone, d-limonene</td>
<td></td>
</tr>
<tr>
<td>Caraway seed</td>
<td>Fructus carvi</td>
<td>Strong, aromatic, carvone</td>
<td>Bitter, burning</td>
<td></td>
<td>Terpineol, cineol, terpinyl, borneol acetate</td>
<td></td>
</tr>
<tr>
<td>Cardamom seeds</td>
<td>Fructus cardamomi</td>
<td>Aromatic</td>
<td>Pungent, cool, burning</td>
<td>8.0</td>
<td>Sugar, gum</td>
<td></td>
</tr>
<tr>
<td>Carob (locust bean) (St. John's bread)</td>
<td>Fructus ceratoniae siliquae</td>
<td>Aromatic, spicy</td>
<td>Sweet</td>
<td></td>
<td>Carotol, pinene, limonene, palmitic-β, butyric acid</td>
<td></td>
</tr>
<tr>
<td>Carrot seed</td>
<td>Daucus carota</td>
<td>Slightly aromatic</td>
<td>Red and yellow color principle</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Carthamus (American saffron, safflower)</td>
<td>Florets of carthamus tintorius</td>
<td>Distinct</td>
<td>Bitter, slightly acrid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cascarilla bark (chateau)</td>
<td>Cortex cascariae</td>
<td>Faint</td>
<td>Bitter</td>
<td>3.0</td>
<td>Cymol, cascarilllin</td>
<td></td>
</tr>
<tr>
<td>Cassia bark, Chinese</td>
<td>Cortex cinnamomi cassiae</td>
<td>Cinnamon</td>
<td>Sweet, pungent</td>
<td>1.2</td>
<td>90 per cent cinnamic aldehyde</td>
<td></td>
</tr>
<tr>
<td>Cassia, Batavia</td>
<td>Cinnamonum burmanni</td>
<td>Aromatic</td>
<td>Sweet, pungent</td>
<td></td>
<td>90 per cent Cinnamic aldehyde</td>
<td></td>
</tr>
<tr>
<td>Cassia buds</td>
<td>Unripe fruit of cinnamomum</td>
<td>Cinnamon</td>
<td></td>
<td>0.5</td>
<td>60 per cent sugars, albuminoids, hydroxymethyl anthraquinones, gum, tannin</td>
<td></td>
</tr>
<tr>
<td>Cassia fistula, dried</td>
<td>Fructus cathartocarpus fistula</td>
<td></td>
<td>Sweet pulp</td>
<td>2.0</td>
<td>80 per cent Cinnamic aldehyde</td>
<td></td>
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<tr>
<td>Cassia flowers</td>
<td>Flores cassiae</td>
<td>Cinnamon</td>
<td></td>
<td>1.9</td>
<td>80–90 per cent Cinnamic aldehyde</td>
<td></td>
</tr>
<tr>
<td>Cassia leaves and twigs</td>
<td>Cinnamomum cassia, china</td>
<td>Cinnamon, spicy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cassia, Saigon</td>
<td>Cinnamomum loureirii</td>
<td>Aromatic</td>
<td>Sweet, pungent</td>
<td></td>
<td></td>
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<tr>
<td>Cassis (oil) anciene</td>
<td>Acacia farnesiana</td>
<td>Floral, iris, ionone</td>
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<td></td>
<td></td>
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<tr>
<td>Cassis (oil) romaine</td>
<td>Acacia cavenia</td>
<td>Floral, perfume</td>
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<td></td>
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<td></td>
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<tr>
<td>Castor seed (oil)</td>
<td>Ricinus communis</td>
<td>Characteristic</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Castoreum (castor)</td>
<td>Caster fiber</td>
<td>Pungent, rum</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Perfume application</td>
<td></td>
<td></td>
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<tr>
<td>Plant</td>
<td>Active Constituent(s)</td>
<td>Description</td>
<td>Amount</td>
<td></td>
<td></td>
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<td>-------------------------------</td>
<td>----------------------------------------</td>
<td>-------------------------------------</td>
<td>--------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catechu (cachou)</td>
<td>Acacia catechu</td>
<td>None</td>
<td>Bitter, tart, dark brown coloring principle</td>
<td>Catechin, tannin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cayenne pepper (chilies)</td>
<td>Capsicum</td>
<td>Pleasant, ginger</td>
<td>Sharp, pungent, spicy</td>
<td>Cedrol, cedrene, cedrenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cedar wood</td>
<td>Juniperus Virginica</td>
<td>Incense, fragrant, chamomile</td>
<td>Aromatic</td>
<td>Apio, cedanolid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Celery leaves</td>
<td>Apium graveolens</td>
<td>Aromatic</td>
<td>Spicy, characteristic</td>
<td>Sedime, phenolic, limonene, sedanonic acid</td>
<td></td>
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<tr>
<td>Celery root</td>
<td>Apium graveolens</td>
<td>Aromatic</td>
<td>Celery, sour, bitter, astringent</td>
<td>Erythrocentaurin, resin, sugar</td>
<td></td>
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</tr>
<tr>
<td>Celery seed</td>
<td>Fructus apii</td>
<td>Characteristic, celery</td>
<td>Bitter</td>
<td>Tannin, resin, esters of anglicolic, and tiglic acid</td>
<td></td>
<td></td>
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<tr>
<td>Century herb</td>
<td>Herba centaurii</td>
<td>None</td>
<td>Aromatic, bitter</td>
<td>Prunasin, benzaldehyde, glucose, hydrocyanic acid</td>
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<tr>
<td>Chamomile flowers German</td>
<td>Matricaria chamomilla</td>
<td>Characteristic camphoraceous</td>
<td>Aromatic, bitter, fruity</td>
<td>Amygdalin (0.8 per cent)</td>
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<tr>
<td>Chamomile flowers Roman</td>
<td>Flores chamomillae romanac (Anthemis nobilis)</td>
<td>Camphoraceous, orange, orris</td>
<td>Sweet, benzaldehyde</td>
<td>Benzaldehyde, hydrocyanic acid, benzaldehyde cyanhydrin</td>
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<tr>
<td>Cherry bark, wild</td>
<td>Prunus virginiana</td>
<td>Like bitter almond</td>
<td>Benzaldehyde</td>
<td>Used in soups and salads</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cherry kernels</td>
<td>Semen cerasi</td>
<td>Benzaldehyde</td>
<td>Benzaldehyde</td>
<td>Quinine, tannic acid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cherry laurel</td>
<td>Prunus laurocerasus</td>
<td>Like bitter almond</td>
<td></td>
<td>75 per cent Cinnamic aldehyde, eugenol, phellandrene, linalool, pinene, furfural, benzaldehyde</td>
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<tr>
<td>Chervil leaves</td>
<td>Anthriscus</td>
<td>Aromatic</td>
<td>Spicy, pharmaceutical</td>
<td>90 per cent eugenol</td>
<td></td>
<td></td>
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<tr>
<td>Chichory root</td>
<td>Cichorium intybus</td>
<td>Coffee</td>
<td>Coffee adulterant</td>
<td>1.5</td>
<td></td>
<td></td>
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<tr>
<td>China root</td>
<td>Rhiboma chiniae</td>
<td>None</td>
<td>Sweet, astringent</td>
<td>1.8</td>
<td></td>
<td></td>
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<tr>
<td>Chiretta herb (chirata)</td>
<td>Herba chirotae</td>
<td>None</td>
<td>Most strongly bitter</td>
<td>0.1</td>
<td></td>
<td></td>
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<tr>
<td>Chives</td>
<td>Allium fistulosum</td>
<td>Aromatic</td>
<td>Like onion, tasteful</td>
<td>3.0</td>
<td></td>
<td></td>
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<tr>
<td>Ginehona bark (peruvia bark)</td>
<td>Cortex chiniae (Cinnamonis cinnamomii)</td>
<td>Anise, clove, cinnamon</td>
<td>Bitter, pharmaceutical</td>
<td>3.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cinnamon bark, ceylon</td>
<td>Cortex cinnamomii ceylanica</td>
<td>Fragrant</td>
<td>Warm, sweet, aromatic</td>
<td>4.5</td>
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<tr>
<td>Cinnamon flowers</td>
<td>Flores cinnamomii</td>
<td>Cinnamon</td>
<td>Floral, sweet, aromatic</td>
<td>0.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cinnamon leaves</td>
<td>Cinnamomum zeylanicum</td>
<td>Cinnamon, spicy</td>
<td></td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Scientific Name</th>
<th>Flavor Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cubebed berries</td>
<td>Fructus cubebae</td>
<td>Spicy, coriander</td>
<td>18</td>
</tr>
<tr>
<td>Cumin seed (curry)</td>
<td>Fructus cuminii</td>
<td>Aromatic, characteristic</td>
<td>4.0</td>
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<tr>
<td>Curcuma (turmeric)</td>
<td>Curcuma longa</td>
<td>Curcuma, characteristic</td>
<td></td>
</tr>
<tr>
<td>Coriander buds</td>
<td>Ribes saxifragaceae</td>
<td>Fragrant, characteristic</td>
<td></td>
</tr>
<tr>
<td>Cypress, leaves—shoots</td>
<td>Cupressus sempervirens</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Dandelion</td>
<td>Taraxacum</td>
<td>Fragrant, cinnarin, vanilla</td>
<td></td>
</tr>
<tr>
<td>Deer tongue leaves—(wild vanilla)</td>
<td>Liatris odoratissima</td>
<td>Caraway, carminative</td>
<td></td>
</tr>
<tr>
<td>Dill seed</td>
<td>Fructus anethi</td>
<td>Slight aroma</td>
<td></td>
</tr>
<tr>
<td>Doggrass (tritveum)</td>
<td>Agropyron repens</td>
<td>Characteristic</td>
<td></td>
</tr>
<tr>
<td>Dittany of Crete</td>
<td>Herba origani cretici</td>
<td>Characteristic</td>
<td></td>
</tr>
<tr>
<td>Dittany root</td>
<td>Radix dictamnii</td>
<td>Weak, aromatic</td>
<td></td>
</tr>
<tr>
<td>Dragons blood</td>
<td>Sanguis draconis</td>
<td>Aromatic</td>
<td></td>
</tr>
<tr>
<td>Elderberries</td>
<td>Fructus sambuci</td>
<td>Insignificant</td>
<td></td>
</tr>
<tr>
<td>Elder flowers, dried</td>
<td>Sambucus caprifoliacea</td>
<td>Characteristic</td>
<td></td>
</tr>
<tr>
<td>Elecampane root</td>
<td>Radix helenii</td>
<td>Spicy, camphoraceous</td>
<td></td>
</tr>
<tr>
<td>Elemi, resin</td>
<td>Camaroua infectic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elm bark (inner bark)</td>
<td>Cortex ulmi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erigeron (fleabane, butterweed)</td>
<td>Erigeron canadensis</td>
<td>Peculiar, persistent</td>
<td></td>
</tr>
<tr>
<td>Estragon (taragon) herb</td>
<td>Artemisia dracunculus</td>
<td>Anise, peculiar</td>
<td></td>
</tr>
<tr>
<td>Eucalyptus leaves</td>
<td>Folia eucalypti</td>
<td>Spicy, aromatic</td>
<td></td>
</tr>
<tr>
<td>Fennel seed</td>
<td>Fructus foeniculi</td>
<td>Aromatic, characteristic</td>
<td></td>
</tr>
<tr>
<td>Foemugreek seed</td>
<td>Semina foeni graecii</td>
<td>Sweet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(trigonella)</td>
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<td></td>
<td>-pinene, eadinene, limonene</td>
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<td>-Cymol, cumene</td>
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<td>-Phellandrene, termerol, val-</td>
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<td>-Pinene, cymene, camphene,</td>
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<td>-furfural, teraneol, cam-</td>
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<td></td>
<td>-phor Taraxasterol, choline, le-</td>
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<td></td>
<td>-vulin, inulin</td>
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<td></td>
<td>-60 per cent Carvone, limonene</td>
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<td>-Triticin, glucose, mannite,</td>
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<td></td>
<td>-inose Carvacol</td>
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<td>-Volatile oil, fat, resin, tannin</td>
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<td>-Alantol, inulin, helenin</td>
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<td>-Phellandrene, d-limonene</td>
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<td>-Gum, tannic acid</td>
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<td>-d-Limonene, terpineol, ess-</td>
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<td></td>
<td>-Methyl chavicol (para-methoxy-</td>
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<td>-ally phenol)</td>
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<td>-Cineol, pinene, eucalyptol</td>
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<td></td>
<td>-60-70% Anethol, fenchone, pinene, camphene, diphen-</td>
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<tr>
<td>English</td>
<td>Nomenclature</td>
<td>Latin</td>
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<td>---------------------------</td>
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<td>Frankincense</td>
<td>Boswellia carterii</td>
<td>Lemon-like</td>
<td>Balsamic</td>
</tr>
<tr>
<td>(olibanum)</td>
<td>boswellia jerata</td>
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<tr>
<td>Fir needles, Canadian</td>
<td>Abies balsamea</td>
<td>Pine</td>
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<td>balsam</td>
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<td>Galanga root</td>
<td>Rhizoma galangae</td>
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<td>Aromatic</td>
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<td>Galbanum (gummi)</td>
<td>Ferula galbaniiella</td>
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<td>rubricaulis</td>
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<td>Gambir (leaves and twigs)</td>
<td>Aerouaria gambir</td>
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<td>Gardenia, flowers</td>
<td>Gardenia grandiflora</td>
<td>Neroli, grape</td>
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<tr>
<td>Garlic</td>
<td>Bulbus ali sativi</td>
<td>Characteristic, penetrating</td>
<td></td>
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<tr>
<td>Genet (gemenet or jennet)</td>
<td>Genista papilionaeae</td>
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<tr>
<td>Gentian root</td>
<td>Radix gentianae</td>
<td>Insignificant</td>
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<tr>
<td>Geranium herb</td>
<td>Pelargonium odoratissimum, p. graveolens, p. capitatum, p. roseum</td>
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<td>Rhodinol</td>
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<td>Geranium rose</td>
<td>Rose petals and Pelargonium species</td>
<td>Rose</td>
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<td>Ghattigum (Indian gum)</td>
<td>Anogeissus latafolia combretaceae</td>
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<td>Ginger grass</td>
<td>Cymbopogon sofia</td>
<td>Ginger, palmarosa</td>
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<td>Ginger root</td>
<td>Rhizoma zingiberis</td>
<td>Camphoraceous, spicy, aromatic</td>
<td>Tart, peppery, burning, slightly bitter</td>
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<tr>
<td>Plant</td>
<td>Flavoring</td>
<td>Description</td>
<td>Notes</td>
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<tr>
<td>--------------------------------------------</td>
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<tr>
<td>Grains of Paradise (seeds)</td>
<td>Amomum melegueta</td>
<td>Spicy, cardamom</td>
<td>Peppery</td>
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<tr>
<td>Ground ivy</td>
<td>Herba hederae teretris</td>
<td>Aromatic</td>
<td>Bitter</td>
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<tr>
<td>Guaiacwood</td>
<td>Lignum guajaci (livitae)</td>
<td>Licorice, aromatic</td>
<td>Bitter-sweet, burning, anise, clove</td>
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<tr>
<td>Haw bark (hawthorn)</td>
<td>Crateagus roseacae</td>
<td>Aromatic</td>
<td>Color principle</td>
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<tr>
<td>Hay</td>
<td>Foenum</td>
<td>Pleasant, characteristic</td>
<td></td>
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<tr>
<td>Hickory bark</td>
<td>Juglans</td>
<td>Insignificant</td>
<td>Strong bitter</td>
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<tr>
<td>Holy thistle</td>
<td>Flores humuli lupuli</td>
<td>Mustard-like</td>
<td>Bitter</td>
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<tr>
<td>Hops</td>
<td>Herba marabii albi</td>
<td>Mint, ginger</td>
<td>BITTER</td>
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<tr>
<td>Horehound herb (White horehound)</td>
<td>Radix armoraciae</td>
<td></td>
<td>Balsamic, ginger, camphoraceous, rosemary</td>
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<tr>
<td>Horseradish</td>
<td>Herba hysopii</td>
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<td>Mustard constituents</td>
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<tr>
<td>Imperial masterwort</td>
<td>Rhizoma imperatorii</td>
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<td>Imperatorin, ostenthin</td>
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<td>Iva herb</td>
<td>Herba ivae moschatae</td>
<td>Camphoraceous</td>
<td>Cinon, moschatin, ivain, achillein</td>
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<td>Jasmine, flowers</td>
<td>Jasminum grandiflorum</td>
<td>Indole, jasmine</td>
<td>Jasmone, indole, methyl anthranilate, benzyl acetate, linalool, linalool acetate</td>
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<tr>
<td>Juniper berries</td>
<td>Fructus juniperi</td>
<td>Aromatic, terpine</td>
<td>Sweet, bitter, burning</td>
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<tr>
<td>Labdanum, gum resin</td>
<td>Cistus labaniferus</td>
<td>Turpentine</td>
<td>1.5</td>
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<tr>
<td>Larch agaris, dried fruit body</td>
<td>Fungus laricis</td>
<td>Musty, faint</td>
<td>Bittersweet, burning, disagreeable</td>
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<tr>
<td>Laurel leaves, bay leaves</td>
<td>Laurus nobilis</td>
<td>Aromatic</td>
<td>3.0</td>
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<tr>
<td>Laurel berries (cherry)</td>
<td>Fructus lauri</td>
<td>Spicy</td>
<td>50 per cent cineol, pinene</td>
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<tr>
<td>Laurel leaves (cherry)</td>
<td>Folia lauro cerasi</td>
<td>Benzaldehyde, weak</td>
<td>Bitter</td>
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<tr>
<td>Lavender, flowers</td>
<td>Lavandula vera</td>
<td>Characteristic</td>
<td>0.5</td>
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<tr>
<td>Lemon balm</td>
<td>Folia melissae</td>
<td>Linalool, geraniol</td>
<td>Benzylaldehyde, hydrocyanic acid</td>
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NATURAL FLAVORINGS FROM VEGETABLE PLANTS
<table>
<thead>
<tr>
<th>English</th>
<th>Nomenclature</th>
<th>Latin</th>
<th>Distilled Odor</th>
<th>Property</th>
<th>Extractive Taste</th>
<th>Yield of Volatile Oil Per Cent</th>
<th>Organic Substances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lemon grass</td>
<td>Andropogon citratus</td>
<td>Lemon-like</td>
<td>Citrus</td>
<td>85 per cent Citral, Citral, lemon oil, 90 per cent d-limonene</td>
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<tr>
<td>Lemon peels</td>
<td>Cortex citri fructus</td>
<td>Characteristic, lemon</td>
<td>Citrus</td>
<td>2.0</td>
<td>Glycyrrhizin, Citral, lime oil, limonene, Linalool, Sugar, gum, tannin, volatile oil</td>
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<tr>
<td>Lettuce, wild</td>
<td>Radix liquiritiae</td>
<td>Insignificant</td>
<td>Sweet, slimy</td>
<td>0.5–1</td>
<td>Terpineol, sugar, gum, malic, anglicia acid</td>
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<tr>
<td>Licorice root</td>
<td>Citrus medica acida</td>
<td>Characteristic, lined</td>
<td>Citrus</td>
<td>17</td>
<td>Similar to nutmeg, Pulque, mescal</td>
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<tr>
<td>Limes</td>
<td>Bursera delpeschiana</td>
<td>Aromatic</td>
<td>Tea, sweet, pharmaceutical</td>
<td>1.8</td>
<td>Terpineol, tannin</td>
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<tr>
<td>Linaloe, wood-fruit</td>
<td>Tilia cordifolia</td>
<td>Aromatic</td>
<td>Color principle</td>
<td>0.2–2 per cent Caffeine, tannin</td>
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<td>Linden flowers (dried)</td>
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<tr>
<td>Logwood chip (heartwood)</td>
<td>Hemaosyphon</td>
<td>Aromatic</td>
<td>Burning, spicy, celery, sweet, bitter</td>
<td>3–6</td>
<td>Coumarin, resin, volatile oil</td>
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<td>Lovage root</td>
<td>Canthium</td>
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<td>Lungwort</td>
<td>Herba pulmonariae</td>
<td>None</td>
<td>Fermented</td>
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<td>Maca (macis)</td>
<td>Myristica fragrans</td>
<td>Fragrant, pine, camphoraceous</td>
<td>Bitter, slimy</td>
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<tr>
<td>Maguey leaves (mescan)</td>
<td>Agave atrovirens</td>
<td>Tequilla</td>
<td>Nutmeg-like</td>
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<tr>
<td>Maidenhair herb</td>
<td>Herba capillorum veneris</td>
<td>Aromatic</td>
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<tr>
<td>Marigold, pot</td>
<td>Calendula officinalis</td>
<td>Penetrating</td>
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<td>Marjoram, sweet</td>
<td>Herba majoranae (hortensis)</td>
<td>Thyme-like, camphoraceous</td>
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<tr>
<td>Marythistle</td>
<td>Fructus cardui mariae</td>
<td>None</td>
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<tr>
<td>Mastich gum</td>
<td>Resina mastiche</td>
<td>Aromatic</td>
<td>Spicy, bitter</td>
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<tr>
<td>Mastich herb syrian</td>
<td>Herba mari veri</td>
<td>Camphoraceous</td>
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<td>Mate</td>
<td>Yerba santa</td>
<td>Tea, stable flavor</td>
<td>Stimulating</td>
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<td>Matico leaves</td>
<td>Folia matico</td>
<td>Spicy</td>
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<td>Melilot (sweet clover)</td>
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<td>Mignonette, flowers</td>
<td>Reseda odorata</td>
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<td>Herba melloti</td>
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<td>Plant</td>
<td>Description</td>
<td>Flavor Description</td>
<td>Pungency</td>
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<tr>
<td>Mugwort</td>
<td>Herba artemisiae</td>
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<td>Bitter</td>
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<td>Mullein flowers</td>
<td>Flores verbasec</td>
<td>Pleasant</td>
<td>Bitter</td>
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<td>Musk seed (ambrette seed)</td>
<td>Semina abelmoschi</td>
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<td>Mustard seed, black</td>
<td>Brassica nigra</td>
<td>Pungent, acid, irritating</td>
<td>Pungent</td>
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<td>Myrrh</td>
<td>Myrrha</td>
<td>Balsam-like</td>
<td>Bitter</td>
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<td>Myrtle, leaves</td>
<td>Myrtus communis</td>
<td>Pine</td>
<td>Spicy</td>
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<tr>
<td>Naringin (C2H2O14)</td>
<td>Citrus decumana</td>
<td>Catmint</td>
<td>Bitter (1:10,000 threshold of identification) Menthol</td>
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<td>Nepeta</td>
<td>Nepeta cataria</td>
<td>Aromatic, spicy, pinene, borneol</td>
<td>Bitter, camphoraceous characteristic</td>
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<td>Nutmeg</td>
<td>Nuces moschate</td>
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<td>Olive</td>
<td>Olea europea</td>
<td>Commiphora</td>
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<td>Onion</td>
<td>Flores aurantii</td>
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<td>Opoponax, resin</td>
<td>Flowers aurantii fructus dulci</td>
<td>Aromatic</td>
<td>Spicy, bitter</td>
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<tr>
<td>Orange flowers, neroli</td>
<td>Flowers aurantii immaturi</td>
<td>Aromatic</td>
<td>Spicy, sweet</td>
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<tr>
<td>Orange peels, (bitter)</td>
<td>Cortex aurantii fructus viridis</td>
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<td>Bitter</td>
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<tr>
<td>Orange peel, sweet</td>
<td>Cortex aurantii fructus dulci</td>
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<tr>
<td>Oranges, unripe</td>
<td>Fructus aurantii immaturi</td>
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<td>Oregano (Mexican sage)</td>
<td>Origanum vulgare</td>
<td>Camphoraceous</td>
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<td>Orvis root, dried</td>
<td>Rhizoma iridis (florentinae)</td>
<td>Aromatic, ionone</td>
<td>0.2</td>
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<tr>
<td>Palmarosa (Indian grass)</td>
<td>Geranium</td>
<td>Rose-like</td>
<td>0.2</td>
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</tbody>
</table>

Farnesol, hexadecanolactone
95 per cent Allyl isothiocyanate, carbon disulfide, allyl cyanide
Gumnic aldehyde, pinene, eugenol, M-cresol, bisabolene
Pinene, cineol, camphene
Menthol, caprilic-, valeric-eaters
Fixed oil, myristicin, pinene, myristol, phenol, furural, safrol, phellandrene
Olein, palmitin allyl propyl bisulphide
Bisabolene
Citra, linalool, nerol, linalyl acetate, geranil, methyl anthranilate, phenyl ethyl alcohol
90 per cent d-Limonene, decylc aldehyde, hesperidin
90 per cent d-Limonene, decylc aldehyde
Irene, methyl esters, iridin, oleic acid, tannin, miristin
Geranil
<table>
<thead>
<tr>
<th>English</th>
<th>Latin</th>
<th>Flavor Property</th>
<th>Extractive Taste</th>
<th>Yield of Volatile Oil Per Cent</th>
<th>Organic Substances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paprika (mild variety)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Vitamin C</td>
</tr>
<tr>
<td>Parsley fruit</td>
<td>Petroselinum sativum</td>
<td>Pleasant</td>
<td>Slightly sweet, pungent</td>
<td>none</td>
<td>Pinene, apiolepin</td>
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<tr>
<td>Parsley seeds</td>
<td>Fructus petroselini</td>
<td>Spicy</td>
<td>Pleasant</td>
<td>7</td>
<td>Apiolepin, pinene</td>
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<td>Patchouli, dried leaves</td>
<td>Pogostemon patchouli</td>
<td>Persistent odor</td>
<td>Bitter</td>
<td>6</td>
<td>Eugenol, terpenes</td>
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<tr>
<td>Peach kernels</td>
<td>Semen persicaria</td>
<td>Weak</td>
<td>Eugenol</td>
<td></td>
<td>Amygdalin (2.4 per cent)</td>
</tr>
<tr>
<td>Peanut skins</td>
<td></td>
<td></td>
<td>Bitter almond</td>
<td></td>
<td>Protein, pigment, oil</td>
</tr>
<tr>
<td>Pennyroyal, European Peppers, black</td>
<td>Herba pulegii</td>
<td>Characteristic</td>
<td>Burning, biting</td>
<td>2.5</td>
<td>Pulegone</td>
</tr>
<tr>
<td>Pepper, white</td>
<td>Piper nigrum</td>
<td>Spicy</td>
<td>Less burning than</td>
<td>1.0</td>
<td>Piperine, di-limonene</td>
</tr>
<tr>
<td>Peppermint herb</td>
<td>Piper album</td>
<td>Faint, spicy</td>
<td>black pepper</td>
<td></td>
<td>Piperine, di-limonene, 1-</td>
</tr>
<tr>
<td>Perilla, leaves, Petiver, leaves, (young shoots), Pimento (allspece)</td>
<td>Perilla nankinensis</td>
<td>Hay-like</td>
<td>Bitter, cool</td>
<td>0.7-2.5</td>
<td>phellandrene</td>
</tr>
<tr>
<td>Radix pimpinella</td>
<td>Citrus aurantium</td>
<td>Spicy, clove-like, camphoraceous</td>
<td>Pungent, cinnamon, clove, cardamom, coriander</td>
<td>4.5</td>
<td>60 per cent menthol, methylacetate, cadinene, menthone, 1-limonone, perillie aldehyde, pinene, geraniol, linalool, methylanthranilate, eugenol, cineol, phellandrene, Caryophyllene, palmitic acid, methyl ether, tannin</td>
</tr>
<tr>
<td>Pinecones</td>
<td>Fruites amoni</td>
<td></td>
<td>Sharp</td>
<td>0.38</td>
<td>Phellandrene, bornyl acetate, cadinene, pumilone, Terpenes</td>
</tr>
<tr>
<td>Poplar buds, black</td>
<td></td>
<td></td>
<td>Sweet-sour</td>
<td></td>
<td>Pinene, limonene</td>
</tr>
</tbody>
</table>

**Table 3 (Contd.)**
<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Species Name</th>
<th>Description</th>
<th>Flavor</th>
<th>Principal Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poppy seed</td>
<td>Papaver somniferum</td>
<td>Nutlike</td>
<td>Nutty, pleasant</td>
<td>60 per cent fixed oil</td>
</tr>
<tr>
<td>Quassia wood</td>
<td>Lignum quassie</td>
<td>None</td>
<td>Intensive bitter</td>
<td>Quassine, picrostannine</td>
</tr>
<tr>
<td>Quercus hark</td>
<td>Aspidosperma quercachro</td>
<td>Aromatic</td>
<td>Color principle</td>
<td>Apidospermine, tannin, quercachro</td>
</tr>
<tr>
<td>Quince seed</td>
<td>Cydonia vulgaris</td>
<td>Raspberry</td>
<td>Pharmaceutical</td>
<td>Oxyl methyl antirachinon, malic acid, sugar, starch</td>
</tr>
<tr>
<td>Raspberry leaves</td>
<td>Rubus idaeus (rosaceae)</td>
<td>Faint</td>
<td>Bitter, tart</td>
<td>30 per cent citronellol, 40 per cent geraniol, phenyl ethyl alcohol, nerol</td>
</tr>
<tr>
<td>Rhubarb root</td>
<td>Radix rataulceae</td>
<td>Aromatic</td>
<td>Characteristic</td>
<td>Cineol, pinene, borneol, camphor, camphene, cineol, bornyl acetate</td>
</tr>
<tr>
<td>Rose, flowers</td>
<td>Rosa damascena</td>
<td>Characteristic, floral</td>
<td>Characteristic, sweet</td>
<td>0.006</td>
</tr>
<tr>
<td>Rose hips</td>
<td>Fructus cynoshati</td>
<td>Sour</td>
<td>Bitter, camphoraceous</td>
<td>2.0</td>
</tr>
<tr>
<td>Rosemary</td>
<td>Rosmarinus officinalis</td>
<td>Fragrant, spicy</td>
<td>Slightly bitter, aromatic, camphor, eucalyptus</td>
<td>Pinene, camphene, borneol, camplur, camphene, cineol, bornyl acetate</td>
</tr>
<tr>
<td>Rosemary flowers</td>
<td>Flores rosmarinii</td>
<td>Minty, borneol, eugenol, pinene</td>
<td>Camphoraceous, bitter</td>
<td>Cineol, pinene, borneol, bornyl ester, tannin</td>
</tr>
<tr>
<td>Rosemary leaves</td>
<td>Folia rosmarinii</td>
<td>Balsamic</td>
<td>Persistent</td>
<td>Methyl n-nonyl ketone, methyl n-heptyl ketone, Wax, yellow-red coloring matter</td>
</tr>
<tr>
<td>Rue</td>
<td>Ruta graveolens</td>
<td>Intense, characteristic</td>
<td>Aromatic, iodine, characteristic, color principle</td>
<td>Little</td>
</tr>
<tr>
<td>Saffron</td>
<td>Crocus sativus</td>
<td>Spicy, rum</td>
<td>Bitter, balsamic, unique, characteristic</td>
<td>Thujaone, borneol, cineol, pinene</td>
</tr>
<tr>
<td>Sage leaves</td>
<td>Folia salviae (officinalis)</td>
<td>Aromatic</td>
<td>Sweet</td>
<td>Sugar, gum</td>
</tr>
<tr>
<td>St. John's bread, carob bean</td>
<td>Fructus ceratoniae</td>
<td>Butter</td>
<td></td>
<td>Red coloring matter, santalin, santal, puercarin</td>
</tr>
<tr>
<td>Sandalwood, red</td>
<td>Lignum santali rubrum</td>
<td>Faint cinnamon, vanilla, persistent</td>
<td>Tart, bitter, pleasant, color principle</td>
<td></td>
</tr>
<tr>
<td>Sandalwood, white</td>
<td>Lignum santali album</td>
<td>Cedar</td>
<td>Burning, bitter</td>
<td>4.5 Santalol</td>
</tr>
<tr>
<td>Sassafras</td>
<td>Lignum sassafras (bark of s. albidum)</td>
<td>Anise, incense</td>
<td>Aromatic, bitter, astrigent</td>
<td>4.0 80 per cent Safol, heliotropin, pinene, eugenol, camphor, phellandrene</td>
</tr>
<tr>
<td>Savory, summer</td>
<td>Herba sativaj (hortensis)</td>
<td>Pungent, mint aromatic</td>
<td>Sharp, spicy, camphoraceous</td>
<td>Phenol</td>
</tr>
</tbody>
</table>
### Table 3 (Cont.)

<table>
<thead>
<tr>
<th>English Nomenclature</th>
<th>Latin Nomenclature</th>
<th>Flavor Property</th>
<th>Extractive Taste</th>
<th>Yield of Volatile Oil Per Cent</th>
<th>Organic Substances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schinus molle (pepper tree) Senna leaves</td>
<td>Foliculae sennae</td>
<td>Spicy</td>
<td>Pepper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sesame seed (Benne seed)</td>
<td>Sesamum indicum</td>
<td>Odorless</td>
<td>Fatty, bland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simaruba bark Snakeroot</td>
<td>Radix serpentariae</td>
<td>Terpineol, pinene, bornol</td>
<td>Strong bitter, tart, camphoraceous</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Soy bean</td>
<td>Soja hispida</td>
<td>Characteristic</td>
<td>Fatty, characteristic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spearmin</td>
<td>Mentha spicata or cardacca</td>
<td>Mint, characteristic</td>
<td>Mint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spruce</td>
<td>Tsuga canadensis</td>
<td>Agreeable</td>
<td>Pharmaceutical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squills, white (sea onion) Star anise seed</td>
<td>Uringena maritima or indica Fructus anisi stellati</td>
<td>Anise</td>
<td>Bitter</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>Styrax (sweet gum oriental) Tagetes</td>
<td>Lycium arubal orientale Genus cardaccae</td>
<td>Characteristic</td>
<td>Characteristic</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Tangerine (mandarin)</td>
<td>Citrus nobilis</td>
<td>Orange</td>
<td>Citrus, sweet</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Tansy leaves</td>
<td>Folia tanacetii</td>
<td>Wormwood, caraway, camphoraceous, strong</td>
<td>Bitter, thujon</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Tarragon</td>
<td>Artemisia dracunculus</td>
<td>Anise</td>
<td>Aromatic, not sweet</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>Thyme</td>
<td>Herba thymi vulgaris</td>
<td>Aromatic, thymol, eugenol, bornol</td>
<td>Bitter, tart, unique, characteristic</td>
<td>2.5</td>
<td></td>
</tr>
</tbody>
</table>

*FOOD FLAVOURINGS*
**NATURAL FLAVORINGS FROM VEGETABLE PLANTS**

- **Tonka**
  - Semina tonica
  - Balsamic, vanilla, Coumarin
  - Burning, bitter, woodruff, benzaldehyde
  - Very astringent, color principle
  - Coumarin (1.5 per cent)

- **Tuberose root**
  - Polianthe tuberosa
  - Floral
  - Pungent, color principle
  - Methyl anthranilate, methyl benzoate

- **Tuberose**
  - Rhizoma curcumae
  - Spicy, characteristic
  - Aromatic, sweet-bitter
  - Curcumin, termerol, phellandrene, valerianic and capronic acids

- **Turmeric root**
  - Radix valerianae
  - Borneol, ginger, camphoraceous characteristic, penetrating
  - Sweet, characteristic
  - Valeric acid, borneol, bornyl ester, pinene, camphene, coniferylvanillin

- **Valerian root**
  - Vanillia planifolia
  - Balsamic, spicy, characteristic
  - Aromatic
  - Piperonal, heliotropin

- **Vanilla beans**
  - Prunus serotina
  - Benzaldehyde, aromatic
  - Bitter, pungent, tart
  - Citral
  - Vetiverol, sesquiterpenes

- **Vervain, European**
  - Caulocarpus winteri
  - Gaultheria procumbens
  - Root beer
  - Prunasin, enzyme-emulsin

- **Vetiver root**
  - Hamamelis virginiana
  - Faint, tobacco
  - 0.65
  - Methyl salicylate

- **Walnut leaves**
  - Asperula odorata
  - Insignificant
  - Drimind, drimindic acid

- **Wild cherry bark**
  - Eridictyon californicum
  - Spicy, unpleasant, characteristic, absinth
  - 0.5-2
  - Asabinth, thujon, phellandrene, cadinene, valeric acid, palmitin

- **Wintergreen leaves**
  - Herba and flores absinthii
  - Balsam
  - 0.13
  - Tannin, achillein

- **Winters bark**
  - Herba milfolii
  - Floral
  - 2.0
  - Achillein

- **Woodruff**
  - Unona odoratissima
  - Borneol, Cineol
  - Benzyl benzoate, linalool, geraniol, esters, pinene, paracresol methyl ether

- **Wormwood**
  - Herba and flores absinthii
  - Aromatic, bitter, burning, ginger
  - Resin
and northern regions of South America. Para copaiba is thin, transparent, and yellow. Maracaibo and Maranham are more viscid, darker in color, and translucent. Copaiba consists of resin and volatile oil.

Guaiacum wood (Guaiacum officinale) is a hard and compact wood of greenish-brown color. It grows in the West Indies and southern Florida. Guaiacum wood is heavier than water. Guaiacum resin is obtained from the wood by raising one end of a log and firing it. The heat melts the resin and it flows out through a groove cut in the other end of the log. The constituent of the resin is guaiaconic acid, which is converted by oxidizing agents such as ferric chloride, ozone, and hydrogen peroxide into a substance called "guaiac blue."

Gutta percha is prepared by drying and purifying the latex of various species of Palaquium and Payena leerii, large trees of the Malay Archipelago.

Kino refers to Malabar, or Cochin, kino. It is obtained from the trunk of Pterocarpus marsupium. The juice is boiled and yields a dark ruby-red coloring powder. Kino contains kinotannic acid, catechol, and gallic acid.

Labdanum is derived from varieties of rock roses in Cyprus and Crete. It has an ambergris-like odor.
Licorice (*Glycyrrhiza*) consists of the peeled root and stem of *Glycyrrhiza*. It contains glycyrrhizin, an acidic glucoside with a sweet taste; sugar, starch, proteins, fat, and resins.

Myrrh is a resin similar to opoponax.

Oak moss resin is a lichen growing on oak trees.

Olibanum, also known as frankincense, is a gum-resin obtained from various species of *Boswellia*, small trees of Somaliland and Southern Arabia. It contains water-soluble gum and volatile oil. The odor is fragrant.

Opoponax is a fragrant resin derived from the tree *Comminphora erythraea*.

Storax or styrax is obtained from a tree in Turkey and is composed of storesinol which contains cinnamic acid and styrol. Styrax or storax has a sweet odor due to its content of cinnamic acid.

Witch hazel, *Hamamelis virginiana* grows in the United States and Canada. The bark contains tannin, small quantities of gallic acid, resin, and fat. The leaves contain volatile oil. The distillate of witch hazel is used in the United States as an antiseptic after shaving.

**ALKALOIDS AND GLUCOSIDES**

Alkaloids are organic substances occurring in vegetable plants combined with acids as salts. Most alkaloids are compounds consisting of carbon, hydrogen, nitrogen, and also generally oxygen. Many of them are derivatives of the nitrogen ring compounds pyridine, quinoline, and iso-quinoline occurring in coal tar. The well-known alkaloids are atropine, caffeine, morphine, nicotine, and quinine.

Glucosides are substances of vegetable plants whose compounds hydrolyze in the presence of dilute mineral acids or enzymes with the formation of a sugar and other organic substances.

*Aloe* is the juice which flows from the cut leaves of various species of *Aloe*. The constituent of aloe is a pale yellow crystalline glucoside called aloin, a derivative of tetrahydroxymethyl-anthraquinone. The use of aloe in bitter liqueurs is restricted in many countries.

*Capsicum*, the dried ripe fruits of *Capsicum minimum*, possesses a faint characteristic odor and an extremely pungent taste. The best material is cultivated in Sierra Leone and Zanzibar. The pungency of capsicum is due to capsaicin. The drug also contains fixed oil, red coloring matter, and a liquid alkaloid. Capsaicin is a crystallizable compound.

*Chamomile* flowers (*Anthemidis flores*) derived from the plant *Anthemis nobilis*. They possess a strong aromatic odor and bitter taste. They are up to one per cent of volatile oil, which is a crystalline bitter glucoside called anthemic acid also wax, fatty oil, and glucose.
Caffeine and theobromine are derived from vegetable sources such as: cocoa, up to 2 per cent theobromine, coffee up to 2 per cent caffeine, guarana up to 5 per cent caffeine, cola or kola up to 2.5 per cent caffeine with traces of theobromine, mate, or Paraguay tea up to 2 per cent caffeine, tea up to 5 per cent caffeine with traces of theobromine. The taste of caffeine is bitter. Combined with acids it forms caffeine citrate. Theobromine, however, has no stimulant action.

Coca leaves originate from the plants *Erythroxylum truxillense* and *Erythroxylum coca*. Coca leaves contain several alkaloids, the most important of which is cocaine.

Gentian is the name said to originate from Gentius, an ancient king of Illyria, who first established its medicinal virtue. Dried gentian root contains the bitter principles gentiin and gentianamarin. Gentiopierin, which is present in the fresh root, is hydrolyzed by the fermentative changes which take place during the process of slow drying. In addition there are a yellow phenolic body, a trisaccharide sugar called gentianose, and pectin present.

Mustard (*Sinapis*). There are two varieties of mustard; white mustard, of the dried ripe seeds of *Brassica alba*, and black mustard, of the seeds of *Brassica sinapioides*. The white seeds contain a crystalline glucoside, sinalbin, together with an enzyme, myrosin, which in the presence of warm water hydrolyzes the glucoside producing acrylnyl isothiocyanate, sinapine acid sulphate, and dextrose. Acrylnyl isothiocyanate is a non-volatile, yellow, oily liquid with a pungent taste and possesses a powerful rubefacient action. The black seeds contain a crystalline glucoside, sinigrin, together with the enzyme, myrosin, which in the presence of warm water hydrolyzes the glucoside producing allyl isothiocyanate, potassium acid sulphate, and dextrose. Allyl isothiocyanate is a volatile liquid with an extremely pungent odor and taste and is quite easily distilled from the seeds. In addition, both contain 25 per cent or more of fixed oil which has a mild rubefacient action.

Rhubarb contains tannin substances, one of which is gluco-gallin, a glucoside. When hydrolyzed with water and mineral acid, gluco-gallin yields galic acid and dextrose. Rhubarb is astringent and exercises a constipating effect.

Sarsaparilla is the root of *Smilax ornata*. It contains the saponin glucosides of parillin, smilasaponin, and sarsasaponin.

Senna is the leaflets derived from *Cassia acutifolia* and *Cassia angustifolia*. Senna is a purgative free from astringent action. Its taste is realike and pleasant.

Quassia is obtained from the trunk of the tree *Picrocra excelsa*. It has an intensely bitter taste but no odor.
Spice Seasoning

Seasoning is a comprehensive term that is applied to aromatic ingredients which improve the flavor of food products. It includes spices and other substances of vegetable origin. Spices are grown principally in the tropical islands of the East and West Indies, the Malay Archipelago, in India, China, Indo-China, Japan, Europe, Africa, and in North America. Various parts of the plants are used for spices. The aromatic and pungent principles which render spices valuable are found in their volatile oils and resins. They are usually small proportions of the spice as a whole. The active principles are also separated in form of essential or volatile oils, oleoresins, and extracts. They are often used as flavor instead of the spice from which it is obtained. The pungent and flavor principles in spices, in addition to having an agreeable effect upon the organs of taste and smell, stimulate the flow of the digestive juices and enhance the enjoyment of food. Spices which are imported and those which are shipped in domestic interstate commerce are subject to the requirements of the Federal Food, Drug, and Cosmetic Act, which is enforced by the Food and Drug Administration.

Classification of Spices

In commerce, the aromatic botanical substances for use in food products are classified as spices, aromatic seeds and herbs, or herbaceous plants.

The commonly used spices are allspice, cassia, cinnamon, cloves, ginger, mace, nutmeg, black and white pepper, turmeric, and capscium fruits. Capsicums include cayenne, red peppers, chillies, and paprika.

The aromatic seeds of which many are dried fruits include anise, cardamom, caraway, celery, cumin, coriander, dill, fennel, fennugreek, mustard, poppy, sesame, and star anise.

The herbaceous plants or herbs are laurel leaves, marjoram, mint, oregano, parsley, rosemary, sage, savory, sweet basil and thyme, garlic and onion.

Comminution

Spices are ground with the aid of hammermills, apparition mills, roller mills, limited mills, pulverizers, and other grinding equipment. Modern grinding machines eliminate the loss of spice and conserve the volatile
Properties of Spices.

Allspice.—Allspice or pimento is the dried, nearly ripe fruit of *Pimenta officinalis linel*, and is also called Jamaica pimento or Jamaica pepper. It is not to be confused with pimiento or Spanish paprika. Pimento is grown in abundance in the West Indies and tropical America. The Mexican spice is larger than the Jamaica but is also inferior in quality. Allspice has an aroma similar to a mixture of nutmeg, cinnamon, and cloves. It has a dark reddish brown color. The size varies from \( \frac{3}{16} \) to \( \frac{1}{4} \) inch in diameter. The shape is nearly globular.

The aroma is strongly fragrant and the taste is pungent. Allspice contains 3 to 4.5 per cent volatile oil with up to 80 per cent eugenol as principal constituent. Allspice is used in flavorings for meats, gravies, fish dishes, pies, puddings, sauces, ketchup, poultry dressing, as well as in bologna, pork sausage, frankfurters, hamburgers, mincemeat, potato sausage, head cheese, pickled pigs feet, and many other meat products.

Cassia and Varieties.—*Cinnamomum cassia* Blume, is cultivated in China and Burma. It has a reddish-brown color; its bark is thicker and coarser than that of Ceylon cinnamon and has a less fragrant aroma. The thin bark is slightly rough and shows longitudinal veiny ridges. The thick bark is grayish than the thin and very rough with no veiny ridges.

*Saigon Cassia.*—The thin bark has a light brown color while the thick bark has a dark somewhat grayish brown color. The aroma is agreeable; the taste is very aromatic, pungent, sweet, and slightly astringent.

*Batavia Cassia.*—Batavia cassia is cultivated in Indonesia. The color of the Batavia cassia, thin bark, is light yellowish-brown and the thick bark is a shade darker. The bark is comparatively smooth; the aroma is agreeable; the taste is sweet and pungent. The three varieties of cassia are used in flavoring of bakery goods, confectionery, canned fruits, and other food. They are also in use as ingredients of many spice compounds for use in pastry, mincemeat, and often in curry powder.

Cassia buds are the dried unripe fruit of *Cinnamomum cassia* and *Cinnamomum loureirii*. Their color is grayish brown. Their size varies. The cassia bud consists of a brown seed which is quite smooth with only part of its upper surface visible. The aroma is cinnamon-like; the taste is sweet, warm, and pungent, similar to cassia bark.
All varieties of cassia contain 0.5–2.0 per cent volatile oil whose principal constituent is up to 90 per cent cinnamic aldehyde.

**Cinnamon.**—The true cinnamon, *Cinnamomum zeylanicum* Nee, is cultivated in Ceylon and the Malabar coast of India, Sumatra, and Java. Its size varies from 36–42 inches in length and approximately 2/5 of an inch in diameter. The shape is cylindrical, compound quills which are a thin rolled bark with light colored veiny lines running lengthwise. The aroma is pleasing and fragrant. The taste is warm, sweet, and aromatic. Ceylon cinnamon bark contains 0.5–1 per cent volatile oil, having as principal constituent up to 75 per cent cinnamic aldehyde. Ceylon cinnamon is used for flavoring blood sausage and bologna, in mincemeat, sauces, icing, condiments, pickles, relishes and preserves, candy, and bakery goods.

The terms cinnamon and cassia are interchangeable in commerce, also they represent two distinct species of the genus *Cinnamomum*. Cinnamon is used when a more delicate flavor is desired than the stronger and more pungent flavor of cassia.

**Cloves.**—The term clove is derived from the Spanish and French word meaning nail. It is the dried flower bud of *Carophyllus aromaticus* L., a small evergreen tree of the Myrele family which is cultivated in the Spice Island, Indonesia, Amboyna, Zanzibar, Madagascar, Ceylon, India, and Malaya. The commercial clove is an unopened bud. The green flower buds, in process of growth, change to a reddish color, at which time they are picked and some dried, the color changing to deep reddish-brown. The size varies from 1/2 to 3/4 of an inch in length. The shape resembles a round headed nail. The aroma is very strong, the taste hot, pungent, and aromatic. Cloves yield 14 to 21 per cent of volatile oil with up to 95 per cent eugenol as principal constituent.

Cloves are graded according to appearance. Zanzibar cloves are graded special. Cloves are used in bologna, head cheese, blood and liver sausage, in flavoring roasts, ham, stews, preserves, cakes, puddings, pickles, pickling spice, mincemeat, pastry spice, and poultry dressing. Whole cloves are often stuck in hams when they are baked.

**Ginger.**—Ginger is the washed and dried or peeled and dried rhizome of the root stock of *Zingiber officinale* Roscoe. A rhizome is an underground stem and not a root, although the commercial term is ginger root. Ginger grows in tropical Asia and is cultivated in the West Indies, India, Africa, China, Japan, and the East Indies. The chief commercial varieties of ginger are Jamaica ginger, India ginger, African ginger, and Japanese ginger. The Jamaica ginger is generally regarded as the best. Ginger yields 1 to 3 per cent volatile oil. Ginger owes its pungency to the volatile oil and to the resinous matter. Ginger is used to give flavor and
pungency to bakery products and is used in flavoring of beverages and for sausage seasoning, pastry spice, mincemeat, curry powder, liver sausage, pork sausage, and frankfurters.

**Jamaica Ginger.**—The Jamaica ginger is considered to be the best quality. Its color is very light buff. The size varies from $2\frac{1}{2}$ to $3\frac{1}{2}$ inches in length. The shape is irregular, branched, and palmate. The appearance is clean, hard, and somewhat fibrous, free from cork. The Jamaica ginger has an agreeable aroma which is somewhat pungent. The taste is aromatic, pungent, and biting.

**India Ginger.**—The Indian ginger is used extensively for blending purposes. It has a pale brown color and is of irregular size, fibrous, with cork not entirely removed.

**African Ginger.**—The African ginger lacks the fine aroma of Jamaica ginger but has an intensely pungent odor.

**Japanese Ginger.**—The Japanese ginger resembles the Indian ginger, cochin, but is an inferior product, lacking aroma and pungency.

**Mace.**—Mace is the crimson aril of *Myristica fragrans* Houpt. Mace clothes the nutmeg kernel and both come from the same tree. It is removed from the nutmeg kernel, flattened, and dried when the color changes to reddish-brown. Mace contains a fixed oil and also a volatile oil which resembles oil of nutmeg. Mace has a shiny, smooth, corn-like, and brittle appearance. The aroma is fragrant and nutmeg-like. The taste is aromatic and slightly warm. Mace contains up to 14 per cent volatile oil and not less than 30 per cent of fixed oil. Mace is used in flavoring of cakes, bakery products, preserves, sauces, salt fish, pickling, relish, mustard sauce, basic sweet dough, mincemeat, and poultry dressing. It is also used as flavor in veal, liver, pork sausage, frankfurter, and bologna. Mace should not exceed one-eighth of the seasoning formula in meat products.

**Nutmeg.**—Nutmeg, *Myristica fragrans* Houpt, grows in the Moluccas or Spice Islands—East India Archipelago. It is cultivated in Pemang, Sumatra, Java, Banda Islands, and the West Indies.

The color of nutmeg is grayish brown. Its size varies up to $1\frac{1}{16}$ inch in length and to $1\frac{15}{16}$ inch in width. The shape is mostly oval and nearly globular. The appearance is wrinkled but smooth to touch. Nutmeg appears hard yet is easy to cut and reveals many brown veins of various lengths. These veins contain the volatile oil of nutmeg which is characteristic and has a strongly aromatic aroma. The taste is slightly bitter, warm, and aromatic. Nutmeg yields up to 15 per cent volatile oil. Nutmeg is graded large, medium, or small. The West Indian nutmegs are imported unlimed while the East Indian nutmegs are limed. Liming
SPICES

protects nutmeg against worms and insects. East Indian nutmegs are superior in quality to West Indian nutmegs. West Indian nutmegs are not as fragrant as East Indian. Nutmeg is used extensively in flavoring of bakery goods, puddings, sauces, minced ham, poultry dressing, sausages, bologna, frankfurters, liver sausage, and head cheese. Nutmeg should not exceed one-eighth of the seasoning formula.

Pepper.—White and black pepper are obtained from the plant *Piper nigrum* L. It grows in the East Indies and is cultivated in many tropical countries. The black pepper is picked when it begins to turn red and dried. Its color is dark brown to black. The shape is nearly globular, small, and wrinkled. It has a penetrating aromatic odor and a hot, biting, and very pungent taste. Black pepper yields 1.5 per cent volatile oil and over 6 per cent oleoresin. Black pepper is used in most sausages. White pepper is obtained by depriving the dried mature pepper corns, *piper nigrum*, of their outer dark coating. The color is light yellowish-gray, the shape nearly globular with a smooth surface. White pepper yields about 1.5 per cent volatile oil and 7 per cent oleoresin.

The white pepper is used in sausages where color is important, such as pork sausage. Both black and white pepper are an important ingredient for poultry dressing, bologna, hamburger, and frankfurter seasoning.

Long pepper is the dried fruit of *Piper longum* L. It is used mainly for pickling purpose.

Turmeric.—Turmeric, of the plant *Curcuma longa* L. grows in the East Indies, Cochin, China, and is cultivated in China, India, East Indies, and West Indies. It has a deep yellow to orange-yellow color and a rough and hard appearance. The aroma is characteristic and peppery. The taste is aromatic and somewhat bitter. The color of powdered turmeric is orange-yellow (Alleppey) and lemon-yellow (Mavras). In the United States preference is given to the orange-yellow turmeric because it will hold the shade better than the lemon-yellow when exposed directly or indirectly to sunlight. Turmeric yields about 5 per cent volatile oil.

Turmeric is used in flavoring of meat and egg dishes. In the manufacture of mustard, turmeric brings the color up. It is also used in the manufacture of pickles and as an ingredient of curry powder.

Capsicum Spices.—Capsicum spices include cayenne pepper, paprika, red pepper, chile pepper, spiced chili powder, pimiento, crushed red pepper, flakes and dices of sweet pepper, chile, and turmeric. Capsicum spices are cultivated also in California and in many parts of the world. The small fruited varieties of capsicum spices are more pungent or "hotter" than the varieties producing larger fruit which are milder and sweeter. Dried capsicum, red peppers, vary in size, shape, and flavor. The small peppers are known as chillies, they are very acid and are used
whole for pickling purpose or ground to make cayenne pepper. Chilli powder is made by grinding mild or pungent varieties of capsicum.

**Cayenne Pepper.**--The name Cayenne derives from a municipality in French Guiana, on the northern coast of South America. Cayenne pepper — *Capsicum frutescens*, *Capsicum baccatum*, and other species of capsicum, is cultivated in the tropical parts of South America, Central America, Africa, India, and Japan. The color is dark to bright red, the color of the seeds yellow. Normally, they are dried shiny pods, flat, and wrinkled. The aroma is characteristic and pleasant. The taste is sharp, biting, and pungent. There is no volatile oil in cayenne. The seeds are acrid and pungent. Ground cayenne pepper is very irritating. The pungency factor enables the hot peppers to be used partially as replacement for black pepper. The principal uses are in frankfurters, bologna, Mexican sausage, smoked country sausages, and in sausages which are marketed in the South. It is also used as flavoring for meat, fish, and sauces.

**Paprika.**--Generally, there are two types of paprika, the mild or Spanish, and the pungent or Hungarian paprika. Paprika is of the plant *Capsicum annuum* Linn. It is cultivated in Hungary, Bulgaria, Spain, Portugal, Argentina, Chile, United States, and Canada. The mild paprika has a bright color, rich red to bright and rich red dark. The aroma is pleasant, the taste is agreeable, slightly sweet and mildly pungent. Because of its rich color, flavor, and vitamin C content, paprika is used for garnishing and flavoring fish and meat dishes, salad dressings, salads, fancy meats, chile sauces, tomato catsups, and as an ingredient of ground spice formulas for frankfurters, mince specialties, bologna, and other sausages.

**Pimiento.**—Among the other capsicum varieties is Pimiento, not to be confused with pimento or allspice. It is principally used for spot color purposes in meat loaves and in certain national specialties. Pimiento, Pimenti, or Spanish paprika has the characteristics of that grown in Spain.

**Chilli Pepper and Chillies.**—Chilli pepper is produced in large quantities in California. It resembles paprika. Chilli pepper or chillies is a small whole red, very pungent, dried ripe capsicum fruit. Tabasco chillies are small, extremely pungent peppers which are used in making cayenne pepper for pickling purpose and in the manufacture of tabasco sauce. The principal use of chilli pepper is as an ingredient of chilli powder.

**Aromatic Seeds**

*Anise* seed is the dried fruit of *Pimpinella anisum* L. It is commonly grown and cultivated in warm and hot climates of Egypt, Russia, Turkey.
Syria, Cyprus, Bulgaria, Germany, Italy, France, Spain, India, Mexico, and South America. The color is greenish-gray to grayish-brown. The size varies from \(\frac{3}{25}\) to \(\frac{3}{16}\) inch in length. The shape is oval. The aroma is characteristic, agreeable, the taste is pleasant, sweetish, and aromatic. Anise seed yields up to three per cent of essential oil having up to 90 per cent anethol as principal constituent.

**Anise seed** is commonly used in dry sausage, mortadella, and pepperoni. It is also used in bakery goods, meats, confectionery, and in cordials.

Capers are the buds of unexpanded flowers of *Capparis spinosa* L., which grows in the south of Europe and North Africa. Capers are used for flavoring pickles, relishes, and sauces.

**Caraway** is the dried fruit of *Carum carvi* L. It grows and is cultivated in Russia, Syria, Poland, Bulgaria, Rumania, Holland, Morocco, Canada, and in the United States. The principal source of supply is Holland. The color of caraway is light to dark brown. The shape is curved and tapered at each end. It is up to one-fourth inch in length and is hard and sharp to the touch. The aroma is characteristic and agreeable; the taste is pleasant, aromatic, sweetish, and slightly sharp. The ground caraway seed yields up to 70 per cent of volatile oil, having up to 60 per cent carvone as principal constituent. Caraway seed is used for flavoring bread, cheese, and sauerkraut, in sausage seasoning and in mixed pickling spice, also in cordials.

**Cardamom**, often called cardamon, is the dried seed of the plant *Elettaria cardamomum* Matam. It grows and is cultivated in India, Malabar, Mangalore, Mysore, in Ceylon, and Central America. The fruit consists of a pod or shell containing the seed. The seeds lose their aromatic constituents shortly after removing from the shell or capsule. Cardamom yields up to eight per cent volatile oil. Cardamom seeds are used in cooked meat sausages such as liver sausage and head cheese. It is used for flavoring bread, cake, and cookies and as an ingredient of curry powder for sausage, pork sausage, and hamburgh seasoning, as well as in whole mixed pickling spice.

**Celery seed** is the dried fruit of *Apium graveolens* L. It grows in southern Europe and is cultivated in France, Holland, Great Britain, India, and in the United States. The color is brown with pale colored ridges. The size of celery seed is up to \(\frac{1}{16}\) inch in length, the shape is small with stalk ends attached. The aroma is characteristic. The taste is warm and slightly bitter. Celery seed yields up to 3 per cent volatile oil.

Celery seed is used principally in pork sausage, in the kitchen as a substitute for fresh celery to flavor soups, salads, tomato juice, spreads, sauces, and in celery salt which is a mixture of ground celery seed and free-running table salt. Celery salt is used in meat and sausages.
**Coriander** seed is the dried fruit of *Coriandrum sativum* L. It grows in Europe and is cultivated in Russia, Asia Minor, India, South America, and in the United States. The color is yellowish-brown. The size is up to 3/16 inch in diameter. The shape is globular. The seed breaks easily apart and is recognized by its straight and wavy ridges. Coriander yields up to 1 per cent of volatile oil.

Coriander is used in frankfurters, Berliner sausage, Bologna, veal, minced ham, Polish sausage, and other meat products. It is also used for flavoring bakery goods, in mixtures of pickling spice, curry powder, Hindu spice, in flavoring of tobacco products, gin, and cordials.

**Cumin seed**, of the plant *Cuminum cyminum* L., grows in North Africa and in the Mediterranean countries of Europe. It is cultivated in Morocco, Sicily, Malta, Cyprus, Egypt, Iran, and India. The color is yellowish-brown. The size is up to one-fourth inch in length. The shape is oval, convex, ridged, with a short length of stem attached. The aroma is strong and distinctive resembling caraway. The taste is warm and aromatic. The seed yields up to 4.5 per cent of volatile oils, having up to 35 per cent cuminol as principal constituent.

Cumin seed is used in making curry powder, in flavoring of bread, soups, rice and meat dishes and meats, pickles, cheese, chilli powder, Hindu spice, pungent mango pickles, green mango chutney, and in cordials.

**Dill seed** of the plant, *Anethum graveolens* L., grows in Europe and is cultivated in England, India, and in the United States. The color is light brown; the size varies up to 3/16 inch in length; the shape is oval. The aroma is aromatic and resembles faintly that of caraway. The taste is warm, aromatic, and slightly sharp. Dill seed yields up to 4 per cent of volatile oil with up to 60 per cent carvone as principal constituent.

Dill seed is used for flavoring soups, salads, meat and fish sauces, meat dishes, dill pickles, for seasoning frankfurter, bologna, liverwurst, summer sausage, and pork sausage.

**Fennel seed**, of the plant *Foeniculum vulgare* Miller, grows and is cultivated in Germany, Rumania, Italy, France, North Africa, Russia, Syria, India, and Japan. The color is greenish or yellowish-brown. The size varies up to 3/16 inch in length. The shape is oblong oval, straight, or slightly curved. The aroma is pleasant and aromatic. The taste resembles that of anise seed. Fennel seed yields up to 6 per cent of volatile oil.

Fennel seed is used in fish dishes, soups, sauces, in sweet pickles, in bread, rolls and pastries, and in cordial flavors.

**Foenugreek**, of the plant *Peganum harmala* L., grows in southern Europe and is cultivated in France, Germany, Morocco, Egypt,
India, and in the United States. The color is brownish-yellow. The size varies up to \( \frac{3}{16} \) inch in length and up to \( \frac{1}{4} \) inch in breadth. The shape is oblong—rhomboidal. The aroma is strong, pleasant, and reminiscent of burnt sugar. The taste is farinaceous and slightly bitter.

Foenugreek is used in curry powder, in maple, and in rum flavors.

Mustard is the seed of an herb which is grown commercially all year round in China, Japan, India, Italy, Russia, Holland, England, Denmark, Canada, Montana, California, and in other parts of the United States.

The principal kinds are white mustard seed, commonly called yellow, of the plant *Sinapis alba* L. The color is yellowish; the size varies up to \( \frac{3}{32} \) inch in diameter. The aroma is not perceptible. The taste is pungent.

Black mustard seed, commonly called brown, of the plant *Brassica nigra* (L.) Koch, is produced in Chile and South America. The aroma is not perceptible but when crushed in the presence of a little water, a sharp irritating aroma is given off, due to the presence of allyl isothiocyanate. The taste of black mustard seed is pungent. Brown mustard, of the plant *Brassica juncea*, contains approximately 1 per cent volatile oil. Black mustard contains approximately 1.5 per cent volatile oil. White mustard contains the nonvolatile sinablin mustard oil and an excess of myrosin.

Commercial mustard flours are mixtures of the flour from white and black or brown mustard seeds. The products are obtained by crushing, grinding, and sifting the whole mustard seeds. Ground mustard is used to add flavor and piquancy to all kinds of meat, to prepare mustard pickles, and in the manufacture of mustard paste.

Poppy seed, of the plant *Papaver somniferum* L., grows in Asia and is cultivated in France, Poland, Holland, Germany, Hungary, India, Turkey, England, Canada, and the United States. The color is considered blue, commercially. The size is about \( \frac{3}{64} \) of an inch in length; the seed is kidney shaped, small, hard, and clean looking. The aroma is pleasant and slightly nut-like. The taste is nutty. Poppy seeds contain about 60 per cent fixed oil. Poppy seeds are used on bread, rolls, cake, cookies, and strudle.

Herbs

Laurel leaves or Bay leaves are the dried leaves of *Laurus nobilis* L. They grow in the Mediterranean countries and are cultivated in Greece, Spain, Portugal, Asia Minor, and Central America. On the surface of the leaf the color is green; the underside is pale green and somewhat yellowish. Laurel leaves are used whole or cracked. The aroma of the crushed leaves is delicate and fragrant. The taste is aromatic and bitter.
They yield up to 3 per cent volatile oil with the principal constituent up to 50 per cent cineol.

Laurel leaves are used principally in vinegar pickle when packing pigs feet and lamb and pork tongue. They are also used in flavoring of soups, stews, game dishes, fish and sauces, pickles, and mixed pickling spice.

*Marjoram* is the dried leaves, with or without small portions of the flowering tops, of *Majorana hortensis* M. It grows in western Asia and in the Mediterranean countries. It is cultivated in France, Germany, Hungary, Spain, Portugal, England, North Africa, South and North America. The color of the dried herb is light green with a slight grayish tint. The whole leaves are small with hairs on both sides of the leaf. The aroma is pleasant, fragrant, and spicy. The taste is fragrant, spicy, slightly sharp, bitterish, and camphoraceous. Marjoram yields up to 0.9 per cent of volatile oil.

Marjoram leaves are used for flavoring liver and Polish sausages and head cheese, in soups, stews, dressings, salads, egg and vegetable dishes, cheese, and poultry dressing.

*Mint* represents many varieties of the genus *Mentha*. The following species are important to spice flavorings: spearmint—*Mentha spicata* and peppermint—*Mentha piperita*. Mint grows in Europe, Asia, England, and in North and South America. The properties are alike. Mint appears as dried, whole and broken leaves, with leaf stalks attached. The aroma is strong, sweet, and characteristic. The taste is warm, pleasant, fragrant, spicy and pungent, with a cooling aftertaste. Spearmint yields 0.3 per cent of volatile oil, having the principal constituent, carvone, up to 66 per cent. Both the English peppermint and the American peppermint yield up to one per cent volatile oil.

Mint is used for flavoring meat, fish, sauces, soups, stews, vinegar, teas, tobacco, and cordials.

*Origanum vulgare* L. is cultivated in Greece and Italy. It grows abundantly in Mexico and is also known as Mexican sage. Oreganum is a perennial herb of the mint family. The color of the dried herb is light green. The aroma is strong, aromatic, and camphoraceous. The taste is fragrant, spicy, and agreeable. Oreganum is used for flavoring soups, meat dishes, pork, fish, egg dishes, salads, and chili powder.

*Parsley*, of the plant *Petroselinum sativum*, Hoffm., grows in the Mediterranean region and is extensively cultivated in the United States especially in Louisiana. The color of the dried herb is green. The aroma is pleasant, characteristic, fragrant, and spicy. The taste is characteristic and agreeable. The volatile oil of the parsley leaves is different from the oil obtained from the seed, which yields up to 7 per cent volatile oil.
Dried parsley is used in flavoring soups, meat, fish dishes, vegetable dishes, salads, and in garnishing. It is also used as an ingredient in meat and poultry seasoning.

_Rosemary_, of the plant _Rosmarinus officinalis_, grows and is cultivated in Yugoslavia, Spain, Portugal, and other parts of Europe as well as in the United States. The color of the dried herb is brownish-green. Rosemary leaves have a tea-like fragrance. The crushed rosemary, however, has an agreeable and fragrant, spicy aroma, with a camphoraceous note. The taste is fragrant, spicy, pungent, bitter, and camphoraceous. Rosemary leaves yield up to two per cent of volatile oil.

Rosemary is used for flavoring soups, sauces, vegetable dishes, and meat.

_Sage_ is the dried leaf of _Salvia officinalis_ L. and is a member of the mint family. It grows and is cultivated in Yugoslavia, Portugal, Spain, Cyprus, England, Canada, and in the United States. The sage plant is sensitive to climatic conditions. The variations in the fertility of the soil, the degree of moisture, temperature, wind, rain, and sunshine of the same fields and cultivated by the same planter and harvested in the same manner often yield crops of sage which are totally unlike in character and in essential oil content from year to year. The finest grades of sage are grown in Dalmatia and Yugoslavia. Sage blends well with the red and white pepper and salt but not with all other spices. Sage yields up to three per cent volatile oil.

Sage is used in pork sausage and baked loaf. The color of the dried herb is gray, tinged with green; the aroma is strong, fragrant, and spicy. The taste is fragrant, spicy, warm, astringent, and a little bitter. Sage is the most important herb in every kitchen for flavoring meat and fish dishes and in making poultry stuffings. It is used in poultry dressing, sausage, liver sausage, and hamburger seasoning.

_Savory_, _Satureja hortensis_ L., grows in Southern France, Germany, Spain, and other parts of Europe; also in England, Canada, and United States. The aroma is fragrant. The taste is slightly sharp and slightly camphoraceous. The summer savory is the dried leaf and flowering tops of the plant. Savory is used in flavoring of soups and sauces, egg, salad dishes, and poultry dressing. It is used in pork sausage and is good in any other sausage.

_Sesame seed_, of the plant _Sesamum indicum_ L., grows and is cultivated in India, Turkey, China, and other parts of Asia. The color is creamy white. The size varies up to 1/6 inch in length. The shape is oval, compressed, with a small protuberance at one end. The aroma is faintly nutty; the taste is agreeable and nutty. Sesame seed is used in Turkish
confections, on bread, rolls, cookies, and biscuits. They improve taste and impart a nut-like flavor. Sesame oil does not contain volatile oil but has a fixed oil.

**Tarragon** is the dried leaves and flowering tops of *Artemisia dracunculus* L. It is used for flavoring vinegar, pickles, mustard, and to a limited extent for the flavoring of soups, salads, and meat dishes. The aroma is anise-like.

**Thyme** is the dried leaf and flowering tops of *Thymus vulgaris* L. and grows in France, Germany, Spain, Italy, and other parts of Europe, also in England, North Africa, Canada, and the United States. The crushed leaves yield a fragrant and aromatic odor. The taste is pungent and aromatic. Thyme yields about 2.5 per cent volatile oil.

Thyme is used in liver sausage, pork sausage, head cheese, and bock wurst. It is also used in the flavoring of soup, meat, fish, and in poultry dressing.

**Valerian root, Valeriana officinalis** L. has a sweetish and camphoraceous taste. It is used in the manufacture of flavors, tinctures, and essences.

**Zedoary root, Curcuma zedoaria** Roscoe, is a member of the ginger family and is native to India. It is aromatic, with a pungent taste. It is used in the manufacture of flavors and bitters.

**Condimental Vegetables**

**Garlic** is the bulb of *Allium sativum* L. of the lily family. It grows wild in Sicily, Italy, and Southern France. Its cultivation is universal. The principal constituent of garlic is a volatile oil but it also contains mucilage, albumin. The garlic contains about 0.1 per cent of volatile oil.

Garlic has a pungent odor and a strong taste. The strength of garlic varieties varies according to source, variety, age, and condition. California garlic differs from Mexican garlic. The white, pink, and yellow varieties all vary in flavor. Fresh garlic is juicy. With the evaporation of moisture goes some of the flavor. Prolonged storage causes spoilage. Garlic is used in Polish sausage and in many types of smoked sausage. Garlic powder is the ground powder of dehydrated garlic. It has a strong, heavy, persistent aroma and taste. The comparison between fresh and powdered garlic is 1:5. Garlic powder should be kept in a closed container otherwise it will become lumpy and hard. Garlic salt is a mixture of garlic powder and free-running table salt. Starch is sometimes added to prevent caking.

Garlic powder is used in Italian type sausages, cold meat, and salami. Garlic salt improves the flavor of meat dishes, salads, and sauces and goes well with tomato juice.
Onion is the bulb of a liliaceous plant Allium cepa L. having a characteristic and well known flavor, aroma and taste. It is cultivated widely. Onion is used in liver sausage, head cheese, and baked loaf. Sometimes it replaces garlic.

Onion is available in dehydrated form which seems to be more uniform in quality than the fresh bulb. Onion powder is the product of dehydrated onion with aroma and taste similar to fresh onion. It should be kept in closed containers otherwise the powder absorbs moisture and becomes lumpy and hard. The comparative strength of onion powder and onion bulb is 10 to 12:1. Onion powder is used in delicatessen meats, sausages, gravies, relishes, pickles, and sauces.

Onion salt is a mixture of onion powder and table salt with or without starch. Starch is added to prevent the caking of the powder.
Cocoa and Chocolate

The principal raw material used in making cocoa powder and chocolate is cocoa bean. An exotic tropical tree produces the seeds or cacao beans. The cocoa bean played an important role in the Aztecs' traditions and legends, and perhaps no other food has an equally romantic history. They believed the plant to be of divine origin, and that Quatzalcault, a prophet of Indian mythology had brought the seeds from Paradise and sown them in his gardens. By eating the fruit he acquired universal knowledge and wisdom, and was held in great reverence by the people.

The original cocoa products were not sweetened, and much impetus was given to their use when Spanish nuns of Guanaca developed formulas for sweetening them. Spain was the first country in Europe to manufacture chocolate and was a leader in the industry for many years. About the year 1606, the use of cocoa beans was introduced into Italy, from whence it passed across the border to Austria and France, and eventually to London where about 1700 it had become an exceedingly fashionable beverage.

The foundation for the modern milk chocolate industry was laid in 1876 by Daniel Peter of Vevey, Switzerland who developed a method of blending milk with sugar and chocolate.

GROWTH, CULTIVATION, AND VARIETIES OF COCOA BEANS

Cocoa beans are the seeds of trees belonging to the species Theobroma cacao. These trees flourish in a warm, moist climate within an area of about 20° North and South of the Equator. The finest cocoa beans are grown in South America, which is the home of the cocoa tree. In the Amazon and the Rio de la Plata water area of Brazil grow over a hundred million cocoa trees. Among the varieties of cocoa are the Bahia beans which are of outstanding quality; then Para cocoa beans which have a very mild chocolate flavor. Equador produces the finest cocoa. The beans have a unique aroma and a characteristic chocolate flavor which is difficult to obtain from other beans.

The cocoa varieties are known as Arriba, Machala, or Calao Guayaquil cocoa. The Arriba beans have a greater value than the Machala beans. Machala cocoa beans are smaller and have a more bitter taste than Arriba beans.

Venezuela also grows some of the finest cocoa. Their varieties are
known as Caracas, Carupano, Puerto Cabello beans. Caracas beans are large and the taste is of a strong chocolate flavor. Carupano beans have a harsher chocolate flavor but otherwise are similar to Caracas beans. Puerto Cabello beans have a reddish-brown color and sweet chocolate flavor.

Costa Rica beans have a mild flavor and a characteristic aftertaste.

Trinidad has the most important cocoa production in the West Indies Islands. The beans have a very good flavor.

Grenada produces some very good cocoa.

Jamaica beans have an aromatic flavor. However, the taste is rather bitter and harsh.

Haiti beans are small with little flavor.

San Domingo or Samana cocoa has a bitter flavor.

Cuba cocoa is of good quality.

Mexican beans are large and the flavor of the nibs is mild.

African cocoa beans from the Gold Coast of Africa are called Accra beans, after the name of the port from which they are exported. Accra beans form the basis for many chocolates, especially the cheaper sorts.

Nigeria is another cocoa producing country. The Nigerian beans resemble Accra beans in appearance and flavor. The Cameroons grow cocoa beans which are small size with kernels of bitter taste. Other African cocoa is grown in Sierra Leone, Kenya Colony, Tanganyika Territory, and Uganda.

Ceylon cocoa beans are round and light colored with a delicate taste and aroma.

Java, like Ceylon, produces cocoa beans of the highest quality.

COCOA PRODUCTION

The ripe cocoa pod weighs about a pound and it is filled with a pale pink, soft, sweet pulp, in which twenty-five to forty beans are embedded. The beans are very bitter due to the presence of tannin. They are altered by fermentation which makes the finished product palatable. During fermentation, changes occur in the beans. The color changes to brownish red. The bitter taste almost disappears.

After fermentation, the beans still contain about 33 per cent moisture and this must be reduced, desirably to 6 to 8 per cent moisture by drying, to obtain a product which can be stored. During the drying process, air continues to penetrate into the bean and enzymatic oxidation is completed, resulting in a further reduction in the astringency and a formation of the parent constituents which will later, during roasting, give rise to the typical chocolate flavor and aroma.

Chemical changes taking place during roasting play an important part
in flavor development. Chemical decomposition takes place, producing new and aromatic substances which are important components of the complete chocolate flavor. Dehydration, oxidation, and solubility changes take place in the tannins and bitter astringent substances. Unpleasant volatile materials, including hydrocarbons, ketones, volatile acids (butyric, acetic), pungent organic bases, and amine products of protein, are driven off. Any lipase present which would cause fat instability is destroyed. Water, of course, is lost and starch dextrinized, the latter contributing to the definite increase in water soluble matter after roasting. The bean loses any last trace of gumminess, becomes dry and brittle, and of such a nature that it can be easily ground.

Probably the most subtle and least understood chemical changes take place during the conching operation. This action, although mild, is prolonged and serves to remove the last traces of harsh flavor and unpleasant volatile acids and other organic substances are removed. Final oxidation of astringent tannin substances takes place. Moisture content is further reduced and fluidity increased. At somewhat elevated temperatures, a definite but very mild caramelization may be achieved, producing distinctive flavor effects. Thus, conching brings about the final chemical changes in the chocolate.

Commercial cocoa beans consist of an outer shell and an inner kernel, called the nib, which is surrounded by a thin skin. The average cocoa bean consists of more than fifty-four per cent cocoa butter, cocoa matter, and cocoa shell. Cocoa butter consists of a mixture of glycerides. A glyceride is a compound of glycerin and fatty acids.

Cocoa Powder and Cocoa Butter

In the milling process, the nibs are finely ground and the butter is released from the cells, the effect being the production of a free-flowing liquor of rich dark color and heavy aroma. In this form, it is known to the manufacturer as "chocolate liquor," and is the basic material from which the manufacturer produces other chocolate products. Some of it is cooled and solidified into cakes which are sold to the housewife as "baking chocolate."

To manufacture cocoa powder and cocoa butter, the heated chocolate liquor is placed in huge hydraulic presses where it is subjected to a pressure of 6000 lbs. per square inch. This pressure forces some of the cocoa butter through a retaining medium which holds back the solid mass.

The cocoa butter is filtered and used by the manufacturer in several ways. He uses it in making "sweet chocolate" and "milk chocolate," or cools and solidifies it into various forms and sells it for confectionary,
pharmaceutical, and sundry other uses. Cocoa butter has certain unique properties for it is one of the most stable edible fats, possesses a pleasant flavor and aroma, and combines well with other confectionery ingredients. Furthermore, it is solid and easy to handle at ordinary room temperature, and yet it liquefies at body temperature.

Constituents of Cocoa

After removal of cocoa butter from the cocoa nib, a brown mass of cocoa matter remains which contains purine, theobromine and caffeine, enzymes, carbohydrates, and tannin. Theobromine gives cocoa stimulating properties like caffeine to coffee. The most important constituent, however is tannin. It determines extensively the color and taste of cocoa. In the fermented bean the amount of cocoa tannin is constant.

Other constituents of cocoa matter are starch, up to 0.50 per cent sugar and minerals. The sugar consists of dextrose and levulose. The ash of cocoa matter contains mineral salts, including potassium phosphate.

Cocoa shell comprises about 12.5 per cent of the bean and contains theobromine, coloring matter, mineral constituents, and other substances.

Breakfast and Dutch Processed Cocoa

The mass that is left in the hydraulic press after the cocoa butter has been removed is in the form of large hard cakes. It is reduced to its final usable form by pulverizing it into an extremely fine powder. It is then packed into containers and sold to the housewife as “breakfast cocoa,” and also to confectioners, bakers, ice cream manufacturers, and others.

“Dutch processed cocoa” is made by treating the beans, nibs, or chocolate liquor with an alkaline solution, such as sodium bicarbonate, to bring out color and flavor modifications. The amount of alkali which can be used is specified and controlled by Federal Government. Other than the use of alkali, Dutch processed cocoa is made similarly to American process cocoa.

Chocolate

The most popular chocolate product is the milk chocolate bar. Chocolate liquor, pure fluid whole milk, and powdered sugar are the basic ingredients for this item. After intimately mixing these ingredients, the mixture is then passed through a series of large steel roll refiners where an intense shearing and rubbing action reduces the mass to a uniform paste which is so smooth that the coarsest particles will be less than 50 microns in size. This smoothness is one of the necessary characteristics which makes chocolate a delight to the palate, but this is not enough. To further improve the product, it is now processed for 72 hours in machines called
“conches,” in which the chocolate is pushed back and forth by a large cylindrical stone rolling on a stone bed. By this action, any rough edges on the fine chocolate particles are smoothed off, desirable flavor is further developed, and the entire mass is most intimately blended together. It is in the conches that the last delicate flavor effects which we have come to expect from fine chocolate are developed.

After conching, the viscosity of the chocolate is adjusted to the point where it is most easily handled, and it is then cooled and cast into bars, blocks, and other forms. Almonds, peanuts, or other ingredients can be added before casting, if desired.

“Sweet chocolate” and “semi-sweet chocolate” are processed similarly to milk chocolate except that no milk is used. A good deal of sweet and semi-sweet chocolate is sold to confectioners for making chocolate-covered candies. Increasingly large amounts of semi-sweet chocolate are being used by the housewife to make cookies, candy, cakes, and other items.

Types of Cocoa

Semi-cocoa, which contains 32 to 45 per cent fat and possesses a chocolate-like flavor.

High-quality cocoa, which contains from 25 to 35 per cent fat and is used in ice creams, beverages, icings, and chocolate syrups.

Breakfast cocoa, which contains not less than 22 per cent fat. It is used in chocolate biscuits and crackers, cakes, and fudge.

Semi-dry cocoa, which generally contains from 15 to 18 per cent fat and is used for cocoa-milk drinks, chocolate flavored desserts, chocolate pies, and chocolate flavored syrups.

Dry cocoa, which contains from 10 to 12 per cent fat. It is generally used in the preparation of chocolate-milk beverages.

Very dry cocoa, which contains from 6.5 to 7.75 per cent fat and is used for imitation chocolate coatings by incorporating sugar and a vegetable oil, usually coconut oil. It is also used as dusting powder in confectionery.

Defatted cocoa, which contains from 0.5 to 3.0 per cent fat and is used as dusting powder and in the preparation of imitation chocolates.

pH Values of Cocoa

Cocoa exhibits hygroscopic properties, due largely to the fact that during the roasting process a major portion of the starch present in the raw nibs is converted into dextrins under the influence of heat. These dextrins show a great affinity for moisture when incorporated into a batter which must be compensated for by a reduction in flour.

Cocoa products may vary in their values from 5.2 to as high as 8.8 for heavily Dutched cocoa. The pH of natural cacao products, which
include chocolate liquor and cocoa powder, is generally within the range of 5.2 to 6.0. This variation in pH is attributable to the variable amounts of different organic acids and other acid-reacting substances that are present. The pH of Dutched cocoas is influenced by the type and amount of alkali used, the normal range being from 6.0 to 8.8. Natural cocoas, being acid in character, require the use of baking soda. The acidity of the cocoa liberates the carbon dioxide gas from the sodium bicarbonate and thereby aids in aerating the batter. At the same time the acidity is neutralized with an improvement of the cocoa color. An increase in the alkalinity causes a deterioration of flavor at a pH above 8.0.

### Table 4

<table>
<thead>
<tr>
<th>Composition of Chocolate Liquor</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>1.70</td>
</tr>
<tr>
<td>Fat</td>
<td>54.00</td>
</tr>
<tr>
<td>Theobromine</td>
<td>1.08</td>
</tr>
<tr>
<td>Caffeine</td>
<td>0.42</td>
</tr>
<tr>
<td>Other nitrogen substances</td>
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<tr>
<td>Pure starch (by diastase)</td>
<td>8.21</td>
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<tr>
<td>Crude fiber</td>
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<tr>
<td>Other carbohydrates</td>
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<td>Total ash</td>
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<td>Water—soluble ash</td>
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<tr>
<td>Water—insoluble ash</td>
<td>2.32</td>
</tr>
<tr>
<td>Acid—insoluble ash</td>
<td>0.02</td>
</tr>
</tbody>
</table>

**Chocolate Fudge**

A good chocolate fudge should have a distinct fine chocolate flavor, good texture, a pleasing appearance, and a long shelf-life. An average chocolate fudge will contain about 5 per cent non-fat-cocoa material on the dry basis. This corresponds to 6 per cent or 11 per cent chocolate liquor. Some fudges contain approximately 20 per cent fat.

Either cocoa or chocolate liquor may be used. The cocoa may be high, medium, or low fat and may be either American or Dutch process. So far as flavor is concerned, the finest result will be obtained by the use of a good quality chocolate liquor. If cocoa is substituted for chocolate liquor in a formula for the sake of economy, care must be used to prevent a corresponding decrease in the quality of the product. In order to maintain the same desirable texture and keeping qualities in the fudge an allowance should be made for the difference in fat content of the cocoa and chocolate liquor. Approximately 58 lbs. of cocoa and 42 lbs. of some added fat can be used in place of 100 lbs. of chocolate liquor. However, the same fine flavor will not be obtained by the use of the cocoa and
furthermore if some fat other than cocoa butter is used, caution should be observed, that the shelf-life of the fudge is not shortened, due to the greater tendency towards rancidity of these fats as compared to cocoa butter.

Occasionally, some Dutch process cocoa may be used to obtain a certain minimum color and flavor at the lowest cost. In general, the color and flavor of these products will not compare with those where a higher percentage of a milder cocoa is used. Where cocoa is used, it is usually cooked in with sugar, glucose, and other ingredients. Chocolate liquor can be either handled this way, or, at least with smaller batches, added after the batch has cooked and before it cools. This cooking of the cocoa may destroy some of the flavor due to the tendency of the cocoa to burn. This may be another reason why fudges made from liquor have a finer flavor. If the chocolate liquor is used, it is added after the batch has cooled.

There are other uses for cocoa powder including such items as chocolate flavored syrups, chocolate flavored puddings, flavoring for tobacco, pharmaceutical preparations, instant cocoa coatings of the summer type, and as an ingredient in numerous household recipes.

Cocoa Nibs Flavor   MF 54

Ingredients

| 210 lbs. roasted cocoa nibs |
| 128 lbs. alcohol 95 per cent |

Procedure

(a) 105 lbs. roasted cocoa nibs are comminuted to powdered mass. The powdered cocoa nibs are mixed with a prepared menstruum consisting of:

| 128 lbs. alcohol 95 per cent, and |
| 272 lbs. water. The mixture is left to stand three days and is agitated twice daily; it is poured into an extractor which is fitted with a filter sack; no circulation of the menstruum is required. |

(b) It will take about 24 hours to obtain a drainage of the extract from the mixture for the first yield of:

| 80 lbs. cocoa flavoring extract which is used in the procedure (h). |

(c) The drainage of the extract from the mixture of (a) will continue to yield:

| 120 lbs. cocoa flavoring extract, which is used in procedure (f). |

(d) The remaining mash is mixed with water of equal quantity in weight; the mixture is then distilled at atmospheric pressure to yield:

| 80 lbs. cocoa flavor distillate of approximately 38 per cent alcohol content; it is used in (e). |

(e) 105 lbs. roasted cocoa nibs are comminuted to a pulverized mass. The powdered cocoa nibs are mixed with a prepared menstruum consisting of:
120 lbs. cocoa extract of procedure (c),
80 lbs. cocoa flavor distillate of procedure (d), and
200 lbs. water.

The mixture is left to stand three days for extraction and is
agitated twice daily; then it is poured into the extractor in
which a filter cloth is fitted to permit drainage of the extract;
no circulation of the menstruum is required.

(f) After 24 hours the drained extract is taken off, with a yield of:
160 lbs. cocoa flavoring extract which is used in procedure (f).

(g) The remaining mash is then distilled at atmospheric pressure to obtain
75 lbs. cocoa flavor distillate of approximately 45-50 per cent alcohol
content, which is used in procedure (h).

(h) The finished mixture consists of:
80 lbs. cocoa flavoring extract of procedure (b)
160 lbs. cocoa flavoring extract of procedure (f)
75 lbs. cocoa flavor distillate of procedure (g)

Total
315 lbs. or 35 gal. cocoa nibs flavor

Property of Flavor: 1 gal. cocoa nibs flavor is derived from 6 lbs. cocoa nibs.

Cocoa True Flavor Concentrate MF 55

Ingredients
1000 lbs. cocoa powder—Dutch processed—18 to 24 per cent fat
60 gal. alcohol, 95 per cent

(a) First procedure:
500.00 lbs. cocoa powder—Dutch processed of 18 to 24 per cent fat con-
tent, are mixed with a menstruum consisting of:
272.00 lbs. or 40 gal. alcohol, 95 per cent
705.50 lbs. or 85 gal. water

Total
977.50 lbs. or 125 gal. menstruum of approx. 30 per cent alcohol content;
the cocoa powder is added in slow flow to the menstruum and
under continuous agitation of the mixture to avoid formation
of lumps; to it are added:
37.50 lbs. glycerin.

This addition will assist in dissolving fatty substances of the
cocoa powder.

(b) Put a filter-sack into the extractor tank and pour the mixture (a) into it:
the mixture is allowed to remain in the extractor for two days
to drain; there should be ample space left free between the
filter sack and the bottom of the extractor for the separated
flavoring extract. On the third day the extract is taken off
and should yield: 40 gal. cocoa flavoring extract, which is to
be used in the chocolate flavor—formula MF 55h.

(c) The remaining mash of the extraction is then mixed with:
1037.50 lbs. or 125 gal. water, and the mixture is distilled at atmospheric
pressure to obtain a yield of:
841.50 lbs. or 105 gal. flavor distillate of approx. 20 per cent alcohol content; the distillate is used in (d) and the remains of the still are discarded.

(d) Second procedure:
500.00 lbs. cocoa powder—Dutch processed of 18 to 24 per cent fat content, are mixed with a menstruum consisting of:
841.50 lbs. or 105 gal. cocoa flavor distillate of (c) of approx. 20 per cent alcohol content and:
136.00 lbs. or 20 gal. alcohol, 95 per cent
Total
977.50 lbs. or 125 gal. menstruum of approx. 30 per cent alcohol content; the cocoa powder is added in slow flow to the menstruum under continuous agitation to avoid formation of lumps; to the mixture are added:
37.50 lbs. glycerin
(ec) Put a filter sack into the extractor, leaving a few inches free space to facilitate drainage of the flavoring extract. Pour the mixture of (d) into the filter sack and let stand two days to extract. On third day the extract is taken off to yield: 40 gal. cocoa flavoring extract; it is to be used in the chocolate flavor formula MF 55h.

(f) The remaining mash of the extraction is then mixed with:
49.80 lbs. or 6.0 gal. water and distilled at atmospheric pressure, slowly, to obtain a first fraction with a yield of:
20.00 gal. cocoa flavor distillate of about 45 per cent alcohol content; it is used in the flavor formula MF 55h.

(g) The distillation is continued to recover all the rest of alcohol in the second fraction. This yield is used in the next production instead of alcohol and water.

(h) The finished mixture consists of:
20.00 gal. cocoa flavor distillate of (f)
40.00 gal. cocoa flavoring extract of first procedure (b)
40.00 gal. cocoa flavoring extract of second procedure (e).
Total
100.00 gal. cocoa flavor of 30 to 35 per cent alcohol content.

Cocoa Distillate 1 MF 56

Procedure
Distillation, at atmospheric pressure, of:
6.0 lbs. cocoa powder or roasted cocoa nibs, comminuted, which are mixed with:
49.8 lbs. or 6 gal. water, to yield in the first fraction:
1.0 gal. cocoa flavor distillate.
The distillation is then interrupted and the content of the still is discarded.

1 Non-alcoholic.
Cocoa Flavor Distillate

Ingredients
- 600.00 lbs. cocoa powder or roasted cocoa nibs comminuted
- 435.20 lbs. or 64.0 gal. alcohol 95 per cent

Procedure

(a) Pour into still (400 to 500 gal. capacity) with agitator.
- 2158.00 lbs. or 260.0 gal. water;
- apply agitator and slowly add:
  - 300.00 lbs. cocoa powder (Dutch processed) 20 to 24 per cent fat content; keep agitating while adding the cocoa powder to avoid lumping; to the completely dissolved cocoa-water mixture, then add:
  - 272.00 lbs. or 40.0 gal. alcohol, 95 per cent, under agitation; the total of the menstruum is:
- 2593.20 lbs. or 300 gal. of approximately 12.66 per cent alcohol content.

(b) Start distillation by rapidly heating the mixture until it begins to boil and vapors start to rise; at this moment cut down heat in order to avoid overflow of the mixture in the still. The distillation is then kept at a slow flow of the condensate to yield in the first fraction:
- 379.25 lbs. or 50.0 gal. cocoa flavor distillate of approx. 45 per cent alcohol content; it is to be used in (g)

(c) Distillation is continued to recover the rest of the alcohol in the second fraction and to yield approximately:
- 640.00 lbs. or 80.0 gal. distillate of about 18 per cent alcohol content; it is to be used in (d) after the distillation the contents of the still is discarded.

(d) The still is washed, and then filled with:
- 1626.80 lbs. or 196.0 gal. water—and while agitating
- 300.00 lbs. cocoa powder—Dutch processed—of 20-24 per cent fat content are added; the second fraction of 640.00 lbs. distillate of (c) is also poured into the still, and finally to the mixture in the still are added:
- 163.20 lbs. or 24.0 gal. alcohol, 95 per cent—to obtain a total menstruum of:
- 2430.00 lbs. or 300.0 gal. of approx. 12.66 per cent alcohol content.

(e) Distill slowly at atmospheric pressure to obtain:
- 379.26 lbs. or 50.0 gal. cocoa flavor distillate of about 45 per cent alcohol which in the first fraction; it is to be used in (g).

(f) Continue distillation in order to recover the rest of alcohol in the second fraction with a yield of:
- 640.00 lbs. or 80.0 gal. distillate of about 18 per cent alcohol which is to be used in the next production batch.

*Alcoholic
The finished mixture consisting of:

- 50.00 gal. cocoa flavor distillate of (b)
- 50.00 gal. cocoa flavor distillate of (e)

Total
100.00 gal. cocoa flavor—45 per cent alcohol

Chocolate Flavor—White  MF 58

Procedure
Dissolve:

- 1.0 lb. vanillin in:
- 20.0 gal. cocoa flavor distillate of formula MF 57.

Chocolate Flavor—Dark  MF 59

Procedure
20.0 gal. mix chocolate flavor, white, of formula MF 58.
80.0 gal. cocoa flavoring extract, formula MF 55, or MF 54

Total
100.0 gal. finished chocolate flavor of approx. 30 to 35 per cent alcohol content.
The word coffee comes from the Arabic qahwah. Coffee was first a food, then a wine, a medicine, and finally a beverage. In the beginning the dried coffee berries were crushed and mixed with fat to form food balls. Then a wine was made from the raw beans and dried skins. The roasting of the beans began in the 13th century. The beverage was introduced from Arabia into Turkey in 1554; Venice in 1615, France in 1644, England and Vienna in 1650, and North America in 1668.

The most suitable climate for coffee is a temperate one within the tropics, in zones which are free from frost. Higher altitudes tend to enhance quality. The coffee fruit ripens about 6 to 7 months after the tree has flowered or blossomed, and becomes a deep purplish-crimson color. In size, color, and shape, it resembles the cranberry. It is then ready for picking.

Coffee is prepared for the market by the “dry” and the “wet” methods. In the former, the whole fruit is sun-dried or mechanically dried and cleaned by machine. The seeds or “beans” are often handpicked. In the latter method, the fruit flesh or pulp is removed from the ripe fruit by machine. The next mucilaginous layer is digested by “natural” fermentation for 16 to 60 hours depending on temperature or other conditions, or more quickly by the use of enzymes. The now dispersible mucilage is completely removed by washing. Sometimes it is removed mechanically by washing accompanied by scrubbing or attrition. Caustic soda has also been used but on a very limited scale. The coffee is now dried by sun or mechanical drier. During the drying, the seed shrinks within its “parchment” shell and becomes detached from it. The seed is next separated from the parchment by machine milling leaving the gray-green beans known as “green” coffee in which form it is shipped to the region of consumption and roasted shortly before sale or use.

A substantial portion of the roasted coffee is ground and extracted by boiling water. The resulting concentrated “brewed” extract is evaporated to dryness by drum or spray and the resulting soluble powder is known as “instant” coffee. During the roasting process there is a weight shrinkage of approximately 16 per cent.

The principal chemical constituents of coffee are caffeine and caffeol. Caffeine supplies the stimulating quality. The caffeol supplies the flavor. The correct preparation of coffee requires that the beans be freshly roasted.
and ground for use in flavors and in beverages. Tap water, free from objectionable tastes and odors, is important for best results. Coffee should not be boiled because an undesirable flavor change takes place. Freshly brewed coffee always tastes best.

Acidy is a term used to describe a coffee in which this desirable characteristic occurs. An acidy flavor is sharp and pleasing to the taste as op-

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**FIG. 15. COFFEE PERCOLATOR**

(1) Perforated tray with welded air vent; (2) Delicate screen; (3) Perforated tray, top; (4) Cloth with cord for tight sealing top and bottom trays as well as screen between both trays; (5) Top tray—perforated. It is laid on the granulated coffee after having used the plunger 7 to tighten the coffee and to flatten the surface; (6) Cover; (7) Plunger; (8) Air vent; (9) Air vent; (10) Cover handle; (11) Outlet.

1, 2, 3, and 4, are put together and adjusted outside tank; the cloth is tightened above top and below bottom trays. They are then inserted into the tank.
posed to sour or sourish or fermented taste. Old crop coffees are never acidy.

**Growth and Cultivation**

**The principal producing countries are:**
- South America: Brazil, Colombia, Ecuador, and Venezuela.
- Central America: Mexico, El Salvador, Guatemala, Honduras, Nicaragua, and Costa Rica.
- West Indies: Cuba, Haiti, Dominican Republic, and Jamaica.
- Pacific: Hawaii.
- Far East: Indonesia.
- Several other countries grow coffee, but produce little or none in excess of their own needs.

Coffee is graded in the countries of origin by taste experts who prepare samples by strictly standardized roasting and brewing methods. Similarly, the buyers of coffee in the consuming countries blend coffees from many sources attempting to maintain a standard quality which the public associates with each particular brand. The same standardized taste test is used in this case also.

**Varieties**

Brazilian coffees are classified into four great groups, which bear the names of the ports through which they are exported, namely, Santos, Rio, Victoria, and Parana. Among the Brazilian coffees, Santos is the most popular due to its sweet, clear flavor. Rios have a pungent flavor and aroma which many consider undesirable. Paranas have good flavor and are similar to Santos. Mexican coffees are mellow, rich in body, and of fine acidity.

The Guatemalas: Cobans and Antiguas are aromatic and make fine blenders. Salvadors are similar in quality to those of Guatemala. Nicaragua's coffees are fine roasters and of good quality. The high altitude coffees of Costa Rica are acidy, rich in body, of fine flavor, and make superior blenders.

Washed Cuban, Santo Domingo, Haiti, and Jamaica coffees all bear a similarity, being grown in the same West Indies areas. Until a few years ago Medellins, due to their full body, were considered to be the outstanding Colombian coffee. Now Armenias are considered of a higher quality than Medellins on account of their fine acidity. Manizales rank a very close third for their rich flavor and aroma. Venezuelans enjoy a good
market. Washed Caracas are best in roast. Meridas are considered to be the best of the Maracaibos, having a delicate flavor.

Mocha coffees from Arabia have a unique, acid character and a heavy body which make them useful for blending with fancy mild washed types. High grade milk coffees, grown in Kenya, Tanganyika, and Belgian Congo, are also received with favor by consumers in Europe and America. The best Java coffees come from the Preanger, Cheribon, Buitenzorg, and Batavia districts. Sumatra coffees are also popular. Among the Ethiopian coffees the Longberry Harrar are clear acidy to sourish. Djimma, Sidamo, Lekampti coffees are neutral in taste. Kona coffee from Hawaii are of fine flavor and blend well with any high grade mild coffee.
Roasting

Most roasters blend the different types of coffee when green. During roasting the moisture is driven off by the heat, the beans swell up by the liberation of gases, and the aromatic oils are driven to the surface. When roasting coffee, the coffee bean should never reach a temperature greater than 390° to 415°F. The roasting is continued until a certain shade of brown is reached. The end point is determined by comparison with a standard sample. If the process is checked by spraying with water it is known as a wet roast; in the dry roast the dependence is altogether on forced air cooling. Cooling and stoning operations follow, in specially designed machines. Grinding machines crush or break the whole bean into a desired minimum size with a minimum of heat in order to retain their aroma for brewing later on.

Brewed coffee contains caffeine, amino acids, sugars, caramel, trigoneline, caffeic acid, chlorogenic acid, mineral matter, various organic materials, and traces of coffee oil.

Percolated Coffee Extract MF 60

Ingredients

200.00 lbs. coffee, drip grind.

Procedure

(a) Boil water and use one gallon of boiling water to rinse tank, then drain off water;
(b) Dip trays Nos. 1, 2, 3, 4, and 5 of coffee percolator, Fig. 15 (page 126), as well as plunger 7, in boiling water to sterilize;
(c) Put trays 1, 2, 3, and tightening cloth 4 into tank;
(d) Put into 100-lb. Hobart mixer:
   50 lbs. coffee, drip grind, and add:
   2.75 gal. boiling water slowly to the agitated coffee; use slowest agitation; repeat same procedure for balance of coffee; then scoop each batch into percolator;
(e) When all the coffee is in the percolator use plunger 7 to flatten and slightly tighten the surface layer of coffee. In the beginning use the plunger harder to make the surface firm all around; then use a lighter pressure to even the surface and to remove grooves;
(f) Put perforated tray 5 on top of coffee;
(g) Add slowly:
   36.25 gal. boiling water; water will slowly pass coffee. It takes about one hour to get the water into and through the coffee.
(h) Take off 12.5 gal. first extract. It will take about 3 to 5 minutes to do it; the first yield will show about 38° Brix;
(i) The flow of take off will continue, however, at lower Brix;
(j) Take off 5 gal. second extract of about 18° Brix and concentrate it by freezing overnight; chop iced coffee extract and centrifuge. Yield: about 24° Brix.
Again freeze this yield; chop the iced coffee extract and centrifuge.
Final yield: 1.5 gal. 38–42° Brix.

(k) Mix the concentrates of (h) and (j) to yield: 14 gallons of 38° Brix.

(l) Remaining coffee has no flavor value and is discarded.

**Concentrated Coffee Extract**  
**MF 61**

**Ingredients**
- 30.0 lbs. ground roast coffee
- 68.5 lbs. hot water of 180°F.
- 12.5 lbs. 95 per cent alcohol

**Procedure.**—Use a 50 gal. tank with spigot at middle of the bottom; Fig. 16 shows the coffee extractor, which can also be used for extraction of botanical ingredients and vanilla. Put specially made extractor tray-stand inside tank.

For extraction, use three trays with small holes at bottom. The trays are placed above each other with ample space left between walls;

(a) weigh out 3 10 lb.-lots of ground roast coffee and put 10 lbs. in each tray evenly, then load trays into tank;

(b) cover the coffee of the top tray with a perforated plate over which the menstruum is to be sprayed;

(c) weigh out 22.5 lbs. of water, and in separate container, weigh out 7.5 lbs. of alcohol 95 per cent; heat the water to 180°F.; then pour alcohol slowly into the water; mix, then pour the mixture over the upper tray; cover tank immediately; let stand for 1.3 minutes to drain;

(d) repeat procedure by weighing out 12.5 lbs. water and 2.5 lbs. alcohol 95 per cent in separate containers, then heat, mix, and extract; let stand for 15 minutes to drain;

(e) again weigh out 12.5 lbs. water and 2.5 lbs. alcohol 95 per cent in separate containers and repeat procedure (d); let stand for 15 minutes to drain;

(f) weigh out 7 lbs. water, heat to boiling point, and pour over upper tray; let stand for half an hour to drain;

(g) take out the first tray with extracted coffee from extractor; empty into press or centrifuge;

(h) weigh out 7 lbs. of water and heat to boiling point and pour it over second tray; cover tank immediately; let stand for 30 minutes to drain;

(i) take second tray with extracted coffee out of extractor and empty it into press or centrifuge;

(j) weigh out again 7 lbs. of water and heat to boiling point; pour it over remaining third tray; let stand for 30 minutes to drain; then take out tray with extracted coffee and empty it into press or centrifuge.

(k) Extract yield is approximately 34 lbs;

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1 For use in cordials and flavor compounds.
(l) press or centrifuge extracted coffee and mix with the 34 lbs. extract yield of (k);

(m) finished yield is: 38 lbs. coffee extract.

(n) The pressed remains are mixed with: 8 lbs. water; the mixture is distilled at atmospheric pressure to yield: 2 lbs. coffee flavor distillate.

(o) Mixture of

- 38 lbs. coffee extract of (m) and
- 2 lbs. coffee flavor distillate of (n)

Yield

40 lbs. concentrated true coffee extract.
CHAPTER 10

Natural Flavorings From Vanilla Beans

MEXICAN VANILLA

Columbus discovered America on October 12, 1492. Some historians believe that Columbus was not only unaware of the importance of his first voyage, but that he actually did not know where he was going, where he was when he got there, and where he had been when he got back to home port. It is for this reason that the colonization which followed his first voyage takes on such great importance, not only in setting the stage in our country for establishing the original thirteen colonies, but in the history of vanilla which follows.

After the Spanish standard had been firmly rooted in Cuba, another area that provided appeal for exploration was Mexico. After being offered large grants of land and slaves, one of the first to make such a voyage was Hernando Cortez. Landing on the southeastern coast of Mexico, and hearing stories of the fabulous wealth of Montezuma, the Aztec ruler, his army moved inland. In his Conquest of Mexico, Prescott pictures in great detail this hazardous and bloody march from the coast into the heart of the country. Months later, the sun lit up the rooftops of a stately and magnificent city. It was Tenochtitlan, the capital of Montezuma’s empire, today known as Mexico City. Cortez and his army were greeted with pomp and graciousness. The Spaniards were dazzled by the wealth around them. One of Cortez’ officers noticed that the Emperor drank with great relish the liquid from one certain cup.

“What is that which your leader imbibes with such delight?” the officer asked the courtier.

“It is ‘Xoco-latl,’” he was told.

The Spaniards, astonished at the excellence of the flavor, soon discovered that the beverage was made from the pulverized bean of the cacao tree, from whose fruit chocolate is made, and the bean of tlilxochitl, or black flower. It was the Spaniards who named the bean vainilla, meaning “little pod,” or “little scabbard.” Instead of the spices of the East, Cortez returned from his explorations with products of a different character; bags of cocoa and vanilla beans.

The first written description of vanilla was made by the Franciscan friar, Bernardino de Sahugen, who landed in Mexico ten years after Cortez’ conquest. Francisco Hernandez, the foremost Spanish naturalist of his day, was the first authority on vanilla. He was sent on a mission to Mexico in 1571 by Philip the Second of Spain, and in his history, he men-
tions vanilla under both its botanical name *Aracn aromatieus*, and its vernacular name “*tlilxochitl*.”

True, the generic name vanilla, relating to a class of related products, was first used by Plumier in 1703, but botanically speaking, the genus vanilla was not accepted until 1739, when Swartz distinguished two kinds, *Vanilla aromatieus* and *Vanilla claviculata*. *Vanilla planifolia*, the present vanilla of commerce, was named by Charles Morren of Liege, Belgium in 1836 and later confirmed by other botanists such as Andrews, Sallisbury, etc.

It was Hugh Morgan, apothecary to Queen Elizabeth of England, who first suggested that vanilla should be used as a flavoring in its own right, rather than in combination with the cocoa bean. Vanilla has vindicated Morgan’s faith by becoming undisputably the world’s most prized flavor.

**The Secret of Vanilla**

It took more than three centuries after the discovery of vanilla, and its introduction to commerce, to learn how to grow it outside Mexico. It was as though the spirit of Montezuma had rendered it infertile in the hands of white men.

The Totonaco Indians of Mexico, the forerunners of the present owners of vanilla plantations, watched strangers take cuttings of their vanilla, and joked about their efforts to grow it elsewhere. It was planted in Java and India under the same conditions as grown in Mexico, yet it would not yield beans.

Vanilla is the fruit of an orchid. It took that most exquisite and delicate of all flowers to produce vanilla flavor.

Those who observed the cultivation procedure of the Mexican Indians, recorded that vanilla requires a warm and moist climate, averaging from 75° to 85°F. the year around.

It also requires a clay soil rich in humus, with a mixture of shade and sunshine, shade predominating. The land must be gently sloping—not too flat nor too steep. With this information, attempts were made all over the world to naturalize it in countries with similar climatic conditions, yet these were not the only essentials of its fertility.

It was not until 1836 that botanist Morren discovered the secret of vanilla’s reluctance to bear fruit outside of Mexico. The reason is that the anatomy of the flowers is such that self-pollination is impossible. Noting the short blooming period of the vanilla orchid, Morren discovered that a tiny bee of the *Melipone* variety, seemed to inhabit the producing region of Mexico. By studying the flower from the standpoint of pollination, he noticed the difficulties that any other insect would have in achieving fertilization. Proposing artificial pollination for the blossoms, he be-
came the first to produce vanilla pods outside Mexico. He thus laid the foundations for a new French industry which has paid many, many times more than the plunder derived by Cortez’ conquest of Mexico, and broke Mexico’s monopoly of the lucrative vanilla trade.

Five years after this discovery, a former slave, Edmond Albins, who was employed on a vanilla plantation on the Island of Reunion in the Indian Ocean, discovered a practical method of manual pollination which is used to this day. It is now accomplished by hand, the left hand holds the flower, the right a short wooden needle. If fruit is to be formed, it must be carried out the moment the flower unfolds and is undertaken daily and repeated yearly before the harvest.

Using this process the French soon started vanilla cultivation on many of their islands in the Indian Ocean, East and West Indies, and French Oceania. The most important producing area is the northern part of the east coast of Madagascar. French vanilla beans are known as “Bourbon” vanilla, since cultivation first started in the Island of Réunion, east of Madagascar, known at that time as the Island of Bourbon. With Nosy-Bé near the northwestern tip of Madagascar and the nearby Comoro Islands, they are the three important French island territories producing vanilla. The French contribute about three-fourths of the world’s vanilla beans. Following Morren’s discovery, and in view of the increased demand, Mexico instead of depending upon the bee as formerly, adopted manual pollination as being more efficient than nature.

The Mexicans plant vanilla by attacking a forest with their machetes, and skillfully cut away all but the upright young saplings of trees with good foliage. These are called the support-trees. A shallow trench is next scooped around each sapling, and one or two cuttings, or slips of the vanilla vine are planted loosely, usually in January, and tied to the tree. In a short time the cuttings send forth roots which creep along the surface of the ground beneath a mulch of decayed leaves and vegetation. The upper part of the cutting soon twines around the supporting tree and grows in a zig-zag fashion, thus forming a garland.

The plant will flower the second year of its growth. To strengthen the vines, pollination is often delayed by the planters. Clusters of 20 or more buds will arise on short stalks in the angle between the leaf and the stem. It may take as long as six weeks for the bud to develop into a flower. The satiny, lime-yellow orchid will achieve full glory one morning, and by early afternoon it is gone. Any woman who is fortunate enough to have been presented with an orchid, knows that as beautiful as it is, the flower has no aroma. The aroma and flower seem to have been saved by nature for the vanilla bean, from which the most universally liked flavoring extract is made.
Curing of Vanilla

The vanilla bean as shipped to the United States resembles a good-sized string bean. The matured pod as it is picked in the forest is about the thickness of a man's middle finger. It is obvious that somewhere in between the bean has lost both size and weight.

In addition, neither the orchid blossom nor the green pod have much vanilla flavor. Yet, pure vanilla has a flavor for which it is justly famous. In between picking and shipping is an exacting process known as "curing." It is during the curing process that pure vanilla comes into its own as a flavor that has no peer, for the flavor is the result of naturally-induced enzymatic action.

During the harvest season, workers move among the vines every day. The beans do not all mature at the same time, and they must be picked at the moment when they have gathered all the elements of their flavor.

The Mexican, or sun process, is the oldest curing method in use. In Mexico, few planters of vanilla beans do their own curing, since this is a highly developed specialty. After being gathered, they are usually loaded on mule trains, and transported to trading centers of which Papantla, in Vera Cruz, is the oldest, but no longer the largest. These are nervous days for the planter, for his investment in time and labor is reaching its culmination. When he reaches Papantla, or any of the other curing centers, he visits the curers, rarely selling all his crop to one firm; usually "shopping around" to see if he can get better prices.

The buyers, in turn, must be highly skilled to select healthy, ripe beans, for each bean they are buying will lose about 80 per cent of its weight in the curing process. They must know market conditions, and judge unerringly the quality of the bean being offered. As soon as the beans are purchased, the curing process gets underway.

There are two principal curing processes; the older one as developed in Mexico, and the simpler one as developed in Madagascar.

The Mexican process usually takes place in a series of buildings which enclose a huge patio. The beans are stored in sheds for a few days, until they start to shrivel.

Next, the beans are gathered rapidly and placed in large mahogany sweating boxes. A number of mats are placed over and around the sweating box, so that proper temperatures can be maintained for the important flavor developing enzymatic reactions which are accompanied by slight fermentation. This important work lasts for at least 24 hours, and the whole process may be repeated as much as 6 or 8 times during the early part of the curing which will extend over a period of 2 or 3 weeks, in which time the green beans acquire a dark chocolate brown color.
Later on, the beans are given less frequent sunnings and sweatings to help reduce moisture to the proper levels. In between times they are held in large wooden trays for further flavor development and dehydration.

When hundreds of thousands, yes, millions of beans are spread out in the patios, workers constantly circulate among the endless rows, watching them, turning one over here, feeling one there, watching the sky at all times for signs of rain. When rain threatens, the entire labor force moves swiftly to the patio, and all the beans are whisked inside and placed on racks.

The final stages of the curing takes place when the beans are sufficiently advanced to be placed in aging boxes for a period of 2 to 3 months, always receiving the usual careful inspection.

Finally, the beans are carefully bundled according to quality and packed in the special tins lined with waxed paper in which they arrive in the market. Approximately eight months have elapsed since the beans were gathered. Millions of hours of careful, tedious, laborious work have been expended upon them by thousands of workers who earn a mere fraction of what similar work would command in this country.

The skilled workers seem to have pure vanilla in their blood, for they know exactly when the beans are ready for the next step. One error and a year's work can be ruined. The beans must be done to a turn; neither exposed to the sun too long, nor for too short a period.

The shorter Madagascar curing starts by wilting the green pods in hot water. For the next ten days or so, they are spread out on blankets, usually on tables, and when quite hot, are rolled up in the blankets to stand overnight. The warmth provides good conditions for the important enzyme reactions accompanied by slight fermentation. The beans are next spread on large trays, and racked up usually to the ceiling of the curing warehouses where they are allowed to cure and dehydrate naturally.

Finally, these beans are sorted for quality and made up into bundles, usually somewhat smaller than those of Mexico. They are packed in smaller tins, with classifications similar to those of Mexico.

Extracting Vanilla and Imitation Vanilla Flavor

In some countries, notably France and Germany, the beans themselves are frequently demanded by the consumer. In America, where convenience is on a par with quality, homemakers prefer the extract.

Few foods or food flavors have the romantic background or exacting quality standards of vanilla.
The production of pure vanilla extract would not have survived if it did not have something which the synthetic product could not imitate. That “something” is quality of flavor.

The chemical composition of vanilla is still not thoroughly understood. Vanillin is one of the components of flavor. It is found in small amounts in the fully ripe beans. The over-all flavor is enhanced completely during the curing process. Yet of all the natural flavorful constituents of the cured vanilla bean only vanillin is imitated. In imitation vanilla flavor the contributions made to flavor by the other natural constituents of vanilla are missing.

Gnadinger states: “It is well known that a solution of vanillin cannot compare in flavor or odor with vanilla extract. This is because vanillin is only one of the important flavoring constituents of vanilla.”

“Imitation vanilla extracts are widely used by the manufacturers of foods such as ice cream, bakery goods, and candy. They are also used in the household. The strength of these flavors is greater than that of pure vanilla extract. However, the quality of the flavor is decidedly inferior to pure vanilla, and the difference in flavor between imitation and pure vanilla is easy to detect.”

The pure vanilla has a delicate, yet rich and mellow aroma. The imitation has a heavy, grassy odor. In flavor, the pure vanilla extract has a delicate, mellow after-taste. The imitation has a less pleasant after-taste. This can be detected in ice cream, baked goods, and other commercial products by the discriminating consumer.

Sellers of commercial vanilla extract sometimes use a simple test to demonstrate the flavor superiority of pure vanilla. They pour pure vanilla on one lump of sugar, and imitation on another. They first suck the pure sample, and follow by sucking the imitation. The flavor difference is immediately noticed.

MADAGASCAR VANILLA

The vanilla plant was introduced about 1820 in Reunion Island (“Bourbon”), and in Madagascar about 1841. It arrived first at the small island of Sainte-Marie off the east coast of Madagascar, then on Madagascar itself, especially around Antalaha, which remains the capital of vanilla preparation and export.

The vanilla (Stefen Aretander) growing area in Madagascar is only to be found between the 12th and the 24th parallels. The plant requires both heat and humidity, and does not adapt itself to an altitude of above 1500 feet, where it refuses to flower. This means that the plant is confined to a narrow strip on the east coast of Madagascar from Mangoro River estuary at 22° south latitude to Vohemar at 13° south, and to a lesser extent along the northwest coast facing Nossi-Bé, on the Island of Nossi-
Bé itself, and in the Comoro Islands. Very small quantities grow on the African Continent along the coast of Tanganyika.

As the vanilla plant is a creeper, it has to be provided with props. Dead props decay very rapidly in this climate. It is therefore preferable to use small, solid props with a light foliage. In Réunion Island Croton plants or Filao’s (*Casuarina equisetifolia*) are among the most common props in use, while in Madagascar there are noted several others beside Filao’s: *Glyricidia maculata, Jatropha curcas* (the so-called “pignon d’Inde”), *Dracena*, and some species whose French names are muriel, bois de chandelle, bois noir (“Albizia”), etc.

The vanilla plant is propagated by cuttings, which are set out in beds, generally situated on a hillside, so that the creeper can be exposed to the sun as much as possible. These beds are cultivated and manured. The state research stations at Ivoloina (eight miles north of Tamatave) and the very active one 15 miles west of Antalaha are very busy finding out new methods of manuring, and likewise the larger growers carry out experiments on this problem. In the Comores, not very important as producers, they use exhausted lemongrass from the distillations as manure for vanilla.

The vanilla plants can be grown as densely as 3000 to 5000 plants per hectare. While the plants are growing, the soil requires little attention, but a couple of months before the flower buds appear, the creepers are topped to increase the inflorescence or blossoming. About 100 flowers will produce one kilogram of green vanilla pods, ready for harvesting, and to produce one kilogram of a normal “premiere” quality of the finished spice, requires 3.2 to 3.5 kg. of green pods.

**Producing the Vanilla Flavor**

In Madagascar and Réunion the method of helping nature produce the well known and highly estimated vanilla flavor, is the “échaudage,” which means placing the pods (in baskets) into hot water, in most cases about 158°F. either for 15 to 20 seconds, or for a few seconds repeated several times at short intervals. Before this dipping, sorting has taken place, called the first “triage” according to the general aspect of the pods.

Then, still wet and hot, the pods are placed in cases which are closed and covered overnight. Enzymatic splitting of the glycoside can now take place, and the poisonous glycoside is quantitatively converted into aromatic compounds, among which vanillin is the best known, and into harmless monosaccharides.

The third step in the preparation is the “étuve,” sweating the pods after exposure to the sun. This stage takes quite a lot of time as it is repeated several times, both outside in the daytime and indoors at night.
At certain hours, preferably between 11 a.m. and 2 p.m., the pods are exposed to the sun on large areas of bamboo trays in the open (in Réunion on platforms of beach roller-stones). In the early afternoon the pods are wrapped in covers and placed into boxes. This stage, taking place on the 2nd, 3rd, 4th, and 5th days is called the “soleilage” and is followed by another “triaige,” sorting and treatment on trays for drying in the sun. Here, the “classement,” or classification takes place. The pods are sorted into 4 classes: grosses (large, or rather thick pods); demi grosses; avancées (advanced stage of drying); demi séches (half-dry pods). They are classified as 1st, 2nd, 3rd, 4th and 1st split, 2nd split, 3rd split, 4th split, the latter being split at the lower end.

The next stage of the preparation is the “mesurage,” the length measuring of the pods, which have now become their much appreciated chocolate-brown, dark color, and are emitting their delicious aroma, perceptible at a great distance from a house of vanilla preparation. According to length of pods, they are sorted by hand as 22-21-20-19-18\frac{1}{2}-18-17\frac{1}{2}-17-centimeter pods and so on.

Before being exported, the pods have to be wrapped. The wrappers are tied in the middle only in Madagascar, while in Mexico, second largest supplier to the United States, they are tied at both ends and in the middle. In Tahiti, second largest world producer, which grows a different variety of vanilla, the wrappers are tied at both ends. Guadeloupe, a tiny French island in the West Indies, produces vanilla but the pods are shorter, much wider and weigh from 2 to 4 times as much as the Bourbon type vanilla pods. The Guadeloupe vanilla is dispatched loose.

The wrapped vanilla is placed in tin boxes, lined with several sheets of wax paper in order to produce a constant relative humidity in the box during the transport. These boxes contain \(7-7\frac{1}{2}-8\) kg. of prepared vanilla and are dispatched in strong wooden export cases, packed six tin boxes to the case.

The quality of the vanilla depends largely on how well all these different operations are carried out. Some planters or preparators, long established in Madagascar, jealously keep the secrets of their processes, which have been handed to them by their fathers.

Three to four parts of green vanilla pods are required to make one pound of chocolate-brown, prepared vanilla. To dry out the pods effectively in this extremely damp region, infrared rays are used for the final drying.

Vanilla pods are cut into half-inch or third-inch bits, then dried quickly under infrared light (tubular lamps); the infrared-dried pieces exhibit nice crystals of vanillin. Partly because of the improved keeping quali-
ties, these extra dry cuts can be sold at almost the same price as whole pods containing from 30 to 70 per cent of water.

There are the following "grades" of vanilla pods:

"Première" or first quality: whole unsplit pods, flexible, full, sound, with a good aroma, a uniform chocolate-brown color and small spots.

"Deuxièmes fendues": second split quality; same quality, but split.

Third quality: whole, unsplit pods, flexible and dried, chocolate-brown or reddish, sound, good aroma, spots accepted.

"Troisièmes fendues": third split; same quality, but split.

"Quatrièmes" or fourth quality: short pods, flexible or dried, and pods with the ends broken or cut, sound, with good aroma.

"En vrac" or fifth, or loose quality: thoroughly dried pods, woody, ends cut or broken, normal aroma. Marks are accepted for all qualities.

VANILLA EXTRACT AND VANILLA FLAVORS

Vanilla Sources

Vanilla beans are cultivated and cured in Mexico, around the Papantla and Misantle valleys; in Guadeloupe, Dominica, the island of Java, in Madagascar, the Comoro Islands, Reunion, Seychelles, and Mauritius. Tahiti produces an entirely different type of vanilla whose flavor is characterized by its contents of heliotropine.

Differences in quality are due to weather, soil, and altitude at which they are grown, also the extent of pollination and especially the degree of ripeness at the time of gathering, affect quality very materially.

Vanilla beans are packed in tin containers and should have on their label data as to origin, grade, size, date of cure, and moisture content. Though information on the label may serve as a guide, it is still advisable to inspect and select the beans in the storage of the vanilla dealer. The selection is determined by the quality of flavor of beans in the pack.

Composition of Vanilla Flavor

Cured vanilla beans contain vanillin, secondary aromatic compounds, small amounts of heliotropin (only in Tahiti), volatile oil, resins, organic acids, fixed oil, sugar, gum, tannin, wax, cellulose, and water. Their value is not determined by the vanillin content, but more by their fragrance.

The important secondary aromatic compounds that are really responsible for vanilla flavor are due to a complex of aromatic aldehydes, alcohols, and esters whose large number are different in the different varieties of beans and in the different lots of the same bean. Together they form the balsamic fragrance typical of vanilla flavor. The volatile oil is also part of the balsam.
Resins are present in different types and in varying amounts in vanilla beans. When isolated, some of them have a pleasant taste but no odor. Resins constitute, largely, the lead-precipitating material of the beans. They are soluble in alcohol and in alkalis, and entirely insoluble in water. An extract containing large amounts of resins will retain aromatic compounds far longer than one that has smaller quantities of them.

The various acids present in vanilla beans become valuable when chemical changes convert them to esters during the aging process.

Classification of Mexican Beans

There are various grades of Mexican beans: prime, good to prime, good, fair, and ordinary. The same grades apply to Mexican cut beans.

The prime are the choicest beans, free of scabs, warts, and other blemishes. They are chocolate brown to black in color. Their aroma is clean and delicate. Crystallization rarely exists. The beans are 6\(\frac{1}{2}\) to 9\(\frac{1}{2}\) inches long.

The good (Buena) are dark brown, broad, and inclined to hardness or rather toughness. They give better yields of flavorful substances because of their lower moisture content.

Mexican Cut Beans

The prime cuts include shorts and longs. They are usually considered as good as whole beans. The flavor is good. The beans are often crystallized.

The ordinary cuts are dry, broken beans of poorer or undeveloped flavor from the early gatherings.

The Mexican process of curing consists of repeated sweating and drying obtained by the heat of the tropical sun. Mexican cured beans are normally better classified for quality than other varieties.

Classification of Bourbon Beans

Bourbon vanilla beans are classified mainly as prime, firsts, seconds, thirds, fourths, and foxy splits.

Grades prime, extra, or good firsts are perfect beans, fully matured, smooth, broad, and very oily. They have a sweet and delicate aroma, rich chocolate color and are usually well crystallized. Their moisture content is about 37.2 per cent.

Firsts are a degree lower in appearance.

Seconds are sweet flavored, somewhat inclined to hardness. They are close in quality to firsts but not so fine. Their moisture content is about 25.5 per cent.
Thirds are dark brown beans streaked with light, with a pungent odor and good flavor; they are sound, hard cured, but contain scabs and warts. Their moisture content is about 13.7 per cent.

Fourths are smaller in size than thirds, lighter in color; high in resin, and low in vanillin. Their moisture content is usually about 16 per cent.

Foxy splits are reddish brown color, thin, hard cured and woody, shriveled, short lengths, and dry. They are high in vanillin, low in resin.

The Bourbon process involves curing the beans by dipping into hot water and then drying. It yields a somewhat stronger and harsher flavor than that obtained by the Mexican process.
Blending of Vanilla Beans

In the production of vanilla flavor, blends of various grades of vanilla beans are extracted to meet the requirements of the ice cream, confectionery, bakery, and other food industries. Most preferred combinations are:

(a) 50 per cent Madagascar Bourbon vanilla beans—firsts
    30 per cent Madagascar Bourbon vanilla beans—thirds
    20 per cent Madagascar Bourbon vanilla beans—foxy splits

(b) 50 per cent Madagascar Bourbon vanilla beans—firsts
    15 per cent Mexican cuts, medium dry, sweet, not woody
    10 per cent Mexican vanilla beans—firsts
    25 per cent Madagascar vanilla beans—foxy splits

(c) 50 per cent Madagascar Bourbon vanilla beans—firsts
    25 per cent Mexican vanilla beans
    25 per cent Java vanilla beans

(d) 80 per cent Madagascar Bourbon vanilla beans—seconds
    20 per cent Madagascar Bourbon vanilla beans—foxy splits

(e) 15 per cent Mexican cuts, medium dry, sweet, not woody
    35 per cent Madagascar Bourbon vanilla beans—thirds
    50 per cent Madagascar Bourbon vanilla beans—fourths

(f) 25 per cent Madagascar Bourbon vanilla beans—thirds
    75 per cent Madagascar Bourbon vanilla beans—fourths

(g) 50 per cent Madagascar Bourbon vanilla beans—thirds
    50 per cent Madagascar Bourbon vanilla beans—foxy splits

For strong vanilla flavor the following blend is used:

(h) 75 per cent Madagascar Bourbon vanilla beans—thirds
    25 per cent Madagascar Bourbon vanilla beans—fourths

The preferred Mexican blends are:

(i) 60 per cent Mexican vanilla beans—firsts
    40 per cent Mexican vanilla beans cuts, medium dry, sweet, not woody

(j) 48 per cent Mexican vanilla beans—firsts
    32 per cent Mexican vanilla beans—cuts
    20 per cent Madagascar Bourbon vanilla beans—firsts or seconds

Vanilla Extraction

Vanilla flavor is extracted from the beans with alcohol. Distillation destroys the fragrance of the aromatic compounds. The color of vanilla extract is influenced by the quality of the beans, the strength of the alcoholic menstruum, the duration of the extraction, and the presence of glycerin, which is added to retard evaporation and to retain the flavor in the extract. Dry beans give a darker color than moist beans. Glycerin deepens the color of the extract. The amount of extractable color decreases as the strength of the alcohol is decreased.

Best results are obtained with three consecutive extractions at room temperature. Each should take a minimum of five days. The first menstruum should have a maximum alcohol content of 65 per cent. The
alcohol content of the menstruum should take into consideration the moisture content of the beans. The menstruum for the second extraction should be of 35 per cent alcohol content and that for the third extraction of 15 per cent alcohol content. Take-off of all the flavoring extracts should be in a continuous slow flow. After extraction, the remaining material should be washed with water and then pressed or centrifuged. The wash is used to dilute the vanilla extract, after aging, to commercial two-fold and single-fold flavor strengths.

Aging

The purpose of aging is to bring out improved aromas. Vanilla extract should not be stored in new wooden barrels. The vanilla absorbs from the wood tannin and other substances which have undesirable tastes. They should be removed by frequent washing. Vanilla extract should not be stored in containers made of aluminum, lead, nickel, zinc, or copper. Storage of vanilla in stainless steel or glass containers is commonly practiced.

An alcohol content of 42 to 45 per cent accelerates the chemical changes and formation of esters from acids while aging. During this period, the total ester content of vanilla extract, as ethyl acetate, remains fairly constant. However, the nature of the esters changes considerably. The esters of higher alcohols liberate the higher alcohols upon hydrolysis, and the acids formed reunite with lower alcohols, forming volatile esters. The higher alcohols slowly oxidize to give aldehydes. This reaction takes place during storage and is often called “alcoholysis of the esters.”

There is a direct dependency between the time of aging and the tempo of oxidation. The slower the oxidation the better are the forthcoming changes in the esters which produce the quality of aroma and taste in vanilla.

Present Analytical Standards for Vanilla Extract

True vanilla extract should contain a minimum of 13.35 oz. av. of vanilla beans per gallon, with no other ingredients except alcohol (35 per cent) and/or glycerin, sugar, and water (see p. 151).

The quality of vanilla extract cannot be determined by chemical analysis alone. Analysis determines the amount of vanillin present, the lead number, the ash content, and other values. It is used as a means of learning whether the extract has been adulterated. However, tests for analysis do not indicate the quality of the beans used. Winton’s analytical values are often used as a standard for detecting adulteration. These values are
presented in Table 5. There is a relation between ash and lead number. Over 80 per cent of the total ash is soluble in water.

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vanillin, grams per 100 ml. extract</td>
<td>0.11</td>
<td>0.35</td>
<td>0.19</td>
</tr>
<tr>
<td>Ash, grams, per 100 ml. extract</td>
<td>0.22</td>
<td>0.432</td>
<td>0.319</td>
</tr>
<tr>
<td>Soluble ash, grams per 100 ml. extract</td>
<td>0.179</td>
<td>0.357</td>
<td>0.265</td>
</tr>
<tr>
<td>Lead number (Winton)</td>
<td>0.40</td>
<td>0.74</td>
<td>0.54</td>
</tr>
<tr>
<td>Alkalinity of total ash, N/10 acid per 100 ml. extract</td>
<td>30.00</td>
<td>54.00</td>
<td></td>
</tr>
<tr>
<td>Alkalinity of soluble ash, N/10 acid per 100 ml. extract</td>
<td>22.0</td>
<td>40.0</td>
<td>32.0</td>
</tr>
<tr>
<td>Total acidity, N/10 alkali per 100 ml. extract</td>
<td>30.0</td>
<td>52.0</td>
<td>42.0</td>
</tr>
<tr>
<td>Acidity other than vanillin, N/10 alkali per 100 ml. extract</td>
<td>14.0</td>
<td>42.0</td>
<td>30.0</td>
</tr>
</tbody>
</table>

The ash values are useful because the ingredients of imitation vanilla, namely, vanillin, coumarin and substitute sugar, glycerin, and other solvents are practically free from ash. On the other hand, the use of an alkali in the manufacture of vanilla extracts will increase the amount of ash but would also change the values for solubility and alkalinity.

The acidity is due chiefly to organic acids which are dissolved from the beans, and to a lesser degree to natural vanillin; this acidity is a characteristic of a genuine vanilla extract. Low total acidity or acidity other than vanillin are indicative of adulteration.

Practically the same values are obtained with or without sugar or glycerin in the menstruum. Lower alcohol content in the menstruum increases the ash values and diminishes the acidity.

The use of vanillons and Tahiti beans can be detected by testing for anisyl alcohol, anisyl aldehyde, and anisic acid, which are not contained in the Mexicans, Bourbons, South Americans, and Javas.

Definitions and additional information concerning the composition of vanilla extract, vanilla flavor, and a number of other extracts and essential oils are presented in Part 2 of the Appendix.

The Food and Drug Administration of the United States demands a certain standard for all products sold under the name “vanilla extract.” So far no satisfactory method of analysis has been worked out to protect this standard from being neglected, and statistics show that the amount of vanilla extract sold in the United States largely surpasses ten times the total import of vanilla pods into the States. A combination of chromatographic and infra-spectrophotometric analysis seems promising.

Recently workers at the Boyce Thompson Institute for Plant Research
have worked out methods for characterization of vanilla and other plant extracts by paper chromatography (Burchfield and Prill 1960). These methods are presented in detail in Part 3 of the Appendix.

**Powdered Vanilla**

Powdered vanilla is made either by mixing ground beans with sugar or by extracting the flavoring from the beans and then mixing with sugar.

**OLEORESIN OF VANILLA AND TEN-FOLD VANILLA FLAVOR**

Oleoresin of vanilla is derived by evaporation, under vacuum, of the menstruum from an extract of comminuted vanilla beans. A Fitzpatrick Comminuting Machine, Fig. 1, is often used for the comminution of the beans.

The remaining concentrate in the still is a residue consisting mainly of the resinous substances of the vanilla beans in which very little of the balsamic flavor of the original flavoring extract is left.

Oleoresin of vanilla which is diluted with solvents and reduced to single-, two-, or ten-fold strength is in reality a compound and usually requires the addition of vanillin to yield a vanilla flavor. The dilution of oleoresin is not a flavoring extract since it does not contain all the aromatic substances of an extracted flavor.

The normal yield of oleoresin of vanilla is one pound oleoresin from two pounds of vanilla beans. One gallon of ten-fold vanilla flavor is obtained by dilution with solvents of oleoresin of vanilla which is derived from 133.5 ounces by weight of vanilla beans. No more than a four-fold concentration of vanilla flavor is possible by extractive methods. Distillation in any form destroys the fragrance of the aromatic substances of vanilla flavor.

**Oleo Resin of Vanilla (Bourbon) MF 62**

(a) Mix

200 lbs. Bourbon vanilla beans (3rd grades). While comminuting the beans, add part of menstruum consisting of:

- 100 gal. isopropyl alcohol, 99 per cent
- 100 gal. water.

The total of 200 gal. menstruum is used to pass by the rotating blades of the comminuting machine (Fig. 1) for cooling and instantaneous extraction of the comminuted vanilla beans.

(b) The cut beans are then put into the baskets of the extractor. During extraction, continuous heat of not higher than 115°F. is applied for two days. On the third day the extraction continues without heat. On the fourth day the extract is then taken off.
The remaining beans are extracted with another menstruum consisting of:
- 40 gal. isopropyl alcohol, 99 per cent
- 10 gal. water; during the extraction continuous heat of not higher than 115°F. is applied for two days. On the third day the extraction continues without heat. On the fourth day the extract is taken off.

The beans are then extracted with:
- 100 gal. water for one day; on the second day the extract is taken off and the beans are pressed;
- the extracts of (b) and (c) and (d) are mixed and concentrated by vacuum distillation to remove all the isopropyl alcohol and to obtain:
  - 100 lbs. concentrated residue in the still, which is the oleoresin of vanilla.

Property.—One pound of oleoresin of vanilla is made from two pounds of vanilla beans.

Vanilla Extract

Put in vanilla extractor (Fig. 17)

Ingredients:

- 90.00 lbs. Madagascar Bourbon vanilla—seconds
- 90.00 lbs. Madagascar Bourbon vanilla—thirds

Total
- 180.00 lbs. vanilla beans
- 60.50 gal. alcohol, 95 per cent
- 6.00 gal. glycerin
- 55.50 gal. water

First extraction of:
- 180.00 lbs. comminuted vanilla beans, and menstruum consisting of:
  - 11.00 gal. water
  - 3.00 gal. glycerin
  - 36.00 gal. alcohol, 95 per cent

Total
- 50.00 gal. menstruum of 68.4 per cent alcohol content.

Take off yield after 8 days:
- 33.00 gal. flavoring extract;
  analysis: Winton lead No. 1.31
  vanillin 0.70 gm./100 ml.
  alcohol 55.44 per cent

Second extraction—menstruum consisting of:
- 34.50 gal. water
- 3.00 gal. glycerin
- 22.50 gal. alcohol, 95 per cent

Total
- 60.00 gal. menstruum of 35.5 per cent alcohol content.

\(^1\) As described in "Vanilla Extraction" (p. 143).
Take off yield after 8 days:
55 gal. flavoring extract.

(c) Third extraction—menstruum consisting of:
10.00 gal. water
2.00 gal. alcohol, 95 per cent

Total
12.00 gal. menstruum of approx. 15 per cent alcohol content.

Take off yield after 5 days:
12 gal. flavoring extract.

(d) Fourth extraction was made with 20 gal. water for 5 days; the take off yield of 20 gal. extract was used in the next production batch.

(e) Finished mixture consisted of:
33.00 gal. vanilla flavoring extract of (a)
55.00 gal. vanilla flavoring extract of (b)
12.00 gal. vanilla flavoring extract of (c)

Total
100.00 gal. vanilla flavoring extract

analysis: Winton lead No. 1.12
vanillin 0.57 gm./100 ml.
alcohol 42.2 per cent

Two-Fold Vanilla Extract

Put in vanilla extractor (Fig. 17)

Ingredients
25,000 lbs. vanilla beans—seconds
100,000 lbs. vanilla beans—good thirds
41,875 lbs. vanilla beans—foxy splits

Total
166,875 lbs. vanilla beans, corresponding to 26.7 ozs. av. per one gallon two-fold vanilla extract.

Menstruum
285.6 lbs. or 42.0 gal. alcohol, 95 per cent (6.8 lbs. per gallon)
68.4 lbs. or 6.0 gal. glycerin (11.4 lbs. per gallon)
116.2 lbs. or 14.0 gal. water (8.3 lbs. per gallon)

Total
470.2 lbs. or 62.0 gal. menstruum of approx. 65 per cent alcohol content.

¹Made from Madagascar Bourbon vanilla beans.
²Glycerin: Glycerin is a solvent which is used in the manufacture of flavor compositions as well as in the preparation of foods and beverages; glycerin combines the solvent effects of both water and alcohol; it also has preservative action and is stable in storage. Glycerin is sweet and has a pleasant taste which is compatible with
Procedure

(1) Wash vanilla beans in menstruum to separate vanillin from the surface of the beans; then comminute the beans by cutting them with the blades of the comminuting machine (Fitzpatrick); let part of the menstruum flow with the beans during the cutting procedure to avoid heating of the beans by the rotating blades of the comminuting machine; during this procedure also, an instantaneous extraction of the vanilla beans by the flowing menstruum takes place.

(2) The cut beans are then transferred into the extractor, whose capacity is approximately 200 gal. which permits the placement of ten trays with perforated bottoms into it; the trays should fit in each other and leave air space on the sides, between themselves, as well as between them and the wall of the tank; each tray should have enough capacity to allow spreading of up to 18 pounds of cut vanilla beans evenly over the perforated bottom and still leave enough room above the beans for the menstruum to lay on and to pass slowly through the beans from tray to tray; the last tray should rest on a stand of about six inches height so that the extracting menstruum can continuously gather after each circulation through the beans; the contents of the top tray is to be covered by a perforated plate over which the menstruum is uniformly sprayed for even distribution and extraction of the beans. The menstruum is to be rotated twice daily for 8 to 10 days; then the extract is taken off in slow flow. It will take two more days to drain off the required yield of about:

40 gal. vanilla extract which is put aside for use in (6)

(3) 182.6 lbs. or 22 gal. warm water, 140°F. are poured into the extractor over the perforated top cover to pass through the extracted beans in the trays; the menstruum is to be circulated over the beans twice daily for three days; the temperature of the extracting water will drop immediately after the initial circulation to 113°F.; when the temperature of the circulating menstruum reaches 95°F. its alcohol content will be of approximately 30 per cent; on the fourth day the extract is slowly taken off; it will take another day to drain off enough extract to obtain a yield of:

20 gal. vanilla flavoring extract, which is put aside for use in (6).

(4) For the third extraction, another 166 lbs. or 20 gal. warm water of about 140°F. are poured into the extractor the procedure is repeated, as in (3); the alcohol content of this menstruum is

other flavors; its sweetness rate is from 55 to 75 per cent as compared to sucrose. The viscosity of glycerin lends smoothness and high viscosity to flavoring preparations. Glycerin has a high boiling point and is practically non-volatile, and thus retains flavor and secures stability and long shelf-life; the use of glycerin in the extraction of vanilla beans assists greatly in bringing resins in solution and thus in increasing the yield of flavoring and coloring matter.
about 15 per cent. On the fourth day 20 gal. flavoring extract is drained off; it is used in (6).

(5) The fourth and last extraction continues with 20 gal. cold water which is poured into the extractor at intervals of 30 minutes with 5 gal. at the time; the water is let to pass through the vanilla beans without circulation and 5 gal. of extract is taken off each time after a period of 30 minutes until a yield of 20 gal. extract is obtained.

(6) The finished mixture consists of:

| 40 gal. vanilla flavoring extract of (2) |
| 20 gal. vanilla flavoring extract of (3) |
| 20 gal. vanilla flavoring extract of (4) |
| 20 gal. vanilla flavoring extract of (5) |

Total 100 gal. vanilla flavoring extract of about 35 per cent alcohol content, which is to be analyzed for the components listed in Table 6.

(7) The exhausted vanilla beans are either expressed or centrifuged, or again extracted with water without circulation of the menstruum over the beans; the yield is to be analyzed for possible alcohol content; this extract is used in the next production batch.

Vanilla Extract—Single-Fold

Mix

- 0.5 gal. or 4.5 lbs. vanilla extract—two-fold—formula MF 64.
- 0.5 gal. or 1.25 lbs. 95 per cent alcohol
- Then add a mixture of
  - 2.65 lbs. water
  - 0.1 lb. glycerin

Total 1.0 gal. or 8.5 lbs. single-fold vanilla extract

Taste Test for Vanilla Extract Single-Fold and Two-Fold

(1) Mix

| 5.0 ml. syrup, 36 Baumé |
| 93.0 ml. milk |
| 2.0 ml. vanilla extract, single-fold |

Total 100.0 ml.

(2) Mix

| 5.0 ml. syrup, 36 Baumé |
| 94.0 ml. milk |
| 1.0 ml. vanilla extract, two-fold |

Total 100.0 ml.
Table 6

IMPORTANT CRITERIA CONCERNING QUALITY OF VANILLA EXTRACT

<table>
<thead>
<tr>
<th></th>
<th>gm. per 100 ml. extract</th>
<th>gm. per 100 ml. extract</th>
<th>gm. per 100 ml. extract</th>
<th>per cent of extract</th>
<th>ml. 0.1N acid per 100 ml. extract</th>
<th>ml. 0.1N alkali per 100 ml. extract</th>
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FLAVORING EXTRACTS

UNDER THE FEDERAL FOOD, DRUG, AND COSMETIC ACT

Applicable Provisions of the Act

The provisions of the act (Anon. 1959) that are most generally applicable to flavoring extracts and flavors will be found in sections 402 and 403 (a), (c), (d), (e), (f), (i), and (k). Among other provisions of the act, sections 201 (k) to (n) inclusive and 303 (c) and the corresponding regulations, if any, should be especially noted.

Two General Requirements.—Flavors should contain no ingredients that may render them injurious to health.

Flavor labels should not be false or misleading in any particular. The term "labeling" means all labels and other written, printed, or graphic matter (1) upon any article or any of its containers or wrappers, or (2) accompanying such article.

Distinction Between “Extract” and “Flavor”

The vehicle or menstruum of a flavoring extract is ethyl alcohol or proper strength. The terms “extract” and “flavor” are not synonymous. The term “extract” implies an alcoholic product. Flavoring products prepared with vehicles other than alcohol should be labeled with the term “flavor.” Articles labeled “lemon flavor,” “orange flavor,” etc., should contain the same kinds and proportions of flavoring ingredients as are contained in lemon (or orange, etc.) extract. The term “flavor” as used in this book will include both extracts and non-alcoholic flavors.

The Food and Drug Administration definitions for essential oils, flavors and flavoring extracts and regulations concerning the use of vehicles and menstrums other than ethyl alcohol are presented in Part 3 of the Appendix.
SECTION II

Synthetic Flavorings, Additives, and Colorings
Aromatic Chemicals—Food Flavor Additives

THE PURE FOOD AND DRUG LAW

The Federal Food, Drug, and Cosmetic Act of 1938

The Federal Food, Drug, and Cosmetic Act or the national pure food and drug law prohibits the movement in interstate commerce of adulterated or misbranded food. It broadly defines adulteration and misbranding and directs the Secretary of Health, Education, and Welfare to supplement some provisions of the law with more detailed and technical specifications by administrative regulations (Larrick 1959; Anon. 1959).

These supplementary regulations for foods include definitions and standards, selection and certification of safe and suitable coal tar colors, labeling requirements for special dietary foods, and tolerances for safe amounts of pesticidal residues that may remain on raw agricultural commodities and for safe amounts of additives in food.

The Food and Drug Administration is the agency named to enforce this law and the regulations implementing it for products other than meat and poultry.

Adulterated and misbranded products may be removed from the market by Federal court seizures. Persons and firms responsible for the violations may be prosecuted under criminal court proceedings, and potential violators may be restrained by the court from unlawful practices.

Originally the law provided that public hearings be held for interested parties to present their views on new standards or amendments to existing ones and that the final regulation be based entirely on the evidence recorded.

The law was amended in 1954 to require hearings only when genuine controversy arises concerning specific proposals. All interested parties have the opportunity, as before, to comment on the proposed regulations, which are published in the Federal Register.

The law as written in 1938 protected the public against food additives that could be clearly proved to be injurious. It did not, however, require that chemicals be adequately tested and shown to be safe before they are marketed, except for coal tar colors (Larrick 1959).

Lists have been established of coal tar colors that may be used in foods, drugs, and cosmetics. Each batch of color must be tested in the Washington laboratories of the Food and Drug Administration to determine that it is of satisfactory quality and purity. Several colors were removed from
the permitted list in 1955 because modern testing procedures showed that they did not meet the law's requirements. With regard to the use of insecticides on fruit and vegetable crops the Miller pesticide amendment, passed in 1954, requires that safe tolerances are to be set up limiting the amount of residue that may remain on the food crop after it is harvested. If these tolerances are exceeded, the foods can be seized and taken off the market (Larrick 1959).

The 1938 law did not require a manufacturer to test a new chemical before using it in food.

The Food Additive Amendment of 1958

This deficiency of the 1938 act was studied by the Congress from 1950, when it formed a "Select Committee to Investigate the Use of Chemicals in Food," until 1958, when it passed the food additives amendment (Anon. 1959; Larrick 1959).

The substances covered by this amendment are those additives not recognized by competent experts as having been shown to be safe under the conditions of their intended use. Antioxidants, mold inhibitors, rancidity prevention agents and other preservatives, emulsifiers, and stabilizers are examples of the types of additives that are covered.

Substances commonly used in food before January 1, 1958, and generally recognized as safe because of experience based on such use, are exempt from the law. Thus a great many ingredients do not have to go through the clearance procedures of the bill. The exempted food additives are listed in Part 1 of the Appendix.

Substances that get into food accidentally, such as lead ores, for example, are not covered by the legislation. These substances if proper precautions are taken, would not reasonably be expected to get into food, and if they do get in, the food is illegal under the basic 1938 law.

Other additives not covered by the new amendment are pesticide chemicals, which are already taken care of under the pesticide chemicals amendment, and substances that have already been approved by the Government for use in food under the Food, Drug, and Cosmetic Act, the Meat Inspection Act, or the Poultry Products Inspection Act.

The person who wants to promote a new food additive will have to test it for safety on animals and submit the results of the safety tests to the Food and Drug Administration.

Scientists of the Food and Drug Administration will study the safety data and reach an independent decision as to the suitability of the new ingredient for use in our food supply. If the evidence clearly demonstrates that the material is a suitable component of food, then the Department of Health, Education, and Welfare will issue a regulation stating
safe permissible uses for the material. But if there is a question as to the safety of the additive, it will not be permitted, and the public health will be safeguarded in a way that was not possible before (Larrick 1959).

Use of an additive that promotes deception of consumers is not sanctioned. If the additive can only be used in a limited amount, to safeguard health, only the quantity needed to accomplish the intended technical or physical effect will be allowed, and this amount will be allowed only if it is safe. In case the Government and industry are unable to agree about the contemplated use of food additives, industry has a right to a public hearing on the suitability of a proposed additive and the right to appeal an adverse Government decision to the circuit court of appeals (Larrick 1959).

The Food Additive Committee of the Flavoring Extract Manufacturers' Association of the United States has conducted a Food Additives Survey and is submitting (1960) a list of flavor ingredients now in use and believed to be generally recognized as safe.

**CHEMICAL FLAVOR ADDITIVES**

Chemical flavor additives are aromatic substances containing mostly the chemical constituents which occur in fruit, botanicals, and in other sources of food material. Their organic structure is the same as the chemical constituents of natural origin.

Aromatic chemicals are mixed in proper quantities to produce harmonious mixtures resembling closely natural flavors. The proportions of their use in flavoring compounds vary and are determined rather by flavor measurements for exact quantities than by chemical analysis.

Some aromatic chemicals have related odor properties and may assist or duplicate each other in preparing an imitation flavor; others often contain secondary odors which may not be present in the aromatic substance of natural sources although having a similar chemical structure. The undesirable secondary odors and terpenes can be removed either by washing procedures or by fractional distillation with an alcoholic menstruum or are separated by conversion of the aromatic chemical into a cyclic acetal of glycerine. The purification of aromatic chemicals is advisable in imitating flavors which are used in cold beverages, cream centers of confectionery, jelly fillings, sherbet, ices, and medicinal syrups and emulsions, otherwise they may leave an undesirable aftertaste.

The knowledge of boiling points is of great importance in the selection of aromatic chemicals for suitable flavoring compounds. Low boiling aromatic chemicals have to be increased in quantity when they are used in flavorings that are exposed to heat, for they lose a large part of flavor
values during heating. They may also deteriorate easily. Aromatic chemicals with high boiling points which are used in flavoring of bakery products and of hard candy, need little purification for they lose the secondary odors and most of their terpenes by evaporation during the exposure to heat.

Aromatic chemicals which may be found objectionable or doubtful for use as flavor additives in food and beverages should be omitted; usually they can be replaced by other aromatic chemicals of similar flavoring properties either alone or in combination of more than one additive.
Imitation Flavors

The manufacture of imitation flavors has the aim of reproducing a “close resemblance” of aroma and taste of natural flavoring material.

The development of a close resemblance is creative work and depends on the photographic memory of the flavor technologist to recall aroma and taste of every flavor which passed his sensory and gustatory organs. He has to know which ingredients to select and to be able to harmonize them in a suitable flavoring formula.

Natural flavoring materials contain aromatic substances of chemical structure which can be reproduced by chemical process. The presence and identification of aromatic chemicals in natural flavors can be ascertained by chemical analysis either quantitatively or qualitatively. Test by taste and smell assists in measuring their flavor strength. The determination of the thresholds of perception and identification helps to define the flavor properties of aromatic chemicals and thus makes formulation of the intended flavor imitation possible.

The addition of from 5 to 25 per cent of natural flavorings to flavor imitations increases the “near likeness” most effectively. Such combinations are often preferred to genuine products for their stability and resistance to high temperatures. The fortification of natural flavorings with flavor imitations also increases their flavor strength many-fold, reduces moisture content, and makes aroma and taste of the natural flavor more expressive.

The boiling point of aromatic chemicals is of great importance in the creation of flavors for specified uses. Some aromatic chemicals with low boiling temperature may be of little value in a compound which is exposed to baking and confectionery temperatures, or for application in tobacco. They also may not be suitable for pharmaceutical preparations, beverages, or for ice cream and frozen desserts. Compounds of chemical aromatics with crystalline or solidifying properties are of little use in flour mixes for they create lumps in storage.

The flavor technologist must know the conditions the flavor has to comply with in its use. The knowledge of use will enable him to create a flavor compound which will give the required effect to the product for which it is intended.
The flavor formulas in this book contain aromatic chemicals which have been used by flavor manufacturers here and abroad for decades prior to the Food Additives Amendment of 1958 to the Federal Food, Drug, and Cosmetic Act of 1938.

Aromatic chemicals are necessary as flavoring additives for they permit economy by their high concentration and odorous accentuation. They also are present in natural substances in the same form as hydrocarbons, alcohols, ethers, esters, ketones, aldehydes, and organic acids. The intake of aromatic chemicals which are used in imitation flavors is small and often undetectable by analysis. They are odorous substances which give flavor to enhance taste but don’t even last long enough to bypass the temperature of the mouth.

The formulas in this book are to be looked upon as a basis to assist the flavor technologist in the creation of new formulation in order to meet the requirements of the various industries which use flavoring material.

ODOR, TASTE, AND FLAVOR COMPOSITION

The Receptors of Taste and Smell

The Nose.—The nose penetrates inward for about two and a half or three inches, where it joins the top of the throat or pharynx. At the top of the nose is the olfactory region or the “olfactory cleft,” the seat of the
smell receptors. The olfactory region is about one square inch in each nasal chamber. The cellular tissue covering the nerve area of the olfactory region consists of ordinary cells and of delicate olfactory cells. Attached to each olfactory cell are five or six or perhaps eight olfactory hairs, fragile protoplasmic filaments, which project through the membrane covering the area. It is generally believed that the hairs are affected by odorous particles and set off the train of events culminating in our perception of odor. The olfactory hairs are very delicate and easily destroyed, for example, by cold water.

The messages picked up, or the information gathered by the olfactory region in the nose, is carried to the brain by the olfactory nerve. The olfactory nerve travels from the olfactory cleft, high up in the nose, to the olfactory bulb of the brain, to which it transmits its messages.

**The Mouth.**—The end organs of taste occur in the tongue and soft palate of the mouth. The membranous and suspended muscular fold which
partly separates the mouth cavity from the top of the throat is called the soft palate.

It has been estimated that there are about 9,000 taste buds in man. They occur in the middle of the upperside of the tongue, on the inside of the cheeks, on the lips, on the tonsils, and on the small piece of flesh hanging down from the soft palate in the back of the mouth.

Within the taste bud are a number of elongated cells, each of which ends in a minute hair-like process, the gustatory hair, which projects through a minute pore in the surface of the taste bud, which is called the gustatory pore, into the mouth cavity. Direct stimulation takes place on the hairs and the impulse passes through the gustatory cells to the nerve fibers and thence to the brain.

Taste is a complex perception which takes into account odor, temperature, and touch. By closing the nose apertures and tasting aqueous solutions at the temperature of the body, we can reach an irreducible minimum of four tastes, sweet, bitter, saline, and sour and possibly, alkaline and metallic. Some taste buds react to only one taste. The only way they can be distinguished is by applying them to sweet, sour, and other solutions and observing if there is a response. Most of the taste buds are situated in the tongue. The tongue is a very mobile muscle changing in shape at every contraction. It is very sensitive to touch, heat, and cold. The sweet taste is most easily sensed at the tip of the tongue, the bitter at the back, the sour at the edge, and the saline both on the tip and the edge.

Odor, Smell, and Taste

Odor is a volatile substance which has to be in the air to stimulate olfaction. Without the pressure of air, odor bounces off the receptor surface of olfactory and causes no change for stimulus. If odor and temperature are removed, we are left with four tastes, bitter, sweet, salt, and sour.

The nose is exhausted by long smelling at a flavor until after a time it can no longer smell it. The sensory apparatus has become fatigued and needs a rest to regain its efficiency. Taste also becomes fatigued. Lack of awareness might be due either to inattention of the central nervous system or to exhaustion or depression of the activity of the peripheral receptors.

Creation of Flavor Composition

The presence of flavoring constituents in aromatic substances of natural and chemical origin can be determined by various methods of analytical means. Odor and taste, however, have to be examined by the olfactory and gustatory sense organs of the nose and mouth. The flavor strength
of aromatic substances is measured by odor and taste test for threshold of identification in proportions of 1 part flavoring material in 100 parts of soluble menstruum and diluted by the addition of 50 parts sugar syrup of 32 Bé, and water totaling 1000 parts flavored mixture. The findings of the flavor measurement provide the basic figures for the formulation of an intended flavor composition.

The description of odor and taste of the commonly used ingredients, as well as the published formulas in this book, will greatly assist and facilitate the selection of the required flavor components for the creation of a new flavor composition.

**Imitation Apple Flavor**  
**MF 67**

Mixture of

- 0.70 gm. oil of rose (otto)
- 1.40 gm. benzyl formate
- 5.30 gm. geranyl acetate
- 5.30 gm. oil of anise
- 5.30 gm. butyric acid
- 8.85 gm. Palatone (trade name)
- 8.85 gm. citral
- 17.70 gm. aldehyde C₁₆
- 17.70 gm. aldehyde C₁₄
- 17.70 gm. ethyl vanillin
- 17.70 gm. oil of geranium
- 17.70 gm. citronellal
- 17.70 gm. styralyl acetate
- 26.50 gm. geraniol
- 35.40 gm. phenylethyl iso-butyrate
- 35.40 gm. acetaldehyde, 50 per cent
- 44.25 gm. dimethylbenzylcarbinyl acetate
- 44.25 gm. cinnamyl isovalerate
- 70.80 gm. propylene glycol
- 167.75 gm. Hercolyn (trade name)
- 212.50 gm. amyl butyrate
- 221.25 gm. amyl valerate

Total

1000.00 gm.

**Imitation Apricot Flavor**  
**MF 68**

Mixture of

- 30.0 gm. ionone, alpha
- 30.0 gm. ethyl oenanthate
- 120.0 gm. benzaldehyde
520.0 gm. peach imitation—formula MF 115
300.0 gm. propylene glycol

Total
1000.0 gm.

Imitation Banana MF 69

Mixture of
7.2 gm. imitation violet—formula MF 140
22.0 gm. benzyl propionate
24.0 gm. ethyl caproate
24.0 gm. heliotropin
24.0 gm. vanillin
24.0 gm. coumarin substitute—formula MF 93
40.0 gm. linalool
60.0 gm. amyl valerate
120 gm. amyl butyrate
120.0 gm. acetaldehyde
534.8 gm. amyl acetate

Total
1000.0 gm.

Stabilized Benzaldehyde (Benzalglycerin) MF 70
or
Benzaldehyde Cyclic Acetal of Glycerin

\[ \text{C}_6\text{H}_5 - \text{CH} \left\langle \text{CHOH} \right. \text{OCH}_2 \]

(a) Put into glass container:
500.0 gm. toluol (toluene). While agitating, add slowly:
10.0 gm. phosphoric acid 85 per cent (H₃PO₄); then add:
483.0 gm. glycerin (corresponding to 5 molecules or 460 gm. plus 5 per cent excess);
556.5 gm. benzaldehyde (corresponding to 5 molecules or 530 gm. plus 5 per cent excess);

(b) remove water in Bidwell at temperature below boiling point; approximately:
90.0 gm. water will separate while the reaction nears completion; toluene will separate at higher temperature (242.6°F.) at the end;

(c) cool remainder, preferably overnight; a layer of syrupy liquid, approximately 30 gm., will settle on the bottom of the container; it contains mostly phosphoric acid and is to be taken off;

(d) add a solution of:
50.0 gm. sodium carbonate and
500.0 gm. water to the cold toluene layer while agitating;
(e) wash twice more with water, using 150 gm. each time, making sure re­
 remains are neutral or slightly alkaline. Acetals are very sensi­
tive to acid in the presence of water.

(f) Distill off toluene on reduced vacuum of about 100 mm.; then continue
 distillation of benzalglycerine at 4 to 5 mm. vacuum and at
 284° to 320° F.; when distillate turns to yellow color, distil­
lution must be stopped.

The approximate yield is:

850.0 gm. stabilized benzaldehyde or benzaldehye cyclic acetal of
 glycerin or benzalglycerin. Discard useless residue.

Benzaldehyde cyclic acetal of glycerin is the stabilized form of benzalde­
hyde. The chemical character of volatile aldehydes is made completely stable
with undetectable flavor, thereby permitting extended shelf-life without
volatilization and oxidation.

Water, heat, and traces of acid will restore benzaldehyde cyclic acetal of
 glycerin to detectable benzaldehyde without loss of flavor, and to glycerin.

Imitation Berry Flavor Distillate

Slowly distill, at atmospheric pressure, the following ingredients:
2.0 oz. av. butyl butyryl lactate
2.0 oz. av. octyl crotonyl acetate
1.0 oz. av. oil of tagete
2.0 oz. av. Corps praline (trade name of Firmenich and Co. product)
2.0 oz. av. ethyl tiglate
8.0 oz. av. aldehyde C_{16}
1.0 oz. av. aldehyde C_{11}
8.50 lbs. alcohol, 95 per cent, and
4.15 lbs. water to obtain a yield of:
8.00 lbs. imitation berry flavor distillate of approx. 80 per cent alcohol
content.

Imitation Blackberry Flavor

Mixture of
6.0 gm. Palatone (trade name)
10.0 gm. ionone, beta
40.0 gm. methyl anthranilate
40.0 gm. ethyl vanillin
80.0 gm. anisaldehyde
80.0 gm. ethyl cinnamate
80.0 gm. imitation jasmin—formula MF 106
80.0 gm. imitation violet, formula MF 140
100.0 gm. oil of cloves

1 For use in strawberry, raspberry, cherry, black current, cassis, and blackberry true
 fruit and imitation flavors.
224.0 gm. alcohol, 95 per cent
260.0 gm. heliotropin

Total
1000.0 gm.

**Imitation Brandy Flavor**  MF73

Mixture of
- 8.70 gm. vanillin
- 63.80 gm. ethyl propionate
- 49.30 gm. imitation Jamaica rum—formula MF 127
- 70.20 gm. ethyl acetate
- 116.00 gm. oil of Cognac, rectified
- 692.00 gm. diethyl succinate

Total
1000.00 gm.

**Imitation Butter Flavor**  MF74

Mixture of
- 2.64 gm. benzilidine acetone
- 3.74 gm. cinnamic aldehyde
- 4.62 gm. heliotropin
- 5.50 gm. valeric acid
- 8.80 gm. cinnamyl butyrate
- 9.24 gm. ethyl butyrate
- 11.88 gm. benzodihydropyronone
- 36.74 gm. vanillin
- 45.54 gm. lactic acid
- 338.58 gm. butyric acid
- 532.72 gm. diacetyl

Total
1000.00 gm.

**Imitation Butter Flavor**  MF75

Mixture of
- 0.125 oz. av. benzaldehyde
- 0.250 oz. av. oil lemon distilled
- 2.500 oz. av. butyl butyryl lactate
- 3.000 oz. av. diacetyl
- 4.000 oz. av. ethyl butyrate
- 4.000 oz. av. butyric acid
- 5.000 gm. oil of nutmeg dissolved in
- 9.000 lbs. and 2.215 oz. av. vegetable oil

Total
10.00 lbs.

*For pastry*
**Imitation Butterscotch Flavor**  
**MF 77**

Mixture of
- 0.01 gm. oil of lovage
- 0.25 gm. vanillin
- 0.50 gm. oil of lemon, terpeneless
- 4.00 gm. foenugreek solid extract
- 7.74 gm. valeric acid
- 14.00 gm. ethyl acetate
- 25.00 gm. ethyl vanillin
- 28.40 gm. ethyl butyrate
- 76.00 gm. diacetyl
- 84.10 gm. butyric acid
- 2.25 fl. oz. alcohol, 85 per cent
- 5.00 fl. oz. triacetin 69 per cent
- 32.00 fl. oz. propylene glycol
- 22.00 fl. oz. caramel
- 40.00 fl. oz. water
- 18.75 fl. oz. acetic acid, 4 per cent

**Total**  
One gallon flavor.

**Stable Butyric Acid (Tributyrin)**  
**MF 78**

Mixture of

(a) 120.0 lbs. butyric acid, purified  
30.0 lbs. glycerin;  

is put into 50 liter glass container and distilled through Bidwell—to separate 15.5–16 lbs. water; pot temperature 302° to 356°F.

(b) distillation is stopped when water flows very slowly or not at all; discard the water and distill at vacuum of 5 mm. and a temperature
of 176°F, to obtain in the first fraction a yield of approx. 20 lbs. acid;

(c) when temperature rises to about 193°F, change to second fraction and continue vacuum distillation until temperature reaches approximately 320°F; stop the vacuum distillation when the residue changes color; the distillation yield of this fraction should be approximately 100 to 110 lbs. tributyrin.

### Caramel Flavor MF 79

Mixture of:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.5 gm. heliotropin</td>
<td></td>
</tr>
<tr>
<td>38.0 gm. ethyl vanillin, and</td>
<td></td>
</tr>
<tr>
<td>333.5 gm. vanillin,</td>
<td></td>
</tr>
<tr>
<td>dissolved in:</td>
<td></td>
</tr>
<tr>
<td>341.8 gm. alcohol, 95 per cent</td>
<td></td>
</tr>
<tr>
<td>then mixed with:</td>
<td></td>
</tr>
<tr>
<td>5.0 gm. oil of mace or nutmeg</td>
<td></td>
</tr>
<tr>
<td>5.0 gm. ethyl butyrate</td>
<td></td>
</tr>
<tr>
<td>5.0 gm. oil of lemon–five-fold</td>
<td></td>
</tr>
<tr>
<td>5.7 gm. diacetyl</td>
<td></td>
</tr>
<tr>
<td>9.0 gm. oil of orange, sweet, terpenefree</td>
<td></td>
</tr>
<tr>
<td>233.5 gm. rum ether, formula MF 125</td>
<td></td>
</tr>
</tbody>
</table>

**Total**
1000.0 gm. finished flavor

### Imitation Cassia MF 80

Mixture of:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.30 gm. oil of ginger</td>
<td></td>
</tr>
<tr>
<td>0.50 gm. methyl salicylate</td>
<td></td>
</tr>
<tr>
<td>0.50 gm. Vanillinide (trade name)</td>
<td></td>
</tr>
<tr>
<td>2.00 gm. terpineol</td>
<td></td>
</tr>
<tr>
<td>2.00 gm. eugenol</td>
<td></td>
</tr>
<tr>
<td>2.00 gm. methyl ionone</td>
<td></td>
</tr>
<tr>
<td>92.70 gm. cinnamic aldehyde</td>
<td></td>
</tr>
</tbody>
</table>

**Total**
100.00 gm.

### CHEESE AND CHEESE IMITATION FLAVOR

#### Cheese

Cheese is made from the curd of milk of animals by coagulating the casein with an acid or a suitable enzyme.

Throughout the world there are about twenty varieties of cheese with many hundreds of names. The most commonly known are: blue cheese, Cacciocavallo, Camembert, Cheddar, cottage, Cream, Edam, Gorgonzola,
Couda, Limburger, Neufchatel, Parmesan, Processed, Romano, Roquefort, and Swiss, or Emmenthaler.

Protein and fat of the milk is mostly retained in the cheese; the minerals are sometimes recovered from the whey and are incorporated into the cheese.

**Cheese Imitation Flavor MF 81**

Mixture of

- 2.0 fl. oz. butyl butyryl lactate
- 2.0 fl. oz. iso-valeric acid
- 2.0 fl. oz. ethyl butyrate
- 2.0 fl. oz. butyric acid
- 1.0 fl. oz. caproic acid
- 1.0 fl. oz. methyl-n-amyl ketone
- 16.0 fl. oz. alcohol, 95 per cent
- 102.0 fl. oz. propylene glycol

Total

128.0 fl. oz. or one gallon flavor

**Imitation Cheese Flavor, Roquefort MF 82**

Mixture of

- 2.0 fl. oz. butyl butyryl lactate
- 2.0 fl. oz. iso-valeric acid, anhydrous, pure
- 2.0 fl. oz. ethyl butyrate
- 2.0 fl. oz. butyric acid
- 4.0 fl. oz. ammonium iso-valerate
- 1.0 fl. oz. caproic acid
- 1.0 fl. oz. methyl-n-amyl ketone (free of fusel)
- 16.0 fl. oz. alcohol, 95 per cent
- 98.0 fl. oz. propylene glycol

Total

128.0 fl. oz.

**Imitation Cherry Flavor MF 83**

Mixture of

- 1.75 gm. eugenol
- 4.50 gm. cinnamic aldehyde
- 6.25 gm. anisyl acetate
- 9.25 gm. anisic aldehyde
- 12.50 gm. ethyl oenanthate
- 13.50 gm. benzyl acetate
- 25.00 gm. vanillin
- 25.00 gm. aldehyde C16
- 37.25 gm. ethyl butyrate
50.00 gm. amyl butyrate
125.00 gm. tolyl aldehyde
558.00 gm. benzaldehyde
130.00 gm. alcohol, 95 per cent

Total
1000.00 gm.

Imitation Black Cherry Flavor  MF 84

Mixture of
1.00 gm. ethyl vanillin
1.25 gm. heliotropin
5.00 gm. vanillin
173.50 gm. alcohol, 95 per cent
0.25 gm. aldehyde C₁₆
0.75 gm. rose oil (otto)
1.25 gm. aldehyde C₁₄
1.25 gm. cinnamic aldehyde
2.50 gm. oil of cloves
5.00 gm. ionone, beta
5.00 gm. amyl valerate
7.75 gm. anisyl acetate
10.25 gm. benzyl acetate
12.25 gm. amyl acetate
25.00 gm. tolyl aldehyde
25.00 gm. ethyl butyrate
90.00 gm. ethyl acetate
125.75 gm. benzaldehyde
520.00 gm. propylene glycol
1.25 gm. balsam of Peru

Total
1000.00 gm.

Imitation Chocolate Flavor  MF 85

Mixture of
4.000 oz. av. amylphenyl acetate
4.000 oz. av. vanillin
0.125 oz. av. aldehyde C₁₃₈
0.125 oz. av. veratraldehyde
0.500 oz. av. n-butylphenyl ethylacetal
3 lb., 0.25 oz. av. propylene glycol
0.250 oz. av. propylene glycol
6.000 lb. cocoa flavoring extract–formula MF 55

Total
10.000 lbs.

imitation chocolate flavor
Cider Vinegar Flavor  

**MF 86**

Mixture of

- 350 gm. full-flavored apple concentrated juice 68° Brix
- 350 gm. recovered volatile apple essence 100-fold
- 300 gm. glacial acetic acid

Total

1000 gm.

Recommended use 10 gm. to 100 gal. vinegar.

Cider True Fruit and Imitation Flavor  

**MF 87**

Mixture of

- 4.75 gm. amyl acetate
- 4.75 gm. butyl butyrate
- 9.25 gm. ethyl butyrate
- 18.75 gm. amyl valerate
- 87.50 gm. glacial acetic acid
- 150.00 gm. ethyl alcohol, 95 per cent
- 350.00 gm. water
- 375.00 gm. full-flavored apple concentrated juice 68° Brix

Total

1000.00 gm.

The mixture is left to stand 24 hours to permit separation of insoluble substances which are then removed.

Imitation Cocoa Flavor  

**MF 88**

Mixture of

- 6 lbs. cocoa flavor distillate—formula MF 57
- 3 lbs. 5 oz. av. propylene glycol
- 6.00 oz. av. vanillin
- 4.50 oz. av. amyl phenyl acetate
- 0.25 oz. av. benzyl butyrate
- 0.25 oz. av. veratraldehyde

Total

10 lbs. imitation cocoa flavor

This imitation cocoa flavor can also be classified as a chocolate flavor; see **MF 85**, p. 170.

Imitation Coconut  

**MF 89**

Mixture of

- 60.0 gm. vanillin
- 60.0 gm. ethyl vanillin
- 482.5 gm. alcohol, 95 per cent
- 7.5 gm. caprilic alcohol
30.0 gm. caproic acid
30.0 gm. ethyl oenanthate
330.0 gm. aldehyde C₁₈

Total
1000.0 gm.

**Imitation Coconut**  
**MF 90**  
(Oil Soluble)

Mixture of
- 30.0 gm. aldehyde C₁₈
- 5.0 gm. iso-butylphenylacetate
- 100.0 gm. Palatone (trade name)
- 40.0 gm. veratraldehyde
- 60.0 gm. Mellene—cycol tone (trade name)
- 4.0 gm. methylnonylketone
- 80.0 gm. cocoa butter
- 289.0 gm. Hercolyn (trade name)
- 402.0 gm. oil of sesame

Total
1000.0 gm.

**Imitation Coffee Flavor**  
**MF 91**

Mixture of
- 5.000 lbs. coffee extract—formula MF 61
- 28.400 gm.ethyl formate
- 14.400 gm. Cyclotene (trade name)
- 3.500 gm. diacetyl
- 1.775 gm. thional, formula MF I32
- 3.000 lbs. propylene glycol

Total
10.000 lbs. imitation coffee flavor

**Imitation Cognac Green**  
**MF 92**

Mixture of
- 12.50 gm. hexanol
- 100.00 gm. phenylethyl alcohol
- 300.00 gm. ethyl pelargonate
- 587.50 gm. ethyl oenanthate

Total
1000.00 gm.

**Imitation Coumarin**  
**MF 93**

Mixture of
- 460.0 gm. tolylglycerin or tolylaldehyde cyclic acetal of glycerin—formula MF I31
410.0 gm. benzalglycerin or benzaldehyde cyclic acetal of glycerin—
formula MF 70

15.0 gm. Vanitrope, brand of propenyl guaethol (Shilton, Inc.)
10.0 gm. heliotropin
50.0 gm. ethyl vanillin
45.0 gm. vanillin
7.5 gm. aldehyde C18 (gamma nonyl lactone)
2.5 gm. glacial acetic acid

Total
1000.0 gm.

The flavor strength of one part of this flavor equals one part of coumarin.
Coumarin is an aromatic chemical widely distributed in nature. It has been
found in the balsam of Peru, tonka beans, cassia, lavender, orchid, melilot,
woodruff, lirios (lacinaria or deer tongue), and in more than sixty plants be­
longing to about twenty-four natural orders. It is identified by aroma largely
by its strong almond note. Coumarin, because of its versatile flavor and fixative
property, can be replaced only by compound of aromatics and not by a single
aromatic chemical.

Imitation Custard MF 94

Mixture of

0.01 gm. rhodinol
0.49 gm. ethyl oenanthate
0.50 gm. oil of lemon, cold pressed
1.00 gm. butyric acetate
1.00 gm. ethyl butyrate
2.00 gm. diacetyl
4.00 gm. oil of orange, cold pressed
16.00 gm. oil of nutmeg
32.00 gm. ethyl vanillin
64.00 gm. rum ether—formula MF 125
216.00 gm. vanillin
250.00 gm. alcohol, 95 per cent
413.00 gm. propylene glycol

Total
1000.00 gm.

Imitation Custard and Rum MF 95

Mixture of

0.2 gm. ethyl oenanthate
0.3 gm. oil of lemon, cold pressed
0.3 gm. ethyl butyrate
1.0 gm. oil of nutmeg
2.0 gm. oil of orange, cold pressed
10.0 gm. vetraldehyde
18.0 gm. ethyl vanillin
Imitation Cranberry  MF 96

Mixture of

- 0.75 gm. vanillin
- 0.60 gm. methyl salicylate
- 1.75 gm. linalool
- 2.50 gm. benzyl acetate
- 10.00 gm. ethyl benzoate
- 20.00 gm. amyl butyrate
- 20.00 gm. amyl acetate
- 20.00 gm. ethyl valerate
- 39.00 gm. ethyl acetate

Total

114.60 gm. or 4.0 oz. av. dissolved in:

12.0 oz. av. propylene glycol

Total 16.0 oz. av. imitation cranberry

Imitation Date Flavor  MF 97

Mixture of

- 2.5 gm. imitation honey flavor—formula MF 105
- 2.5 gm. eugenol
- 2.5 gm. cinnamic aldehyde
- 12.5 gm. aldehyde C11
- 15.0 gm. imitation neroli—formula MF 112
- 95.0 gm. amyl butyrate
- 150.0 gm. ethyl benzoate
- 250.0 gm. amyl valerate
- 100.0 gm. amyl acetate
- 150.0 gm. ethyl acetate
- 220.0 gm. propylene glycol

Total

1000.0 gm.

Essence Eggnog Imitation  MF 98

Mixture of

- 0.66 gm. vanillin
- 520.40 gm. alcohol, 95 per cent
- 1.10 gm. imitation butter flavor—formula MF 74
- 3.08 gm. oil of lemon, California, cold pressed
### Oil Garlic Imitation (MF 99)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil of nutmeg</td>
<td>6.16 gm.</td>
</tr>
<tr>
<td>Rum ether—formula MF 125</td>
<td>74.80 gm.</td>
</tr>
<tr>
<td>Imitation Jamaica rum—formula MF 127</td>
<td>107.80 gm.</td>
</tr>
<tr>
<td>Water</td>
<td>286.00 gm.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1000.00 gm.</td>
</tr>
</tbody>
</table>

Mixture of:
- 85.0 gm. diallyl sulphide
- 5.0 gm. allyl mercaptan
- 2.0 gm. dimethyl sulphide
- 5.0 gm. butyl thiocyanate
- 3.0 gm. glacial acetic acid

**Total** 100.0 gm.

### Garlic Oil Fortified (MF 100)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil of garlic</td>
<td>18.0 gm.</td>
</tr>
<tr>
<td>Oil of garlic imitation, formula MF 99</td>
<td>2.0 gm.</td>
</tr>
<tr>
<td>Oil of orange terpenes</td>
<td>80.0 gm.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.0 gm.</td>
</tr>
</tbody>
</table>

Mixture of:
- 18.0 gm. oil of garlic
- 2.0 gm. oil of garlic imitation, formula MF 99
- 80.0 gm. oil of orange terpenes

**Total** 100.0 gm.

### Imitation Grape (MF 101)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzilidine acetone</td>
<td>1.725 gm.</td>
</tr>
<tr>
<td>Benzyl propionate</td>
<td>22.075 gm.</td>
</tr>
<tr>
<td>Ethyl caproate</td>
<td>50.200 gm.</td>
</tr>
<tr>
<td>Methyl anthranilate</td>
<td>926.000 gm.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1000.000 gm.</td>
</tr>
</tbody>
</table>

Mixture of:
- 1.725 gm. benzilidine acetone
- 22.075 gm. benzyl propionate
- 50.200 gm. ethyl caproate
- 926.000 gm. methyl anthranilate

**Total** 1000.000 gm.

### Imitation Grape Flavor (MF 102)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imitation grape, formula MF 101</td>
<td>155 gm.</td>
</tr>
<tr>
<td>Butyl stearate</td>
<td>180 gm.</td>
</tr>
<tr>
<td>Herculyn (trade name)</td>
<td>665 gm.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1000 gm.</td>
</tr>
</tbody>
</table>

Mixture of:
- 155 gm. imitation grape, formula MF 101
- 180 gm. butyl stearate
- 665 gm. Herculyn (trade name)

**Total** 1000 gm.
Imitation Concord Grape  

Mixture of

- 2 gm. aldehyde C_{11}
- 2 gm. oil of lime, terpeneneless
- 8 gm. ionone, alpha
- 10 gm. ethyl oenanthate
- 15 gm. aldehyde C_{16}
- 30 gm. cinnamic alcohol
- 30 gm. rum ether, formula MF 125
- 30 gm. methyl naphthyl ketone crystals
- 60 gm. ethyl anthranilate
- 347 gm. dimethyl anthranilate
- 466 gm. ethyl acetate

Total 1000 gm.

Imitation Grenadine Flavor  

(a) Grenadine Base

Mixture of

- 4.00 gm. ionone, alpha
- 4.00 gm. imitation neroli, formula MF 112
- 7.75 gm. ethyl oenanthate
- 7.75 gm. oil of petitgrain
- 23.50 gm. ionone, beta
- 39.00 gm. alcohol C_{12}
- 39.00 gm. imitation violet flavor, formula MF 140
- 39.00 gm. heliotropin
- 46.75 gm. oil of geranium
- 54.50 gm. aldehyde C_{14}
- 70.50 gm. oil of lemon, cold pressed
- 117.00 gm. amyl butyrate
- 132.75 gm. vanillin
- 147.00 gm. ethyl butyrate
- 287.50 gm. ethyl butyrate

Total 1000.00 gm.

(b) Imitation Grenadine Flavor

Mixture of

- 200.00 gm. grenadine base (a)
- 800.00 gm. alcohol, 95 per cent

Total 1000.00 gm.
IMITATION FLAVORS

Imitation Honey Flavor  MF 105

Mixture of
0.375 gm. methyl acetophenone
0.375 gm. oil of geranium
0.375 gm. oil of celery
6.000 gm. ethyl vanillin
12.000 gm. phenyl acetic acid
12.625 gm. methyl phenyl acetate
31.250 gm. ethyl pelargonate
187.000 gm. amyl acetate
100.000 gm. ethyl acetate
250.000 gm. amyl valerate
400.000 gm. alcohol, 95 per cent

Total
1000.000 gm.

Imitation Jasmin  MF 106

Mixture of
1.75 gm. linalyl acetate
2.50 gm. benzyl butyrate
4.75 gm. benzyl acetate
6.000 gm. citronellyl acetate
6.50 gm. oil of cassia
6.00 gm. oil of ylang ylang
7.25 gm. benzyl alcohol
9.70 gm. benzyl formate
11.00 gm. oil of petitgrain
12.10 gm. phenylpropyl alcohol
12.20 gm. linalool
12.20 gm. benzyl benzoate
17.00 gm. oil of rose (Otto)
18.00 gm. para-cresyl acetate
22.20 gm. geranyl acetate
25.25 gm. citronellol
86.50 gm. oil of jasmin
125.00 gm. methyl anthranilate
142.50 gm. yara yara
230.00 gm. indole
240.00 gm. cinnamic alcohol

Total
1000.00 gm.

Imitation Lemon  MF 107

Mixture of
0.50 gm. methyl heptenone
1.00 gm. terpineol
FOOD FLAVORING

<table>
<thead>
<tr>
<th>Composition</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00 gm. linalool</td>
<td></td>
</tr>
<tr>
<td>1.25 gm. aldehyde C_{10}</td>
<td></td>
</tr>
<tr>
<td>1.25 gm. aldehyde C_{9}</td>
<td></td>
</tr>
<tr>
<td>1.75 gm. geranyl acetate</td>
<td></td>
</tr>
<tr>
<td>60.00 gm. citral</td>
<td></td>
</tr>
<tr>
<td>100.00 gm. oil of lemon, cold pressed</td>
<td></td>
</tr>
<tr>
<td>833.25 gm. orange terpenes</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1000.00 gm.</strong></td>
</tr>
</tbody>
</table>

**Imitation Lime**  
*MF 108*

<table>
<thead>
<tr>
<th>Composition</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 lb. cymene</td>
<td></td>
</tr>
<tr>
<td>1 lb. dipentene</td>
<td></td>
</tr>
<tr>
<td>3 lb. oil of lime, distilled</td>
<td></td>
</tr>
<tr>
<td>6.0 oz. av. citral</td>
<td></td>
</tr>
<tr>
<td>2.0 lb. terpineol</td>
<td></td>
</tr>
<tr>
<td>10.0 lb. lemon terpenes</td>
<td></td>
</tr>
<tr>
<td>82.0 lb. 10 oz. av. lime terpenes</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0 lb.</strong></td>
</tr>
</tbody>
</table>

**Imitation Mace**  
*MF 109*

<table>
<thead>
<tr>
<th>Composition</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>717.50 gm. phellandrene</td>
<td></td>
</tr>
<tr>
<td>105.00 gm. dipentene</td>
<td></td>
</tr>
<tr>
<td>110.00 gm. terpineol</td>
<td></td>
</tr>
<tr>
<td>30.00 gm. linalool</td>
<td></td>
</tr>
<tr>
<td>10.00 gm. geraniol</td>
<td></td>
</tr>
<tr>
<td>10.00 gm. eugenol</td>
<td></td>
</tr>
<tr>
<td>5.00 gm. citral</td>
<td></td>
</tr>
<tr>
<td>5.00 gm. oil of cinnamon leaf</td>
<td></td>
</tr>
<tr>
<td>2.50 gm. oil of petitgrain</td>
<td></td>
</tr>
<tr>
<td>2.50 gm. oil of pine</td>
<td></td>
</tr>
<tr>
<td>1.25 gm. aldehyde C_{18}</td>
<td></td>
</tr>
<tr>
<td>1.25 gm. butyric acid</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1000.00 gm.</strong></td>
</tr>
</tbody>
</table>

**Imitation Melon Flavor**  
*MF 110*

<table>
<thead>
<tr>
<th>Composition</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 gm. anisaldehyde</td>
<td></td>
</tr>
<tr>
<td>1.0 gm. methyl cinnamate</td>
<td></td>
</tr>
<tr>
<td>1.0 gm. benzyl cinnamate</td>
<td></td>
</tr>
<tr>
<td>2.0 gm. methyl anthranilate</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1000.00 gm.</strong></td>
</tr>
</tbody>
</table>
IMITATION FLAVORS

2.0 gm. aldehyde C₁₆
5.0 gm. vanillin
2.0 gm. phenyl acetaldehyde
10.0 gm. benzyl benzoate
15.0 gm. ethyl pelargonate
10.0 gm. oil of lemon, cold pressed
20.0 gm. ethyl formate
30.0 gm. amyl valerate
30.0 gm. amyl butyrate
40.0 gm. ethyl valerianate
531.0 gm. propylene glycol
300 gm. water

Total 1000.0 gm.
Less 100.0 gm. separated terpenes
Yield 900.0 gm. to be mixed with:
Plus 100.0 gm. propylene glycol
Total 1000.0 gm. imitation melon flavor, terpene-free

Essence Milk Punch MF 111

Mixture of

7.50 gm. ethyl vanillin
11.00 gm. veratraldehyde
42.00 gm. vanillin
929.50 gm. rum ether—formula MF 125
0.15 gm. oil of nutmeg
0.15 gm. oil of lemon—five fold
3.20 gm. diacetyl
6.50 gm. imitation Jamaica rum—formula MF 127

Total 1000.00 gm.

Imitation Neroli MF 112

Mixture of

5.00 gm. terpinyl acetate
5.00 gm. methyl anthranilate
6.50 gm. linalyl acetate
10.00 gm. oil of neroli Bigarade
13.00 gm. geraniol
27.25 gm. oil of petitgrain terpeneless
28.25 gm. oil of petitgrain

Total 100.00 gm.
Oil of Orange Fortified, 2 Fold

(1) 0.25 gm. alcohol C_{10}
0.25 gm. alcohol C_{12}
1.40 gm. aldehyde C_{10}
0.75 gm. aldehyde C_{12}
1.85 gm. citral
2.00 gm. geranyl acetate
2.00 gm. terpinyl acetate
2.50 gm. linalyl acetate
2.00 gm. citronellol

Total 13.00 gm. orange fortifier

(2) Mixture of 13.00 gm. orange fortifier of (1) and 1287.00 gm. oil of orange, cold pressed

Total 1300.00 gm. oil of orange, cold pressed, fortified two-fold

Imitation Passion Flavor

Mixture of
1.5 fl. oz. oil of lemon, cold pressed
1.5 fl. oz. oil of orange, cold pressed
1.5 fl. oz. oil of bergamot
3.0 fl. oz. imitation peach flavor—formula MF 113
4.0 fl. oz. imitation pineapple flavor—formula MF 118
8.0 fl. oz. imitation grape flavor—formula MF 101
16.0 fl. oz. imitation strawberry flavor—formula MF 129
32.0 fl. oz. alcohol, 96 per cent
60.5 fl. oz. propylene glycol

Total 128.0 fl. oz.

Imitation Peach Flavor

(a) Mixture of imitation peach
168.00 gm. vanillin
304.50 gm. alcohol, 95 per cent
0.75 gm. cinnamic aldehyde
0.75 gm. geraniol
4.00 gm. benzaldehyde
16.00 gm. amyl butyrate
16.00 gm. amyl acetate
30.00 gm. amyl valerate
36.00 gm. amyl formate
38.00 gm. capronic ether
IMITATION FLAVORS

48.00 gm. imitation neroli—formula MF 112
88.00 gm. ethyl valerianate
250.00 gm. aldehyde C\textsubscript{14}

**Total**
1000.00 gm.

(b) Mixture of
287.50 gm. imitation peach of (a) and
600.00 gm. propylene glycol, and
112.50 gm. water

**Total**
1000.00 gm. agitate and let stand 24 hours for separation of terpenes; filter if necessary.

**Oil Black Pepper Imitation** MF 116

Mixtures of
7.875 oz. av. oil of cubebe (Juniperus)
6.000 oz. av. phellandrene
1.500 oz. av. oil of coriander
1.000 oz. av. oil of pimento leaf
0.125 oz. av. oil of patchouli

**Total**
16.000 oz. av.

**Pineapple Ether** MF 117

*(Allyl Phenoxy Acetate)*

Mixtures of
200.0 gm. allyl alcohol
4.6 gm. phosphoric acid
2.5 gm. sulfuric acid
152.0 gm. phenoxyacetic acid
60.0 gm. benzol

**Procedure**

(a) distill using Bidwell apparatus; separate in 6 hours yield approximately 18 ml. water; then stop; pot temperature 187° F.

(b) vacuum distill allyl alcohol at 77° F. and 5 mm. Hg in flask; then wash and neutralize.

(c) yield.
65 gm. heads, first fraction;
110 gm. finished product, second fraction.

**Remarks:** Instead of sulfuric acid and phosphoric acid, also benzylsulfuric acid can be used.
Imitation Pineapple Flavor     MF 118

(a) Imitation Pineapple
Mixture of

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>180.0 gm. ethyl isovalerate</td>
<td></td>
</tr>
<tr>
<td>180.0 gm. ethyl butyrate</td>
<td></td>
</tr>
<tr>
<td>140.0 gm. allyl heptilate</td>
<td></td>
</tr>
<tr>
<td>100.0 gm. n-butyl acetate</td>
<td></td>
</tr>
<tr>
<td>100.0 gm. allyl caproate</td>
<td></td>
</tr>
<tr>
<td>80.0 gm. ethyl propionate</td>
<td></td>
</tr>
<tr>
<td>60.0 gm. allyl cyclohexanc propionate</td>
<td></td>
</tr>
<tr>
<td>60.0 gm. ethyl oenanthate</td>
<td></td>
</tr>
<tr>
<td>20.0 gm. vanillin</td>
<td></td>
</tr>
<tr>
<td>20.0 gm. amyl acetate</td>
<td></td>
</tr>
<tr>
<td>30.0 gm. oil of orange, cold pressed</td>
<td></td>
</tr>
<tr>
<td>10.0 gm. oil of lemon, cold pressed</td>
<td></td>
</tr>
<tr>
<td>10.0 gm. pineapple ether—formula MF 117</td>
<td></td>
</tr>
</tbody>
</table>

Total
1000.0 gm.

(b) Mixture of

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>250.0 gm. imitation pineapple of (a)</td>
<td></td>
</tr>
<tr>
<td>100.0 gm. alcohol, 95 per cent</td>
<td></td>
</tr>
<tr>
<td>400.0 gm. propylene glycol</td>
<td></td>
</tr>
<tr>
<td>250.0 gm. water</td>
<td></td>
</tr>
</tbody>
</table>

Total
1000.0 gm. to be left 24 hours for separation of terpenes

Less:

<table>
<thead>
<tr>
<th>Quantity</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>125.0 gm. separated terpenes; mix remaining;</td>
<td></td>
</tr>
<tr>
<td>875.0 gm. with:</td>
<td></td>
</tr>
<tr>
<td>125.0 gm. propylene glycol</td>
<td></td>
</tr>
</tbody>
</table>

Total
1000.0 gm. imitation pineapple flavor

Imitation Pistachio Flavor     MF 119

Mixture of

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.6 gm. Palatone (trade name)</td>
<td></td>
</tr>
<tr>
<td>8.8 gm. ethyl vanillin</td>
<td></td>
</tr>
<tr>
<td>33.0 gm. heliotropin</td>
<td></td>
</tr>
<tr>
<td>66.0 gm. vanillin</td>
<td></td>
</tr>
<tr>
<td>348.8 gm. alcohol, 95 per cent</td>
<td></td>
</tr>
<tr>
<td>15.4 gm. oil of bergamot</td>
<td></td>
</tr>
<tr>
<td>15.4 gm. dimethyl hydroquinone</td>
<td></td>
</tr>
<tr>
<td>15.4 gm. methyl phenyl acetaldehyde</td>
<td></td>
</tr>
<tr>
<td>15.4 gm. neroli acetate</td>
<td></td>
</tr>
<tr>
<td>15.4 gm. terpineol</td>
<td></td>
</tr>
<tr>
<td>30.8 gm. yara yara (beta-naphtyl methyl ether)</td>
<td></td>
</tr>
</tbody>
</table>
IMITATION FLAVORS

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>46.2 gm. citronellol</td>
<td></td>
</tr>
<tr>
<td>61.6 gm. methyl anthranilate</td>
<td></td>
</tr>
<tr>
<td>79.2 gm. rose water—formula MF 235</td>
<td></td>
</tr>
<tr>
<td>242.0 gm. benzaldehyde</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1000.0 gm.</td>
</tr>
</tbody>
</table>

**Imitation Quince Flavor** MF 120

**Mixture of**

- 0.125 fl. oz. oil of cloves
- 0.125 fl. oz. linalool
- 0.125 fl. oz. aldehyde C14
- 0.250 fl. oz. acetaldehyde
- 1.000 fl. oz. benzaldehyde
- 1.000 fl. oz. oil of orange, cold pressed
- 1.000 fl. oz. benzyl acetate
- 2.000 fl. oz. amyl valerate
- 2.000 fl. oz. amyl acetate
- 4.000 fl. oz. ethyl acetoacetate
- 16.000 fl. oz. alcohol, 95 per cent
- 100.375 fl. oz. propylene glycol

**Total**

128.000 fl. oz.

**Racemic Acid** MF 121

(dl-Tartaric acid)

**Distillation process:**

put into 5 liter pyrex flask (see Fig. 18, p. 160)

3.00 lb. tartaric acid

and add:

0.25 oz. av. vegetable shortening (Crisco) to keep down foaming during distillation

**Distillation yield:** 18 to 20 oz. av.

**Uses:** Racemic acid is used in maple flavor. In mixtures with cyclotene (trade name), it yields a good maple flavoring compound. The ethyl ester of racemic acid has walnut character.

**Racemic Ether** MF 122

**Mixture of**

- 256.0 gm. ethyl propionate
- 440.0 gm. ethyl acetate
- 191.0 gm. racemic acid—formula MF 121
- 64.0 gm. rum ether, formula MF 125
- 16.0 gm. ethyl oenanthate
- 16.0 gm. amyl valerate
<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Amount</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ethyl pelargonate</td>
<td>8.0 gm.</td>
<td></td>
</tr>
<tr>
<td>rhodinol acetate</td>
<td>8.0 gm.</td>
<td></td>
</tr>
<tr>
<td>valeryl acetyl</td>
<td>1.0 gm.</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1000.0 gm.</td>
<td></td>
</tr>
</tbody>
</table>

**Imitation Raspberry  MF 123**

Mixture of

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Amount</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dimethyl anthranilate</td>
<td>1.25 gm.</td>
<td></td>
</tr>
<tr>
<td>Corps Praline (trade name of Firmenich and Co.)</td>
<td>1.25 gm.</td>
<td></td>
</tr>
<tr>
<td>dimethyl sulfide</td>
<td>1.50 gm.</td>
<td></td>
</tr>
<tr>
<td>citral</td>
<td>12.00 gm.</td>
<td></td>
</tr>
<tr>
<td>diethyl succinate</td>
<td>13.50 gm.</td>
<td></td>
</tr>
<tr>
<td>aldehyde C_{14}</td>
<td>15.50 gm.</td>
<td></td>
</tr>
<tr>
<td>imitation violet, formula MF 140</td>
<td>16.00 gm.</td>
<td></td>
</tr>
<tr>
<td>oil of celery</td>
<td>16.00 gm.</td>
<td></td>
</tr>
<tr>
<td>anethol</td>
<td>21.50 gm.</td>
<td></td>
</tr>
<tr>
<td>ethyl valerate</td>
<td>21.50 gm.</td>
<td></td>
</tr>
<tr>
<td>aldehyde C_{16}</td>
<td>30.00 gm.</td>
<td></td>
</tr>
<tr>
<td>vanillin</td>
<td>40.00 gm.</td>
<td></td>
</tr>
<tr>
<td>ethyl acetate</td>
<td>58.00 gm.</td>
<td></td>
</tr>
<tr>
<td>imitation Jasmin, formula MF 106</td>
<td>180.00 gm.</td>
<td></td>
</tr>
<tr>
<td>ionone, beta</td>
<td>572.00 gm.</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1000.0 gm.</td>
<td></td>
</tr>
</tbody>
</table>

**Raspberry True Fruit and Imitation  MF 124**

Mixture of

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Amount</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>imitation raspberry—formula MF 123</td>
<td>250 gm.</td>
<td></td>
</tr>
<tr>
<td>alcohol 95 per cent</td>
<td>250 gm.</td>
<td></td>
</tr>
<tr>
<td>raspberry fruit flavor—formula MF 28</td>
<td>500 gm.</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1000 gm.</td>
<td></td>
</tr>
</tbody>
</table>

*Recommended use*: 0.1 gm. per 3 oz. av. package gelatin dessert. 1.5 oz. per 100 lbs. of soft centers.

**Rum Ether  MF 125**

*Ethyl Oxy-Hydrate*

*Equipment.* Still of about 800 liters capacity and dephelegmator.

*Ingredients*

(a) 260.0 li. alcohol, 95 per cent, or the recovered and redistilled alcohol of a previous production with an alcohol content of about 80 per cent can be used in proportion of:

<table>
<thead>
<tr>
<th>Amount</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>130.0 li.</td>
<td>alcohol 95 per cent, and</td>
</tr>
<tr>
<td>130.0 li.</td>
<td>recovered and redistilled alcohol 80 per cent.</td>
</tr>
<tr>
<td>260.0 li.</td>
<td></td>
</tr>
</tbody>
</table>


(b) 300.0 kg. pyroligneous acid containing 11.5 to 12 per cent acetic acid, tar-free;
(c) 3.0 kg. acetic acid 60 per cent.
(d) 24.0 kg. sulfuric acid 66° Baumé.
(e) 0.5 kg. manganese dioxide.
(f) 4.0 kg. charcoal, powdered or granulated.

Procedure

(g) The ingredients are put into the still (a) followed by (b), (c), (d), (e), and (f). The mixture is very slowly heated, and distilled at atmospheric pressure until all the alcohol is recovered. Dephlegmation is applied to eliminate objectionable odor.

(h) The remaining mash is speedily discarded and cold water is flushed through the still and pipes to remove all odor.

(i) The next day the yield of (g) is mixed with 250 gm. balsam of Peru in the still. It is then slowly redistilled at atmospheric pressure, with dephlegmation turned on, to yield:

- first fraction: 5 to 7 liters distillate which contains a penetrating odor. It is discarded.
- second (middle) fraction: 145 liters rum ether (ethyl oxyhydrate)
- third fraction: 35 liters distillate. It is used in the next production instead of alcohol.
- fourth (tails) fraction: contains the rest of the recovered alcohol which is mixed with charcoal, filtered, and redistilled to higher proof strength. It is used in the next production instead of alcohol.

Flavor property: The second or middle fraction is the pure rum ether or ethyl oxyhydrate.

Imitation Rum Flavor  MF 126

Mixture of

- 1.50 gm. heliotropin
- 2.25 gm. oil of lemon
- 3.25 gm. acetic acid
- 5.75 gm. ethyl vanillin
- 8.00 gm. Palatone (trade name)
- 11.25 gm. butyric acid
- 11.25 gm. vanillin
- 25.00 gm. imitation Jamaica rum—formula MF 127
- 117.80 gm. rum ether—formula MF 125
- 343.95 gm. ethyl acetate
- 470.00 gm. ethyl butyrate

Total 1000.00 gm.

Imitation Jamaica Rum  MF 127

Mixture of

- 0.125 gm. oil of birch tar, rectified
- 0.600 gm. amyl butyrate
0.600 gm. amyl acetate
0.800 gm. vanillin
2.125 gm. oil of cloves
3.000 gm. balsam of Peru
3.500 gm. ethyl butyrate
4.125 gm. styrax
6.000 gm. amyl formate
35.000 gm. ethyl oenanthate
172.000 gm. ethyl acetate
340.000 gm. ethyl formate
432.125 gm. ethyl propionate

Total
1000.000 gm.

Rye Oil MF 128

(a) Mixture of
100.000 gm. fusel oil
12.500 gm. ethyl oenanthate
12.500 gm. chloroform CHCl₃ (b.p. 142° F.)
12.500 gm. sulfuric acid (H₂SO₄)

(b) Add to the mixture of (a):
3.125 gm. potassium chlorate, dissolved in
12.500 gm. water

(c) Distill slowly at atmospheric pressure to obtain a yield of 100 gm. rye oil.

Imitation Strawberry Flavor MF 129

Mixture of
17.25 gm. Corps Praline (trade name of Firmenich and Co.)
362.05 gm. alcohol, 95 per cent; agitate and heat until dissolved, then add:
530.00 gm. propylene glycol
10.00 gm. glacial acetic acid
30.25 gm. aldehyde C₁₁
22.75 gm. benzyl acetate
11.25 gm. vanillin
4.25 gm. methyl cinnamate
2.25 gm. methyl anthranilate
0.20 gm. methyl heptine carbonate
2.25 gm. methyl salicylate
2.25 gm. ionone, beta
2.25 gm. aldehyde C₁₁
2.25 gm. diacetyl
0.75 gm. anethol

Total
1000.00 gm.
Imitation Strawberry Flavor \hspace{1cm} \text{MF 130}

(Wild Strawberry)

Mixture of

- 0.80 gm. ethyl heptylate
- 0.80 gm. oil of sweet birch
- 2.10 gm. aldehyde C_{14}
- 2.40 gm. cinnamyl isobutyrate
- 2.60 gm. ethyl vanillin
- 3.00 gm. Corps Praline (trade name) dissolved in:
  - 3.20 gm. cinnamyl isovalerate
  - 3.40 gm. dipropyl ketone
  - 5.00 gm. methyl amyl ketone
  - 6.00 gm. diacetyl
  - 21.20 gm. ethyl valerate
  - 23.15 gm. aldehyde C_{16}
  - 43.20 gm. ethyl lactate
  - 100.00 gm. alcohol, 95 per cent
  - 783.15 gm. propylene glycol

\begin{align*}
\text{Total} & = 1000.00 \text{ gm.}
\end{align*}

Stabilized Tolyldaldehyde (Tolylglycerin) \hspace{1cm} \text{MF 131}

or Acetal of Tolyldaldehyde

(Tolyl Aldehyde Cyclic Acetal of Glycerin)

\begin{align*}
\text{CH}_3 - \text{C}_6\text{H}_5 - \text{CH} & \overset{\text{OCH}_3}{\text{CHOH}} \\
& \overset{\text{OCH}_2}{\text{CHOH}}
\end{align*}

(a) Put into glass container

- 500.00 gm. toluol (toluene). While agitating, add slowly:
  - 10.00 gm. phosphoric acid 85 per cent\text{-H}_3\text{PO}_4.

Then add:

- 483.00 gm. glycerin (corresponding to 5 molecules or 460 gm. plus 5 per cent excess)
- 630.00 gm. para tolyl aldehyde (corresponding to 5 molecules or 600 gm. 5 per cent excess)

(b) Remove water in Bidwell apparatus at temperature below boiling point; approximately:

- 90.00 gm. water will separate while the reaction nears completion; toluene will separate at higher temperature (242\degree F.) at the end.

(c) Cool remains, preferably overnight; a layer of syrupy liquid, approximately 30 gm., will settle on the bottom of the container; it contains mostly phosphoric acid and is to be taken off.

(d) Add a solution of:

- 30.00 gm. sodium carbonate and
- 500.00 gm. water to the cold toluene layer while agitating; wash twice
more with water, using 150 gm. each time, making sure re­
mains are neutral or slightly alkaline. Acetals are very sensi­
tive to acid in the presence of water.

(f) Distill off toluene on reduced vacuum of about 100 mm; then continue dis­
tillation of tolylglycerin at 4 to 5 mm. vacuum and at 284°
to 320°C; when distillate turns to yellow color, distillation
must be stopped. The approximate yield is:

900.00 gm. stabilized tolylaldehyde or tolylaldehyde cyclic acetal of
glycerin or tolylglycerin; discard useless residue.

Tolytaldehyde cyclic acetal of glycerin is the stabilized form of tolytaldehyde.
The chemical character of volatile aldehydes is made completely stable with
undetectable flavor, thereby permitting extended shelflife without volatilization
and oxidation.

Water, heat, and traces of acid will restore tolytaldehyde cyclic acetal of
glycerin to detectable tolytaldehyde without loss of flavor, and to glycerin.

“Thional”—Coffee and Chocolate Fortifier  MF 132

(Hexanemethylthional)

Distill

60 parts tolylaldehyde
condensed with:
70 parts n-hexyl mercaptan
and
3 drops hydrochloric acid (HCl)
heat until mixture turns red and color does not further de­
velop; then vacuum distill.

Tutti-Frutti Flavor  MF 133

Mixture of

9.25 gm. allyl caproate
18.75 gm. citral
22.50 gm. vanillin
37.00 gm. amyl butyrate
46.00 gm. oil of orange, cold pressed
73.50 gm. ethyl butyrate
185.00 gm. ethyl acetate
185.00 gm. amyl acetate
423.00 gm. oil of lemon, cold pressed

Total
1000.00 gm.

Vanillin, Two-Fold  MF 134

Mix in blender (Fig. 32).

5.00 lbs. Vanitrope (trade name of Shulton, Inc.)
**Imitation Flavors**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.50 lbs. ethyl vanillin</td>
<td></td>
</tr>
<tr>
<td>92.50 lbs. vanillin</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.00 lbs.</td>
</tr>
</tbody>
</table>

**Imitation Bakery Vanilla**

*(Ten-fold)*

Mixture of

- 4.50 oz. av. vanillin
- 1.50 oz. av. Vanillidine (trade name of Van Dyck)
- 1.00 oz. av. ethyl vanillin
- 0.50 fl. oz. benzo dihydropyrene
- 1.00 fl. oz. rum ether, formula MF 125
- 64.00 fl. oz. alcohol, 95 per cent
- 60.00 fl. oz. water (add to make 1 gal. flavor)
- 0.24 fl. oz. caramel

**Yield**

128.00 fl. oz.

Use: One ounce per 100 lbs. cake mix, doughnuts.

**Vanilla-Butter Flavor Imitation**

*(Ten-fold)*

Dissolve

- 2.50 gm. ethyl vanillin
- 5.00 gm. veratraldehyde
- 5.00 gm. benzo dihydropyrene
- 7.50 gm. Vanillidine (trade name)
- 10.00 gm. ethyl butyrate
- 12.50 gm. butyl butyryl lactate
- 17.50 gm. acetoin
- 27.50 gm. vanillin
- 30.00 gm. butyric acid
- 50.00 gm. diacetyl
- 832.50 gm. propylene glycol

**Total**

1000.00 gm.

**Imitation Vanilla Color**

*(Two-fold)*

Procedure: Treat vanillin with KOH and H₂O₂, the mixture turns vanillin to a dark brown liquid; it is used as color for vanilla flavors. Another method is to treat vanillin with NaOH and let oxygen in.

**Vanillin and Vanilla Extract**

*(Two-fold)*

Dissolve

- 49.8 gm. vanillin
2.0 gm. ethyl vanillin
0.3 gm. Vanilidine (trade name)
in:
64.0 fl. oz. propylene glycol; heat, if necessary; allow to cool; then mix with:
4.0 fl. oz. glycerin
32.0 fl. oz. water
16.0 fl. oz. Bourbon vanilla extract, two-fold-formula MF 64
12.0 fl. oz. sugar syrup of 40 Baumé

Total
128.0 fl. oz.

Recommended use: 4 fl. oz. per 100 lbs. cup cake, pound cake, and cream centers; 1 fl. oz. per 5 gal. ice cream mix.

Vanilla Sugar Imitation MF 139
For use in over-all topping, icing, cream filling, and marshmallow topping.

Ingredients per 100 lbs.
12.0 oz. av. Vanilidine (trade name)
12.0 oz. av. ethyl vanillin
12.0 oz. av. vanillin
3.5 fl. oz. rum ether-formula MF 125
3.5 fl. oz. imitation Jamaica rum-formula MF 127
2.0 oz. av. heliotropin
1.5 oz. av. Palatone (trade name)
82.0 lb. regular cerelose-dextrose
8.0 lb. corn starch
3.0 lb. egg coloring, certified egg color

Preparation of color: 3 lbs. certified egg color are mixed in 80 fl. oz. boiling, distilled water; the hot color mixture is added slowly to the vanilla powder in the dry mixer.

Procedure
(a) first pulverize cerelose to required powder, then put it into dry mixer (Day mixer).
(b) mix the vanillins with the rum ether and imitation Jamaica rum, and the powdered heliotropin; then pour the mixture into the dry mixer—while working on cerelose of (a); add flavor through smaller opening of the dry mixer; the large opening is for the purpose of brushing down caked material on the walls; the agitator has to be stopped during brushing of the inside walls of the dry mixer and of the worm;
(c) add the hot color immediately after the flavor;
(d) then add corn starch and mix until dry (about 20 minutes). If the moisture in the room is too high the mixture will take more time to dry; on humid days it dries with difficulty.
Imitation Violet  
\( MF\ 140 \) 

(Orris Imitation)

Mixture of

- 0.10 gm. aldehyde \( C_{12} \)
- 12.50 gm. methyl heptine carbonate
- 22.50 gm. oil of cassia
- 24.90 gm. oil of rose Bulgarian
- 30.00 gm. oil of ylang ylang
- 40.00 gm. oil of santal
- 50.50 gm. heliotropin
- 50.00 gm. oil of guaiac wood
- 150.00 gm. oil of bergamot
- 620.00 gm. ionone, beta

Total  
1000.00 gm.

Imitation Black Walnut  
\( MF\ 141 \)

(a) Ingredients; mixture of

- 9.00 gm. vanillin
- 9.00 gm. heliotropine
- 9.00 gm. racemic acid, formula \( MF\ 121 \)
- 12.50 gm. para-cresylphenyl acetate
- 18.00 gm. ethyl valerate
- 18.00 gm. amyl isovalerate
- 18.00 gm. para-cresylmethyl ether
- 10.70 gm. oil of patchouli
- 0.65 gm. oil of clary sage
- 4.50 gm. aldehyde \( C_{14} \)
- 6.25 gm. aldehyde \( C_{18} \)
- 7.15 gm. benzaldehyde

Total  
122.75 gm. is mixed with:
2147.25 gm. propylene glycol

Yield  
2270.00 gm. to be used in (d).

(b) Dissolve

178.00 gm. fenugreek solid extract
896.00 gm. water, and mix with:
971.00 gm. propylene glycol; the mixture is used in (d)

(c) Dissolve:

10.50 gm. St. John’s Bread, solid extract in
214.50 gm. water; the mixture is used in (d);

(d) Mixture of (b), (c), and (a) to obtain:
yield: 4540.00 gm. or 10 lbs. imitation black walnut flavor.
Whiskey Brown (Oak) Coloring  MF 142
(Also for brandy and vanilla)
Oak bark chips are heated to 302° to 374°F. Burning must be avoided.
Then extract with 50 per cent alcohol and concentrate by evaporation to yield a syrup of about 68 to 70° Brix.

Whiskey Color  MF 143
Roast the bark of the black oak (Quercus tinctoria). Boil the roasted bark for 4 hours in a mixture of
4.50 lbs. glycerin and
4.15 lbs. water.

Whiskey Color  MF 144
Boil quercitrin in water for 20–30 minutes.
Certified Colors

Certified colors are covered under the Food, Drug, and Cosmetic Act of 1938, section 406-B—"The Secretary shall promulgate regulations for the certification of coal tar colors which are harmless and suitable for use in foods."

Certification is safeguarded by the Food and Drug Administration to such an extent that as soon as any container of color is opened, by a person other than the food, drug, or cosmetic manufacturer who intends to use it in his product, it is no longer considered to be certified.

Certified colors may not be converted to liquid paste colors for resale unless the new batch is submitted to the Food and Drug Administration for recertification.

The use of certified, or natural color is permitted in food products to enhance their appearance and make them more pleasing to the eye. They are forbidden when their use conceals inferiority or deceives the purchaser. Individual states and local boards of health have rulings and laws which sometimes do not conform with Federal. Users should therefore correctly inform themselves before coloring a food product for interstate or intrastate shipment. If the coloring of a particular food product is prohibited, no color, whether certified or of natural origin is permitted. In almost every case where artificial color is used, it must be declared on the label; the proper legends to use are as follows:

"Artificially Colored"
"Artificially Colored with Certified Color"
"Artificially Colored with Vegetable or Natural Color."

WATER SOLUBLE PRIMARY FOOD COLORS¹

FD&C Red No. 1 (80 Ponceau 3R)

This is the Maraschino cherry shade; it is used whenever a brilliant lightfast red is required. It is considered fast to light.

FD&C Red No. 2 (184 Amaranth)

FD&C red no. 2 makes a rich burgundy red shade; to brighten the color small amounts of FD & C yellow no. 5 may be added. It is considered fast to light.

¹ Reference Atlas Food Color Guide.
FD&C Red No. 3 (773 Erythrosine)

FD&C red no. 3 makes an almost orange, becoming a brilliant pink or rose shade on dilution.

FD&C Red No. 4 (Ponceau SX)

FD&C red no. 4 is the most brilliant and most yellowish of the certified reds. It is used extensively in combination with FD&C red no. 2 to produce a variety of red shades. This color has many uses in the food industries, such as glazed cherries, etc.

FD&C Yellow No. 1 (10 Naphthol Yellow S)

FD&C yellow no. 1 is a true yellow shade becoming very greenish on dilution. However, as it imparts a bitter taste to food products in presence of acids, it is not generally used. It is largely replaced by FD&C yellow no. 5.

FD&C Yellow No. 5 (640 Tartrazine)

FD&C yellow no. 5 is the most brilliant of all Tartrazines. Tartrazine is a lemon shade used with FD&C blue no. 1, a variety of lime or green shades can be developed.

FD&C Yellow No. 6 (Sunset Yellow F.C.F)

FD&C yellow no. 6 is the orange juice shade—used universally in the beverage and syrup industries, in the confectionery and ice cream trades. In concentrated solutions, it will be a deep orange shade, becoming golden orange on dilution.

FD&C Green No. 1 (666 Guinea Green B)

It is slightly bluer in shade than FD&C green no. 2 and is fairly fast to light. It is used principally in confectionery and ice cream. It should not be mixed with FD&C red no. 2 in grape shades for beverage trade.

FD&C Green No. 2 (670 Light Green S.F. Yellowish)

It produces a slightly bluish green shade and is not fast to light. It is used in confectionery work and to color green cherries. It is rapidly being replaced by blends of FD&C yellow no. 5 and FD&C blue no. 1.

FD&C Green No. 3 (Fast Green F.C.F)

FD&C green no. 3 is very bluish green in solution and most permanent to light; it becomes a yellower green in the presence of citric acid; for lime or mint shades of green, it must be mixed with FD&C yellow no. 5 and is
excellent when mixed with FD&C yellow no. 5 or FD&C red no. 2 for beverage purposes.

**FD&C Blue No. 1 (Brilliant Blue F.C.F.)**

It makes a very beautiful turquoise blue of high brilliance, extremely soluble, and lends itself to combinations of a variety of shades.

**FD&C Blue No. 2 (1180 Indigotine)**

It makes a dark navy blue shade and is used extensively in brown and black mixtures or where a dense color is desirable.

**FD&C Violet No. 1**

It makes a very brilliant violet shade, with good light resistance; when blended with small quantity of FD&C red no. 1 it yields appealing pink shades.

Four ounces of primary colors dissolved in one gallon of water (3.1 per cent) are considered standard for resale purposes (except for FD&C blue no. 2).

**OIL SOLUBLE PRIMARY COLORS**

**FD&C Yellow No. 3 (22 A. B. Yellow)**

It has the same characteristics as FD&C yellow no. 4 except that it is slightly redder in shade.

**FD&C Yellow No. 4 (61 O. B. Yellow)**

It is used principally in coloring oleomargarine and pop corn oils.

Oil soluble colors are dissolved by first heating the oil over a water bath to approximately 150°F.; by pre-heating the oil, the color will dissolve more readily; add color and stir until thoroughly dissolved. 5 oz. av. FD&C yellow no. 3 certified, (A. B. Yellow), and 5 oz. av. FD&C yellow no. 4 certified, (O. B. Yellow), will dissolve in one gallon cottonseed oil.

**BLENDING OF CERTIFIED PRIMARY COLORS**

**Reds**

By mixing FD&C red no. 2, FD&C red no. 1 and FD&C red no. 3 and adding small amounts of FD&C yellow no. 6, FD&C yellow no. 5 and FD&C blue no. 1, various shades of red may be produced.
Yellows
Adding to FD&C yellow no. 5 small quantities of FD&C yellow no. 6 and FD&C red no. 1 or no. 2, various golden egg shades may be produced.
85 parts FD&C yellow no. 5) Medium
15 parts FD&C yellow no. 6) egg shade.

Oranges
Blends of FD&C yellow no. 6 and no. 5 or FD&C red no. 1 and yellow no. 5 produce a more brilliant and stable orange than those made with orange 1.
70 parts FD&C yellow no. 5) Medium
30 parts FD&C red no. 1) orange shade

By increasing the FD&C yellow no. 5, the orange becomes lighter; by decreasing the FD&C yellow no. 5, deeper.

Greens
Blends of FD&C blue no. 1 and FD&C yellow no. 5 will produce any shade of green.
65 parts FD&C yellow no. 5) Medium
35 parts FD&C yellow no. 1) green shade.

By increasing the FD&C blue no. 1, the green becomes bluer or deeper; by decreasing, yellower or lighter.

Violets
Blends of FD&C blue no. 1 and FD&C red no. 2 or FD&C red no. 3 and FD&C blue no. 1 will produce any shade of violet, purple, or orchid. However, as FD&C red no. 3 is not permanent to light, this must be taken into consideration.
80 parts FD&C red no. 2) Medium
20 parts FD&C blue no. 1) violet shade.

By increasing the FD&C red no. 2, the violet becomes redder; by decreasing, bluer. Or use FD&C violet no. 1.

Grape Shades
Blends of FD&C red no. 2, and FD&C blue no. 1, will produce any shade of grape color.
**Bluish Grape**

85 parts FD&C red no. 2) Bluish  
15 parts FD&C blue no. 1) grape shade  
90 parts FD&C red no. 2) Reddish  
10 parts FD&C blue no. 1) grape shade

It is seen from the above formulas that by increasing the FD&C red no. 2, the grape shade becomes redder; by decreasing the FD&C red no. 2, bluer.

**USE OF PRESERVATIVES IN LIQUID COLORS**

Alcohol may be used for dilute solutions such as household colors. Ten per cent (13 oz. to each gallon) is satisfactory. Alcohol should not be used in concentrated solutions as it affects the solubility of certified colors.

Sodium benzoate is a weak preservative and best results are obtained in acid solutions. Use one-eighth oz. dry sodium benzoate in conjunction with one-fourth oz. dry fruit acid to each gallon of color solution. One-tenth of one per cent sodium benzoate without acid has very little preserving value.

Glycerin or propylene glycol may be used but at least 25 per cent by volume is needed to insure the keeping qualities of color solutions.

**MAXIMUM USAGES OF CERTIFIED COLORS**

The table of recommended maximum usages below, are in most cases, greatly in excess of the proportions which are normally used. Only a fraction of the amounts indicated should be necessary to produce satisfactory color in the finished product. However, concentrates, extracts, and other similar preparations are not considered as finished products due to the fact that they are reduced considerably before they are converted into a finished food product.

**FADING OF CERTIFIED COLORS**

Light, acids, and alkalis may act on certified colors causing various reactions, such as fading or changing of shade. The following elements should be avoided as much as possible:

Excessive sunlight, bleaching agents (sulfur dioxide being the most common); tin and iron—are the most common offenders causing a reducing action and resultant fading of color solutions.

Crystallization of the sugar, as the water dries out, is the most common cause of the so-called fading of colored candy. The color is not destroyed. It simply has an affinity for other parts of the candy and thus the color migrates. Impurities in glucose may also cause colors to fade.
Color should be added to ice cream in the freezers, or when the mix is ready for the freezers, thus there is less possibility of bacterial contamination; contact with metals should be avoided as much as possible; if stock solutions are prepared they should be adequately preserved or kept in a cool place to prevent bacterial contamination.
SECTION III

Uses of Food Flavorings
CARBOHYDRATES, FATS, AND PROTEINS

The carbohydrates, the fats, and the proteins (Pyler 1952), constitute nature's three great classes of organic compounds. The carbohydrates include glucose (dextrose), disaccharides, and polysaccharides, starches, and celluloses. Glucose is the building stone of all higher carbohydrates.

Fats are components of plants, and present in greater proportions in animals. They are composed of the same elements as carbohydrates, but in different proportions and arrangements. Plants produce fats by transforming carbohydrates.

Proteins are highly complex nitrogenous substances in all cells of plants and animals. Protein molecules of vegetable plants, in addition to hydrogen, carbon, and oxygen, contain always nitrogen, often phosphorus, and occasionally sulfur.

The protein molecule consists of a large number of different amino acids. They form the basic structural units of protein complexes.

Wheat flour (Matz 1959) may be considered as a complex biological system of proteins, carbohydrates, fats, and minerals in which the normal life process has been interrupted. The natural biological tendencies with which the seed was endowed, such as enzyme reactions, continue to function to a degree modified by the moisture content, temperature, pH, time, and some other components which are in turn acted upon and modified by the fermentation system of the yeast in the dough. Wheat flour (Pyler 1952) among all other cereals is alone capable of forming a dough that will retain gas evolved during fermentation and upon baking yields a light well aerated bread. When flour and water are mixed into dough and this is kneaded thoroughly under water either by hand or by machine, a coherent, extensible, and rubbery mass is obtained.

BREAD FLAVOR

Bread flavor is formed principally in the crust region of the loaf from whence it penetrates into the crumb and is retained there by absorption. The coloring of the crust at high temperatures is attributed to the caramelization of heat-sensitive carbohydrates, and the formation of melanoids. Starch is broken down by heat into highly colored pyro-dextrins. Residual sugars present in the surface layer of the baking dough piece are also transformed or caramelized into brown colored derivatives. Re-
Reducing sugars react under the influence of heat with the amino acids to form highly-colored, highly-flavored melanoidins which are believed to contribute markedly to the characteristic bread aroma. Different amino acids form melanoidins with different characteristic odors. The melanoidin reaction plays a significant part in crust coloration as well as in the formation of the characteristic aroma of baked bread. It is believed that the principal flavoring substances in white bread are diacetyl and acetoin. While present in little more than traces they appear to exert a marked physiological effect. The flavor of rye bread appears to be hydroxymethylfurfural, a colorless and highly volatile substance.

CAKES AND PIES

Cakes

The three basic types of cakes are: (1) layer cakes, such as white layers, yellow layers, chocolate layers, and devil's-food layers; (2) pound cakes; and (3) foam type cakes, such as angel food, sponge-type cakes, and chiffon cakes.

Instead of yeast fermentation, chemical leavening agents such as baking powders are utilized to furnish the necessary amounts of carbon dioxide gas at the right time in the cake baking process. The process lends itself to rapid batter mixing, depositing, and baking.

The flour should be thoroughly bleached, with a pH value of 5.0 to 5.3 and have a fine uniform granulation. Flour is the chief component of the cake structure.

The shortening plays an important role in cake production. It has an important lubricating action, especially during the turbulent movement of melted fat through the mix of gluten and starch during early stages of baking, when it facilitates the great expansion of air cells containing moisture vapor and carbon dioxide gas to make a light, tender texture.

Special emulsified shortenings greatly simplify the cake making process. They hold larger quantities of liquid and give more stable batters that yield a finished cake of larger volume and longer lasting softness.

Shortenings for cake may be partially hydrogenated vegetable, or animal fats, or blends of several of these to a soft plastic consistency at normal working temperatures of 68° to 78°F. Antioxidants may be used to stabilize the finished fat and prevent rapid development of rancidity in storage. Storage temperatures above 90°F. will denature the structure balance within the shortening and greatly decrease the cake making value.

Eggs are also a basic ingredient in cake. They carry flavor and color, exercise a binding action and a structural stabilization, and a leavening function; the lecithin in the egg yolk has an emulsifying action in the
batter. Eggs are used in several forms, as fresh or frozen whole eggs, or separated into yolks and whites or dried eggs, in powdered form, either whole egg whites, or yolks.

The sugars used in cake baking contribute to flavor and texture. Cane or beet sugar of medium sized crystal structure is a basic ingredient, for it is the sharp edges of these crystals that help cut air into the fat during the first, or creaming stage of building the batter. Sugars and syrups of various kinds are also used in the preparation of icings.

Pies

The wide variety of pies can be generally classified as fruit-filled and custard- or cream-filled, which require special preparation of the fillings and baking, or the starch pudding type fillers, and the chiffon fillings, that are added to the baked and cooled pie shells.

Many types of baked products, sweet rolls, coffee cakes, layer or box cakes, and pies may be quick frozen and held for days or weeks until ready for sale.

Freezing of unbaked pies has enabled bakers to produce ahead of demand. Frozen pies may be allowed to thaw out and then baked, or placed in the oven directly and baked.
BAKING TEMPERATURES

Bread

The conditions of heat and humidity maintained in the oven during the baking process must be adjusted to the varying requirements of the type of product being baked. The normal baking temperature ranges from 375° to 450°F. The baking time employed, ranging on an average from 25 to 35 minutes, is controlled primarily by the temperature level, being shorter with high baking temperatures and longer with lower baking temperatures.

Cakes

The oven temperature at which cakes should be baked depends on richness of batter, size of pan, and moisture content of the batter. Batters high in sugar content require low baking temperatures in the range of 325°–350°F., while leaner mixtures may be baked off at temperatures ranging from 350°–400°F. Baking time must be adjusted to baking temperature in an inverse relation; i.e., the higher the temperature, the shorter the baking period.

Doughnuts

Recommended frying temperatures range from 365° to 380°F. Temperatures very much in excess of this range will cause accelerated breakdown of the frying fat and pronounced smoking, and will also impart too dark a crust color to the fried product. On the other hand, temperatures below this range will yield pale colored products and an excess absorption of fat.
PREPARED MIXES

The first prepared mix was made in 1849 when Henry Jones of England assigned a United States Patent No. 6418, to J. Fowler of Baltimore, in which a balanced self-rising flour was prepared from an aged mixture of flour and tartaric acid blended with sodium bicarbonate.

It is estimated that the sale of family mixes at present amounts annually to $300,000,000, bakery mixes to $103,000,000, and institutional mixes to $18,000,000 making a total of $421,000,000. In the next seven years the increase may be from 50 to 60 per cent. There are some 90 different types of mixes on the market and probably an average of five different flavors or minor variations in each type, making approximately 450 to 500 individual mixes in the home field (Matz 1959).

The major constituents of mix ingredients are: flour, leavening agents, shortening, antioxidants, emulsifying agents, eggs (albumen, yolk and whole), milk, sugar, and flavorings.

Leavening Agents for Prepared Mixes

Leavening of cereal products by chemical rather than fermentative means dates from about 1842 when U.S. Pat. 2816 was issued to Conant (1842) for blending flour with tartaric acid, citric acid, alum, or any other known acid in the dry state; sodium bicarbonate, a common household article, was to be dissolved in water, sweet milk, or any other liquid for making up the dough. Early in the 1900's monocalcium phosphate, monohydrate, replaced tartaric acid and cream of tartar, and several patents proposed the addition of fats to self-rising flour, either directly or after imbedding the leavening therein.

Proper leavening of light, moist, flavorful and palatable baked goods depends upon the expansion of preformed gas cells within a dough or batter upon the application of heat.

Carbon dioxide liberated from sodium bicarbonate is by far the most widely used source of leavening gas. Baking acids which react with sodium bicarbonate to liberate gas are:

(1) Phosphates
   (a) Calcium phosphates, including monocalcium phosphate, monohydrate, anhydrous monocalcium phosphate, coated, and dicalcium phosphate, dihydrate.
   (b) Sodium phosphates, including monosodium phosphate, anhydrous, sodium acid pyrophosphate and sodium aluminum phosphate.
(2) Sulfates, such as, sodium aluminum sulfate.
(3) Organic acids, including cream of tartar, tartaric acid, fumaric acid, and glucono-delta-lactone.

Shortening

Nearly all baked products produced from cereal grains require varying quantities of fats or oils of one type or another. Fats contribute to the tenderness, crispness, softness, volume, and to all other aspects connected with the texture of the cereal food.

Baking mixes for prolonged storage require a high keeping quality of the fat. The widespread use of antioxidants, or "oxygen interceptors," has resulted in a major improvement and has greatly broadened the scope of the mix manufacturer in selection of shortenings.

Antioxidants

Precautionary measures are essential in the selection of proper antioxidants for prepared mixes. Gum guaiac, for example, will develop a purple color when exposed to the peroxide-decomposing enzymes. Since flour contains peroxidases, the use of gum guaiac would cause possible color trouble if used in prepared mixes. Propyl gallate turns black if exposed simultaneously to iron rust and moisture. NDGA and propyl gallate produce green discolorations when mixed with egg yolk. No color reaction difficulties have been noted when using BHA, BHT, and citric acid. The use of citric acid and phosphoric acid will aid in inhibiting color development.

Prepared mixes often contain natural antioxidants. Spices used in spice cake mixes are powerful antioxidants and increase rancidity resistance. Sugar, acid phosphates, lecithin, and several other ingredients used in mixes possess antioxidant properties.

Emulsifying Agents

Creaming or emulsification properties of fats determine to a major degree their usefulness in cake mixes. Included in these properties is the ability of the fat to disperse air throughout an aqueous batter in a finely divided and stable state. The emulsion resulting when fats are mixed in aqueous batters will determine the final character of the baked product.

The crystalline structure of the lard responsible for its superiority as a shortening for pie crust and biscuit mixes, is not conducive to suitable creaming and emulsification in aqueous batters; for example, layer cake mixes.

In 1948 a major "break-through" was made in the understanding and evaluation of the effect of fat crystals on creaming quality. The use of
either sodium methoxide or stannous catalytic agents for purposes of securing reorientation of the fatty acids on the glyceride molecule results in both intra- and inter-esterification of the fatty acids contained in the glyceride molecule. As a result of these procedures, a high degree of interchangeability has been developed between the various fats and cake shortenings. The structural arrangements of the glyceride molecules have great influence on the type of crystal produced during solidification of shortenings.

Fats do not “emulsify” in stiff doughs; for example, bread, pie crust, cracker, and biscuit doughs. In such products, emulsification is of little importance. In aqueous doughs and batters, however, fats must disperse themselves in the form of an extremely fine emulsion (usually fat in water emulsion) if the baked product is to be of maximum tenderness, fluffiness, and symmetry.

The air creamed into an aqueous batter is usually held in a suspended state by the fats used in the mix. These air spaces serve as collection points for gases later generated within the baking cake mix from the chemical leavening agent.

Nearly all fats (with the exception of non-rearranged lard) have some ability to emulsify in an aqueous batter. None of the fats, however, is sufficient in itself to produce the desired creaming or emulsifying effect of the modern cake mixes. Among the additives which are commonly used as emulsifying agents are:

- Mono and diglycerides
- Lactylated mono and diglycerides
- Lecithin
- Hydroxylated lecithin
- Polyoxysorbitan monostearate
- Polyoxyethylene stearate
- Sorbitan monostearate
- Sorbitan monooleate

A good cake mix shortening should possess the following properties:

1. quick and easy aeration when subjected to a minimum of mixing;
2. dry, non-greasy body to prevent undue grease soaking and clumping of the cake mixture;
3. the shortening should be bland in flavor and should remain bland after prolonged storage;
4. the final mix should withstand prolonged storage at temperatures as high as 100°F. without serious impairment of cake volume, cake texture, or any other measurable baking characteristic; and
5. the cake mix should perform well when mixed by hand and should not require mechanical mixing.

Doughnut manufacturers use shortenings of high monoglyceride content to produce additional tenderness when desired; however, tenderness and fat absorption go hand in hand and the more tender the final doughnut, the higher will be its fat absorption. There is a wide divergence of opinion concerning the ideal shortening for doughnut mixes.
Egg Products

Egg yolks and whole eggs, although used in relatively small amounts in most baked products and prepared mixes, play a vital role in determining the final quality of the finished product.

According to Pyler (1952) there are six functions performed by eggs in cakes and similar products. These are as follows: (1) binding action; (2) leavening action; (3) emulsifying action; (4) flavor; (5) color; and (6) nutritive value.

Milk

The use of milk in mixes is greatly facilitated by the production of dried milk solids. The introduction of commercial drying equipment in the dairy industry has resulted in the production of products of good quality which will perform consistently from day to day in large scale operations.

Sugars

The functions that sugars play in mixes are: (1) improve flavor; (2) add richness; (3) impart keeping quality; (4) act as a tenderizing agent; (5) contribute to grain and texture; and (6) affect color and crust.

<table>
<thead>
<tr>
<th>Kind of Sugar</th>
<th>Relative Sweetness</th>
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<tbody>
<tr>
<td>Sucrose (cane or beet sugar)</td>
<td>100</td>
</tr>
<tr>
<td>Levulose, fructose</td>
<td>175</td>
</tr>
<tr>
<td>Invert sugar</td>
<td>130</td>
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<tr>
<td>Dextrose hydrate</td>
<td>70</td>
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<tr>
<td>Corn syrup (enzyme converted)</td>
<td>60</td>
</tr>
<tr>
<td>Corn syrup (acid converted)</td>
<td>30</td>
</tr>
<tr>
<td>Maltose</td>
<td>30</td>
</tr>
<tr>
<td>Lactose</td>
<td>15</td>
</tr>
</tbody>
</table>

Powdered sugar is mixed with very low moisture food grade starch to retard caking.

“Drivert” sugar is a trade name for a special sugar manufactured by the California and Hawaiian Sugar Refining Corporation. It is 10 per cent invert and 90 per cent fondant and icing sugar. This combination acts as a moisture retaining agent in products baked from mixes.

Brown sugars are extremely difficult to incorporate as an ingredient due to their caking quality.

Dextrose or corn sugar is used as an ingredient in pancake mixes.

Malt syrup cannot be used because of the difficulty of incorporation.
Dried malt has been used in a very small percentage. It is extremely hygroscopic. Fromalt recently developed by the Froedert Malt Corporation is a caramelized malted barley flour and can be used to impart flavor to mixes.

Molasses is generally used in the production of gingerbread mixes.

Honey has been dried, but it is so hygroscopic that the dried form cannot be used in the production of mixes.

Dried whey is 72 to 73 per cent lactose and has a very pronounced browning and tenderizing effect in cakes.

Maple sugar is used to a very limited extent due to the uncertainty of a uniform supply.

Flavorings

The flavoring ingredients such as vanilla, lemon, nutmeg, orange, and compounds of essential oils and aromatic substances are added in a very small percentage and have little effect on the baking; but flavors such as chocolate, cocoa, caramel, brown sugar, fruits, nuts, and other heavy or solid ingredients at times affect the baking results. With fruits, nuts, etc., it is frequently necessary to use more flour or a stronger type of flour.

SHORTENING

Shortenings are edible fats and oils of vegetable or animal origin. In baked goods, they produce a soft and smooth velvety texture which is called short. Shortening improves the food value and the eating qualities, as well as the appearance and the keeping qualities of bakery products.

Shortening performs important function in cake products in which it is used as a basic ingredient. These functions include the entrapment of air during the creaming process which results in the proper aeration or leavening of the batter and finished cake; fat lubricates the gluten and starch particles, breaking thereby the continuity of the gluten and starch structure that comprises the cell walls and making the crumb tender; it emulsifies and holds considerable amounts of liquid thereby increasing and prolonging the softness of the cakes. Cake batters or doughs are emulsions consisting of an internal phase comprised of the fat and an external phase made up of the remaining ingredients, such as flour, sugar, salt, baking powder, fat, flavor, and other liquid ingredients such as milk, egg, etc.

Margarine

The principal fats and oils used in the preparation of margarine are coconut oil, soybean oil, cottonseed oil, oleo oil, oleo stock, and neutral
lard. Oleo oil beef fat is liquid at room temperature. Neutral lard is leaf
derived at a low temperature. No animal fat is used in vegetable
margarines. Whale oil is sometimes used to a minor extent. Soybean oil
makes up the largest part of all the oil used in margarine. Federal standards require that oleomargarine contain not less than 80 per cent of fat.

The use of milk gives protection against oxidative rancidity but it also
increases the danger of hydrolytic rancidity.

Stabilizers are used to form a water-in-oil type of emulsion. The
stabilizers may be monodiglycerides of fats, various derivatives of poly-
hydric alcohol esters with fatty acids, and other radicals.

Vitamin A is added as fish liver oil, or as a concentrate. Sodium ben-
zoate is also generally added as a preservative.

Often a small amount of diacetyl or imitation butter flavor is added.

**Baker's Margarine**

<table>
<thead>
<tr>
<th>Parts</th>
<th></th>
<th>fat (vegetable oil)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>80.50</td>
<td>2.70</td>
<td>salt</td>
<td></td>
</tr>
<tr>
<td>0.25</td>
<td>0.25</td>
<td>lecithin</td>
<td></td>
</tr>
<tr>
<td>15.50</td>
<td>0.80</td>
<td>monoglycerides</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>milk</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>milk solids</td>
<td></td>
</tr>
<tr>
<td>100.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DAIRY PRODUCTS**

**Butter**

Butter is a mixture of milk fat, buttermilk, and water. Butter is a water
in oil emulsion and has a characteristic aroma and taste which distinguish
it from other edible fats. The flavor of butter is due to the presence of a
very small amount of diacetyl which is formed by the action of lactic acid
fermenting bacteria. These bacteria are able to convert acid in diacetyl.

The natural color of butter is due to its carotene content. Carotene is
found in vegetables and fruits, in grasses, and in other plants. In the ani-
mal body carotene is converted into vitamin A. A yellow dyestuff called
annatto often is used to color butter. Certain oil soluble coal tar dyes are
also used. These colors must be harmless for use in food.

**Starter and Butter Flavor**

Starters are cultures which contain actively growing bacteria to ripen
milk quickly. A starter is prepared by adding (or inoculating) a culture
to a small quantity of milk or skim milk which has previously been pas-
teurized or sterilized to destroy harmful bacteria.
**Table 9**

<table>
<thead>
<tr>
<th>Fatty Acids</th>
<th>Per cent by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butyric</td>
<td>3.7</td>
</tr>
<tr>
<td>Caproic</td>
<td>1.7</td>
</tr>
<tr>
<td>Caprylic</td>
<td>1.0</td>
</tr>
<tr>
<td>Capric</td>
<td>1.9</td>
</tr>
<tr>
<td>Lauric</td>
<td>2.8</td>
</tr>
<tr>
<td>Myristic</td>
<td>8.1</td>
</tr>
<tr>
<td>Palmitic</td>
<td>25.9</td>
</tr>
<tr>
<td>Stearic</td>
<td>11.2</td>
</tr>
<tr>
<td>Arachidic</td>
<td>1.2</td>
</tr>
<tr>
<td>Decylenic</td>
<td>0.1</td>
</tr>
<tr>
<td>Dodecylenic</td>
<td>0.2</td>
</tr>
<tr>
<td>Myristoleic</td>
<td>0.6</td>
</tr>
<tr>
<td>Palmitoleic</td>
<td>3.4</td>
</tr>
<tr>
<td>Oleic</td>
<td>32.8</td>
</tr>
<tr>
<td>Linoleic</td>
<td>3.7</td>
</tr>
<tr>
<td>C18 and C20, unsaturated</td>
<td>1.7</td>
</tr>
</tbody>
</table>

1 Hilditch and Jasperon (1941).

Bacteria are very small organisms, one of the simplest forms of life. They are invisible to the eye and some are difficult to see even under an ordinary microscope. Bacteria become evident through their activities. The life of bacteria begins with growth and reproduction by cell division. When the available food supply decreases by-products of bacterial growth accumulate, reproduction stops and bacteria die.

The first inoculation of milk with a culture is called the mother starter and is held in an incubator for twenty-four hours to facilitate growth of the culture. The mother starter is then transferred to a larger quantity of pasteurized milk to make a second starter. The repetition of the process and transfer of starter to larger lots of milk also increases the active growth of the mother starter and original culture.

The *Streptococcus lactis* is one of the predominating organisms in the butter starter and culture. It forms lactic acid which prevents the growth of harmful bacteria in the milk during fermentation. Other important organisms in butter culture were found to be the *Streptococcus citrocorus* and *Streptococcus paracitrocorus*. They produce lactic acid and also act on citric acid in the milk, forming diacetyl and similar aromatic substances.

**Preparation of Butter Aroma Starter and Starter Distillate**

Only fresh whole raw milk is used for the preparation of starter. The milk is put into a sterilized water jacketed container with agitator and heated to 185° to 190°F. for 30 minutes to sterilize it, and then cooled to
the incubation temperature of 72°F. The mother "double organism" culture is now carefully inoculated at the rate of 16 fluid ounces per 10 gallons into the sterile milk. The bottle containing the culture is poured into the milk with one motion. Care is to be taken that the top of the bottle is not contaminated. The culture is agitated vigorously through the milk and then left to grow and to ferment the milk. During the fermentation the incubation temperature has to be kept uniformly at 72°F.

The incubation is completed with the formation of an even curd over the surface of the fermented milk. The curd is then rapidly cooled without agitation to prevent the formation of overgrowth and whey.

Butter flavor is developed by the fermentation of the dairy salts (citrates) which forms diacetyl. The cultures for use in butter aroma starter are to be renewed for each batch since they do not repropagate well with the bacteria which form lactic acid during the fermentation of the milk.

For larger quantities the process of milk fermentation is repeated by transferring the first starter or so-called mother starter to larger lots of milk under observance of the same procedure and care as of the previous incubation.

The fermented milk is then mixed with water, filtered, and distilled at a low vacuum to obtain starter distillate.

NUTMEG AND MACE

Property and Aromatic Constituents

Oil of nutmeg is widely used in bakery goods and in flavor compositions of other food products. The essential oils of nutmeg and mace have a similar chemical composition. Their odor and taste closely resemble each other. The odor of the oil becomes disagreeable and turpentine-like on exposure to air. However, a 3- to 5-fold fortification with aromatic chemicals having the same contents as this oil prolongs the stability.

There are two varieties of nutmeg oil, the East Indian and the West Indian oil. Odor and taste of the East Indian oil of nutmeg is of superior quality.

Among the aromatic substances of oil of nutmeg are: alpha pinene, dipentene, phellandrene, cymene, linalool, geraniol, camphene, terpineol, safrol, myristicin, eugenol, isoeugenol, butyric acid, and myristic acid. Nutmeg also contains fixed oil which is expressed. It is known as concrete or nutmeg butter. The fixed oil, oleum myristicae, is an orange colored and highly aromatic mass of butter-like consistency.

Knowledge of the constituents of oil of nutmeg offers a suitable guide for formulation of an imitation oil composition.
Cake Emulsifier MF 145

Ingredients

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>200.0 gm. glyceryl monostearate, S fines (trade name)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>150.0 gm. Span 60 (sorbitan monostearate) (trade name)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100.0 gm. Tween 60 (polyoxyethylene (20) sorbitan monostearate) (trade name)</td>
<td>50.0 gm.</td>
<td></td>
</tr>
<tr>
<td>20.0 gm. coconut fatty acids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.0 gm. sodium carbonate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50.0 gm. diacetyl</td>
<td></td>
<td></td>
</tr>
<tr>
<td>475.0 gm. water</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1000.0 gm</td>
<td></td>
</tr>
</tbody>
</table>

Procedure

Mix diacetyl with water and heat up to 160°F., then add coconut fatty acids, sodium carbonate, Tween 60, Span 60, and glyceryl monostearate in that order. Keep mixture hot at all times. Be sure that Span 60 and glyceryl monostearate is completely melted. Use agitator for smooth texture result. Add preservative (0.1 per cent parahydroxybenzoic acid). At 140°F. emulsion forms, increase agitation for a brief period and drop into suitable containers.

Recommended Use.—Up to 2 oz. per 5 lbs. in bakery goods.

Coffee Cake Flavor MF 146

Dissolve:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>92 gm. vanillin, in</td>
<td></td>
</tr>
<tr>
<td>850 gm. alcohol, 95 per cent, then mix with:</td>
<td></td>
</tr>
<tr>
<td>20 gm. cinnamon bark,</td>
<td></td>
</tr>
<tr>
<td>8 gm. oil of bitter almond, free from prussic acid</td>
<td></td>
</tr>
<tr>
<td>10 gm. oil of lemon, cold pressed</td>
<td></td>
</tr>
<tr>
<td>8 gm. oil of coriander</td>
<td></td>
</tr>
<tr>
<td>10 gm. oil of nutmeg</td>
<td></td>
</tr>
<tr>
<td>2 gm. oil of cardamom</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1000 gm.</td>
</tr>
</tbody>
</table>

Custard Flavor MF 147 (with rum flavor)

Mixture of:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 gm. oil of nutmeg</td>
<td></td>
</tr>
<tr>
<td>2.0 gm. oil of orange, cold pressed</td>
<td></td>
</tr>
<tr>
<td>23.0 gm. ethyl vanillin</td>
<td></td>
</tr>
<tr>
<td>192.2 gm. vanillin</td>
<td></td>
</tr>
<tr>
<td>60.0 gm. rum ether, formula MF 125</td>
<td></td>
</tr>
<tr>
<td>0.3 gm. diacetyl</td>
<td></td>
</tr>
</tbody>
</table>
FOOD FLAVORINGS

Kuchen Loaf Flavor    MF 148

Mixture of:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>35.20 gm. ethyl vanillin</td>
<td></td>
</tr>
<tr>
<td>176.00 gm. vanillin</td>
<td></td>
</tr>
<tr>
<td>110.88 gm. oil of cinnamon bark</td>
<td></td>
</tr>
<tr>
<td>35.20 gm. oil of nutmeg</td>
<td></td>
</tr>
<tr>
<td>17.60 gm. oil of cardamom</td>
<td></td>
</tr>
<tr>
<td>17.60 gm. imitation rum flavor, formula MF 126</td>
<td></td>
</tr>
<tr>
<td>7.04 gm. oil of clove buds</td>
<td></td>
</tr>
<tr>
<td>400.72 gm. butter imitation, formula MF 74</td>
<td></td>
</tr>
<tr>
<td>199.76 gm. alcohol, 95 per cent</td>
<td></td>
</tr>
</tbody>
</table>

Total

1000.00 gm.

Lemon Custard Flavor    MF 149

Mixture of:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.25 gm. oil of cinnamon bark</td>
<td></td>
</tr>
<tr>
<td>9.50 gm. oil of nutmeg</td>
<td></td>
</tr>
<tr>
<td>19.25 gm. oil of mandarin</td>
<td></td>
</tr>
<tr>
<td>277.00 gm. oil of lemon, cold pressed</td>
<td></td>
</tr>
<tr>
<td>7.75 gm. ethyl vanillin</td>
<td></td>
</tr>
<tr>
<td>160.25 gm. vanillin</td>
<td></td>
</tr>
<tr>
<td>522.00 gm. alcohol, 95 per cent</td>
<td></td>
</tr>
</tbody>
</table>

Total

1000.00 gm.

Lemon Emulsion    MF 150

Ingredients

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.0 fl. oz. oil of lemon, cold pressed</td>
<td></td>
</tr>
<tr>
<td>32.0 fl. oz. propylene glycol</td>
<td></td>
</tr>
<tr>
<td>2.0 oz. av. gum tragacanth</td>
<td></td>
</tr>
<tr>
<td>80.0 fl. oz. water</td>
<td></td>
</tr>
<tr>
<td>0.18 oz. av. or 5.11 gm. acid citric</td>
<td></td>
</tr>
<tr>
<td>0.36 oz. av. or 10.22 gm. castor oil</td>
<td></td>
</tr>
</tbody>
</table>

Procedure

(1) 0.18 oz. av. or 5.11 gm. acid citric are dissolved in:

2.00 fl. oz. water

(2) 2.0 oz. av. gum tragacanth are mixed with:
32.0 fl. oz. propylene glycol, and whipped until dissolved; to the mixture are added:
16.0 fl. oz. oil of lemon, cold pressed, and
0.36 oz. av. or 10.22 gm. castor oil; the mixture is constantly kept agitated and to it are added:
80.0 fl. oz. water; agitated and to it are added:
(3) the solution of (1) is added to the mixture of (2) and agitated until evenly dissolved; pass through sieve and run through emulsifier (Figs. 20A and 20B).

Madeira Imitation   MF 151

Mixture of:
44.00 gm. oil of nutmeg
132.00 gm. oil of lemon, cold pressed
22.00 gm. oil of coriander
10.00 gm. oil of bitter almond
22.00 gm. diacetvl
44.00 gm. rum ether, formula MF 125
44.00 gm. vanillin
550.00 gm. alcohol, 95 per cent
132.00 gm. propylene glycol

Total
1000.00 gm.

Cake Flavor for Napfuchen   MF 152

Mixture of:
30.0 gm. ethyl vanillin
190.0 gm. vanillin
35.0 gm. oil of bitter almond, free from prussic acid
35.0 gm. oil of nutmeg
70.0 gm. oil of cinnamon
120.0 gm. oil of cassia
220.0 gm. oil of lemon, cold pressed
300.0 gm. oil of orange, cold pressed

Total
1000.0 gm.

Terpene-free Orange Oil Essence   MF 153

Ingredients
4.0 lbs. oil of orange, cold pressed
3.2 oz. av. oil of orange, 10-fold, whose terpenes have been removed by vacuum distillation,
1.5 oz. av. citral
42.5 lbs. or 6.25 gal. alcohol, 95 per cent
39.2 lbs. or 4.0 gal. freshly expressed orange juice
Procedure

(a) Dissolve one gram finely powdered magnesia oxide (MgO) with water.
(b) Add water and magnesia mixture to the oil and stir for 5 minutes.
(c) Let settle for separation of terpenes, Fig. 14, and filter if necessary.

Natural Potato Flavor¹  MF 154

THE POTATO TUBER

Structure of the Tuber

The potato tuber is an abruptly thickened underground stem closely resembling the aerial stem of the potato. The outer skin consists of a layer of corky periderm, some 6 to 14 cells deep, which appears to serve the purpose of retarding loss of moisture and resisting attack by fungi.

Underlying the periderm is the cortex, a narrow layer of parenchyma tissue. Vascular storage parenchyma, high in starch content, lies within the shell of cortex. Xylem and phloem are found in minute strands or bundles, most of which form a narrow, discontinuous ring ("vascular ring") somewhat within the boundary between the cortex and the vascular area. Forming a small central core but radiating narrow branches to each of the eyes, is the pith, sometimes called the "water core." It consists primarily of large cells containing less starch than cells in the vascular area and the innermost part of the cortex.

| Starch, comprising some 65 to 80 per cent of the dry weight of the potato tuber, is calorically the most important nutritional component. In the raw tuber, starch is present as microscopic granules in the leucoplasts lining the interior of the walls of the cells of the parenchyma tissue. The granules are ellipsoidal in shape, about 100 microns by 60 microns on the average. They are thus much larger than the average starch cereal grains.

¹ For use in flour mixes and doughnuts.
When the temperature of a potato is raised to above 122°F., water passes from the non-starchy parts of the cell into the starch granule, which then starts to swell. The starch will begin to gelatinize in the range of 147° to 160°F. In potatoes of high starch content, the cells tend to separate and round off largely because of the swelling of the gelatinized starch. In potatoes of low starch content, the cells tend to retain their original orientation with respect to each other. This results in sogginess.

The starch content of boiled potato tissue is lower than that of the corresponding fresh tissue. This may be due in part to swelling of the starch and resulting cell rupture and leaching. Excessive rupture of cells with concomitant escape of gelled starch causes a gummy texture in the cooked tuber.

**Sugars**

The sugar content of potatoes may vary from only trace amounts to as much as ten per cent of the dry weight of the tuber and thus \( \frac{1}{3} \) to \( \frac{1}{2} \) of the non-starch solids. The two main factors which influence sugar content of potatoes during post-harvest storage are variety and temperature. Freshly harvested mature tubers may contain only traces of sugar, whereas certain varieties of tubers harvested prior to full maturity may have as much as 1.5 per cent sugar. Small tubers are said to contain higher percentages of sugar than do large tubers. At storage temperatures below about 50°F., the total and reducing sugars increase, the rate and extent of increase being greater the lower the temperature down to the freezing point.

**Non-starch Polysaccharides**

As do all higher plants, potatoes contain non-starch polysaccharides which, for the most part, comprise the cell wall and intercellular cementing substances of the tuber. We may conveniently distinguish among the following: (a) crude fiber, (b) cellulose, (c) pectic substances, (d) hemicellulose, and (e) other polysaccharides.

**Phenolic and Related Substances**

The phenolic compounds of potatoes are associated with the color of the raw potatoes. Chemically we may distinguish the following types of phenolic compounds: lignin, coumarins, anthocyanins and flavones, tannins, monohydric phenols, polyhydric phenols (polyphenols).

The lignin of the potato is present, if at all, in very low amounts in the vascular tissue of the tuber. Tannins or their quinones are localized in the suberized tissue of the potato and probably impart the characteristic tan coloration to the skin.
The coumarins, derivatives of the lactone of o-hydroxycinnamic acid, have been claimed to be responsible for the discoloration of cooked potatoes. The color of the flesh and the skin of certain varieties of potato has been ascribed to the presence of anthocyanins and flavones.

Tyrosine, the major monohydric phenol of potatoes, is present in the inner portion of the tuber and constitutes 0.1 to 0.3 per cent of the dry weight of the potato. Recent investigations have been more concerned with the polyphenol chlorogenic acid, a caffeic tannin which constitutes 0.025 to 0.150 per cent of the dry weight of the potato tuber. It is concentrated in a thin layer in the periderm tissue next to the skin. There is about ten times as much chlorogenic acid in the peel as in the flesh of the potato and the concentration in the bud end is about twice that in the stem end.

In the normal, uninjured, healthy potato tuber there is no net oxidation of the phenolic substances to form discoloration products. When the potato tuber is injured by bruising, cutting, or peeling, by disease, or by exposure to toxic vapors, high oxygen tensions, or ionizing radiations, the phenols are rapidly converted to colored melamins.

**Lipids and Organic Acids**

Beside the amino and fatty acids, the following organic acids have been reported to be present in potatoes: lactic, succinic, oxalic, malic, tartaric, citric, isocitric, ascorbic, aconitic,  \( \alpha \)-ketoglutaric, phytic, caffeic, quinic, and chlorogenic.

**Natural Potato Flavor**  
**MF 154**  
(free of starch)

The potato flavor is made by removing the moisture content of peeled potatoes; the separated juice is mixed with propylene glycol; this mixture is then used to extract the potato peels at a temperature of 120°F. for 15 minutes; the extract is drained off either by gravity or by centrifuge; starch separates in storage within 24 hours.

The natural potato flavor is now successfully used in flour mixes and doughnuts instead of potato flour.

**Pound Cake Flavor Oil**  
**MF 155**

Mixture of:

- 27.5 gm. ethyl vanillin
- 126.0 gm. vanillin
- 66.0 gm. oil of bitter almond
- 420.0 gm. oil of cinnamon bark
66.0 gm. oil of cloves
33.0 gm. oil of cardamom
66.0 gm. oil of nutmeg
195.5 gm. oil of lemon, cold pressed

Total
1000.0 gm.

Sweet Dough Flavor MF 156

Mixture of:
150.00 gm. oil of lemon, cold pressed
140.00 gm. oil of orange, cold pressed
2.50 gm. oil of nutmeg
2.50 gm. oil of cinnamon bark
4.75 gm. oil of coriander
71.00 gm. vanillin
18.00 gm. ethyl vanillin
0.15 gm. heliotropin
9.00 gm. citral
0.05 gm. diacetyl, 100 per cent
602.05 gm. alcohol, 95 per cent

Total
1000.00 gm.
THE INSPECTION LAW FOR MEAT PRODUCTS

The meat inspection law makes it illegal to ship meat in interstate or foreign commerce unless the meat has been prepared and processed under the inspection provisions of the law and carries the mark of federal inspection.

The inspection begins with the live animal and continues through the slaughtering operation. It applies to the meat during its many stages of processing and manufacture and to the many ingredients that are used and the processes that are employed in its processing and manufacturing.

The inspection applies also to processed and manufactured meat and meat food products (like smoked ham and bacon) and cooked meats of all kinds (such as sausage and canned products) that are prepared from meat. Among the canned products are corned beef, cooked ham, corned-beef hash, chile con carne, and spaghetti with meatballs.

The meat inspection law is administered by the Agricultural Research Service. The inspector has the power to destroy a condemned product or correct an unsanitary condition. After the inspection control the product-control inspectors take over. Their control extends to the formulation, manufacture, and labeling of the many products that contain meat.

Many ingredients or additives are combined with meat. They include flavorings, spices, water, curing materials, and other foods such as flour, beans, pickles, spaghetti, and dairy products. The inspector sees that these are clean and fit materials to be used in a food product. Rejections of materials are made by the inspector for reasons ranging from insect infestation to filth and chemical contamination.

Anyone who wants to introduce a new chemical additive has to prove it is safe, using methods that are acceptable to the inspection program.

The packer is required to show that the proposed additive is nontoxic and when used as proposed will not create an unsafe condition in the food of which it is an intended ingredient.

Packaging materials must be safe to be in contact with the meat without transferring toxic materials to it. Also, foods must be kept safe from pesticide residues and those that might result from treating animals with estrogenic compounds, antibiotics, and similar agents.

Plastic packaging materials and others intended for use at an inspected meat-packing plant are reviewed to make sure they contain nothing toxic.
Labels on meat products must not be misleading concerning the composition of the product. Statements of ingredients must identify the actual ingredients. Illustrations on labels must not be misleading.

Terms denoting quality must truthfully represent the product to which they refer.

Definitions and standards of identity for the various meats and meat products place maximum limits on the use of such additives as moisture, flour, and many other inexpensive ingredients. Limited amounts of moisture, certain cereals, and nonfat dry milk contribute flavor and texture to certain classes of cooked sausage; excessive amounts of them violate the standard. In frankfurters and bologna, the added moisture must not exceed ten per cent, and the use of fillers is limited to 3.5 per cent. When a filler is used, its presence is declared in the name of the product, as for example, “Frankfurters, cereal added.” The statement of ingredients on the label for such a product includes, of course, a declaration of all ingredients.

Corned-beef hash must contain at least 35 per cent of cooked beef. Meat stews are required to contain not less than 25 per cent of meat; chile con carne, not less than 40 per cent of meat; chile con carne with beans, not less than 25 per cent of meat, all computed on the weight of the fresh meat. Similar requirements apply to such meat foods as spaghetti with meatballs and sauce, scrapple, hamburger, ham spread, tongue spread, pork sausage, and pork with barbecue sauce.

**BEef FLAVORING EXTRACT**

**Beef Extract**

Beef extract is prepared from fresh meat with water and the extract evaporated to contain no more than 25 per cent moisture. Beef extract is manufactured in South American and Australian meat plants. The beef extract is usually obtained from the precooking of fresh lean beef for canned corned beef and/or roast beef. Usually, two or more batches of meat are precooked in the same stock, giving it a solids content of 5 to 6 per cent.

Meat extracts made from fresh meat are light, turbid, and difficult to filter and frequently develop a flocculent precipitate during concentration. The extracts prepared from aged beef contain less organic, insoluble matter than those from fresh beef.

**Preparation of Beef Extract.**—The meat is collected in a storage tank at a temperature of 170° to 180°F. until sufficient quantities are obtained for continuous evaporation. Prior to evaporation the meat is boiled in water for one hour, then held at the approximate boiling temperature for at least
another hour prior to filtering. The extract is then passed through a filter press and transferred to the condensing pans. Care is exercised to prevent grease and scum from the surface from entering the evaporators.

Evaporation takes place in a single, double, or triple effect evaporator of the type used for condensing milk. The single stage evaporator is operated at approximately 25 inches of vacuum and 130°F. The operation continues until a product of 40 per cent solids is obtained. In the second stage the product is concentrated at 29 inches vacuum and 130°F. to 60 per cent solids. The final concentration to 80 per cent solids is accomplished in open, shallow, steam-jacketed finishing pans equipped with agitators at 140°F to 150°F. During the entire procedure the steam coils must be covered by the concentrate to prevent scorching.

SAUSAGES

Sausage Emulsion and Ingredients

Sausages are cylindrically shaped mixtures of various sizes consisting of protein, fat, water, salt, and flavorings. Color, flavor, and texture of sausages depend on the type of meat which is mixed and comminuted together with ice, salt, spice flavorings, curing agents, and selected meat trimmings, to form a sausage emulsion. Exposure to heat then stabilizes or solidifies the emulsion.

Properties of Beef and Sausage Additives

Beef.—The muscle of beef enhances flavor as well as contributes to color and texture of sausages. The beef muscle contains water soluble nitrogenous extractives which act favorably on flavor. They are also the main components of commercial beef extracts.

Fat.—Fat enhances flavor and changes the texture of sausages. They become tender and juicy.

Ice and Salt.—The addition of ice assists in controlling the temperature of the emulsion while it is comminuted. Water and salt make meat protein soluble which then stabilizes the fat globules in the sausage emulsion. Salt also adds to flavor.

Binders.—Cereal flour, potato flour, soy flour, bread or cracker crumbs, milk powder, and casein are some of the binders which are used both to hold together and to extend the meat ingredients in the sausages. The flours which are made from cereals such as corn, durum wheat, and rye and from potato starch absorb water highly; however, they must not readily ferment when mixed with it. The soya flour with its low fat content enables making a sausage flour high in protein content. Rice flours and cracker flours are also high in protein content.
The use of dry milk powder is in limited quantities. Dry milk powder is made from skimmed milk and is used in limited amounts in sausage. Sausages made with small quantities of dry milk powder supposedly have a superior flavor and do not shrink or shrivel in processing as rapidly as sausages in which only corn flour is used.

**Spice Flavorings and Chemical Additives**

Additional characteristics are provided by the flavoring material derived from the leaves, berries, fruit, bark, roots, and flowers of vegetable origin. Spice flavoring consisting of volatile oils and oleoresin or combinations of both complement and replace the use of ground whole spices. These flavorings are usually added to the sausage by first working up the desired quantities with salt or sugar or by direct addition in the form of an emulsion. Spice flavoring consisting of volatile oils and oleoresins are used where it is desirable for the natural color of the meat, which should not be masked by the spices, as for example, in sausages which require ground spices containing sage, cloves, and allspice.

**Other Ingredients Than Spices**

The other condiments used in meat products are pistachio nuts, monosodium glutamate, sausage flour, and dried milk powder. Pistachio nuts are used in head cheese, meat loaves, and braunschweiger. The nuts are grown in Sicily, Turkey, Syria, and Persia on small trees. They are sun-dried. Monosodium glutamate has little flavor of its own but enhances the natural flavor of the product in which it is used. About 0.05 to 0.20 per cent is usually required to give the desired flavoring effect to the finished weight of the product in which it is used. Monosodium glutamate is also used in meat loaves, soups, stew, bouillon cubes, extract of beef, hash, in imitation sausages, canned beef with gravy, vegetables, noodles, and buttered and deviled meat products.

Other additives are ascorbates and iso-ascorbates, which assist in obtaining uniformity and increasing coloring matter.

**COOKERY**

Preparing culinary dishes is like composing harmonious music and well-dished dinner tables serve more to fulfill adventurous expectation than to still hunger.

There are four basic principles in cooked dishes: proper and accurate measurements, proper cooking temperatures, proper length of cooking time, and proper time for serving. Hot foods should come sizzling hot from the broiler or the pan and cold food should be served ice cold.
## Table 11

**USE OF HERBS AND SPICES IN FOOD**

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<th>Bakery Products</th>
<th>Condiments (Chili, Curry, Caper)</th>
<th>Eggs Dishes</th>
<th>Fish Dishes</th>
<th>Meat and Delicacies</th>
<th>Pickling</th>
<th>Poultry Dressing</th>
<th>Pickles and Preserves</th>
<th>Salad Dressing</th>
<th>Sauces</th>
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### Table 11 (continued)
**USE OF HERBS AND SPICES IN FOOD**

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Seasoning is to be made light at the outset of a dish. This caution applies to salting, to pungent peppers, sauces, and herbs in cooked dishes. It is easy to add seasoning ingredients before serving and impossible to detect an overdose when it is in, or to dilute with additional material. Fortified white or red wines, such as Madeira, Marseilles, sherry, and port, add a delicate zest to many soups, sauces, and meat dishes. However, the wine used in cooking, poaching, or basting food is to be added to the cooking dish shortly before serving time. The alcohol content of fortified wines evaporates under heat and with the steam of the cooked dish also goes most of the flavor. Butter added to fish, meat, vegetables, and sauce picks up the basic aromatic nature of the dish and adds richness to the food. The addition of a little sugar on steak before broiling, on pork, or in the boiling water of green peas, corn on the cob, carrots, beans, in green salads, emphasizes the main delicate flavor of the food.

Meat

Under Federal regulations, all meat that is to be shipped in interstate commerce must be federally inspected and stamped. Federally inspected meat bears a stamp placed on all the large, wholesale cuts reading “U.S. Inspected and Passed,” which is stamped on the meat with a harmless vegetable coloring. The government also provides for grading of meat for a very nominal fee only at the buyer’s request.

There are seven official U.S. Government grades of beef: U.S. Prime, U.S. Choice, U.S. Good, U.S. Commercial, U.S. Utility, U.S. Cutter, U.S. Canner. The “U.S.” is part of the name and all meat graded by the government carries the full name of the grade down the entire length of the carcass, so that each retail cut plainly carries the grade marking when the carcass is divided for sale.

Prime grade beef is produced from young and well-fed beef type cattle. Cuts from such beef have liberal quantities of fat interspersed within the lean (marbling). These characteristics contribute greatly to juiciness, tenderness, and flavor of the meat.

Choice grade is of high quality with less fat than the Prime grade.

Good grade lacks the juiciness associated with a higher degree of fatness.

Commercial beef is largely from older animals and usually lacks the tenderness of the three previous grades. Most of the cuts require long, slow cooking with moist heat to make them tender and to develop the rich, full beef flavor characteristic of mature beef.

Utility beef is produced mostly from cattle somewhat advanced in age. It is usually lacking in natural tenderness and juiciness. The cuts of this
grade carry very little fat. However, they provide an economical source of lean meat for pot roasts, stews, or ground meat dishes.

U.S. Cutter and U.S. Canner are the lowest grades of beef. They are used mainly in canned meats and in ground sausage products.


The three groups of pork, meat type, are divided into four grades. U.S. No. 1, U.S. No. 2, U.S. No. 3, and U.S. Cull.

The two basic ways of cooking meat are by dry heat and by moist heat. Dry heat is roasting, broiling, pan-broiling, and frying. Moist heat is braising, and cooking in water. The method of cooking meat depends on the kind and cut of meat and the grade.

Dry heat cooking is successful with meats which have comparatively little connective tissue and which readily become tender when cooked. Moist heat is required by meats with more connective tissue and which are tenderized only by long, slow cooking.

**Meat Gravy.**—The gravy is an important part of the meat course at any meal, for good gravy enhances the flavor of the meat or the starchy food with which it is served. Good gravy should have the definite flavor of the meat with which it is served, not of some other meat.

Every kind of meat gravy has its own typical flavor, only its color varies, which is influenced by the method of cooking, the cooking temperature, and the kind of liquid used for making the gravy. If gravy is too bland, a small amount of grated onion will improve the flavor.

**Pastry and Pies**

Pies are the most popular of all desserts in this country. The pastry must be beautifully browned, tender, flaky, and good in flavor. Equally important is the filling, which must be ample in quantity, delicious in flavor, true in color, and of the right consistency.

There are only four common pastry ingredients. Each one has to be of the right type and accurately measured.

Flour is the ingredient that makes up the bulk of the pastry. An all-purpose flour of good quality is best for pastry. Bread flour contains more gluten and makes a heavier, tougher pastry than does all-purpose flour. Cake flour contains less gluten and makes pastry which tends to be very tender and crumbly. An excess of flour makes pastry dry, hard, and tough. Too little flour makes it sticky or greasy and difficult to handle. Flour should always be sifted before measuring. Sifting before measur-
ing produces flour of uniform compactness and permits accurate measurement.

Salt is an essential ingredient in pastry. It gives the "lift" to flavor. Without salt the pastry is flat in flavor and pale in color.

Shortening makes pastry tender and flaky. Vegetable fat or hydrogenated lard is best for general pastry making. Other fats may be used for variation in flavor. Cold chicken fat makes delicious pastry for chicken pies, fish, or meat pies. Butter also gives a pleasing flavor and a brown color to pastry, but butter pastry is never quite so tender as pastry made with shortening which is 100 per cent fat. The same thing is true of margarine pastry. Oil pastry is very tender but crumbly rather than flaky. Too much shortening makes pastry greasy and difficult to handle; too little makes it solid, hard, and tough.

Water holds together the blended flour-shortening mixture. It should be ice cold. The exact amount of water required for a good pastry varies slightly with the season of the year, dryness of the flour, room temperature, and humidity. Too much water makes pastry wet and sticky. Too little water will not bind the flour-coated shortening particles enough to hold them together.

Milk is sometimes used instead of water, but the pastry tends to be less tender than that made with water. Chilled citrus juices may also be used instead of water.

Sauces

A sauce glamorizes the simplest of food. The four basic sauces for meat, vegetable, and fish are white, veloute, and hollandaise sauces and savory butters. The sauces by other names are derivatives of these four basic sauces. In white sauce the basic ingredient is milk which is thickened with flour and is enriched with butter. In veloute sauce the chief ingredient is rich chicken broth thickened with flour and enriched with butter and seasonings and sometimes cream. The three basic ingredients in hollandaise are butter, egg yolks, and lemon juice with seasonings for accent. In savory butters, the basic ingredient is butter which is creamed and then blended with some other ingredient to give it individual flavor such as lemon for lemon butter, pounded lobster, or shrimp to produce lobster and shrimp butter, and others. The two basic classifications for dessert sauces are hard sauce and liquid sauce such as custard, foamy, and others.

Soups

Soup is an appetizer which is served at the beginning of the meal. Soups are rich in food value.
Cream soups contain milk and butter in addition to the vegetable which usually gives them their flavor.

Chowder is a cream soup containing a large proportion of solid food cut rather coarsely. Fish and clam chowders were the original members of this group. Chowders are often made with vegetables such as corn, potatoes, and even spinach.

Clear soups are made with meat or vegetable broth for flavor. Vegetable soups often have a meat broth base, but their flavor is derived from the vegetables they contain.

Soup may be garnished just by a few crisp croutons floating on top of the bowlful, a sprinkling of chopped parsley, a few kernels of puffy popcorn or one of the puffed cereals, some gratings of raw carrot, or a puff of whipped or thick sour cream. The garnish should be put on just before the soup is served in order to be at its freshest.

Vegetables

Vegetables supply a large proportion of the vitamins and minerals needed for health. Vegetable leaves and stems contain chlorophyll, which is the same substance that makes grass green. Chlorophyll is affected by acids, alkalis, and certain minerals in the presence of heat. To keep the natural color, green vegetables should be cooked quickly and for as short a time as possible. They should be cooked uncovered so the volatile part of the acid present in the vegetables themselves can pass off with the steam instead of remaining in contact with the chlorophyll. Vegetables cooked until just barely tender have a better flavor, better appearance, and retain more food value than when cooked longer.

The addition of a small amount of soda to the cooking water to intensify the green color is not recommended. The slightest excess will make the vegetable slippery and unpleasant to eat. It also destroys a considerable proportion of the vitamin content and makes the color unattractive.

The green vegetables include spinach, chard, asparagus, Brussels sprouts, green cabbage, green beans, peas, and all leafy or stem vegetables which have a green color.

Red vegetables react the opposite of green ones. They turn redder and become more pleasing in appearance when there is acid in the cooking water. The presence of alkali will cause them to turn bluish. The pigments which color red vegetables such as beets and red cabbage are called anthocyanins.

The battle in which they are cooked should be tightly covered. The addition of a little vinegar or lemon juice, or of tart apples, helps to keep the color brilliant.
Red color in beets is also influenced by the care in preparation. Any break in the skin or the tap root results in "bleeding" into the cooking water and makes the cooked beets pale in spite of an acid water.

Yellow vegetables are the least susceptible to color changes of all the vegetables. However, careful cooking methods are recommended to preserve food value and brilliant color. Overcooking often results in a gradual leaking of the pigment, carotene, into the water so that the water becomes bright yellow and the food pale. Yellow vegetables may be steamed or boiled, either covered or uncovered.

White vegetables mostly show no color. They contain substances called flavones, which change to an unattractive brownish gray if there is an excess of iron in the water, or if the vegetable is overcooked. They should be cooked rapidly until just tender. The vegetables of this group are white potatoes, white onions, white turnips, and cauliflower. Potatoes may be cooked covered, but the others belong to the strong-juice class and should be cooked in an uncovered pan.

The strong-juiced vegetables include broccoli, Brussels sprouts, cabbage, cauliflower, kohlrabi, onions, and turnips. They all contain volatile substances which if retained in the kettle by covering it, react on the sulfur content of the vegetables to produce compounds that are not only disagreeable in odor and flavor, but difficult to digest. The unpleasant cabbage odor is caused not by the cabbage itself, but by these unsavory sulfur compounds resulting from prolonged cooking in a covered kettle. Strong-juiced vegetables are cooked quickly in slightly alkaline water until they are just tender and always in an open pot. A generous amount of water is usually recommended.

Pot Liquor

When more than the minimum amount of water is used for cooking, it should never be poured down the sink. It is called "pot liquor" and contains valuable food elements. The water from potatoes cooked without their skins should be saved. It may be used for making meat gravy or to dilute evaporated milk in making white sauces for other creamed vegetables. The pot liquor should always be used as soon as possible after cooking.

CATSUP

Property

Catsup is the name for a variety of products which consist of the strained and concentrated pulp of various fruits to which spice flavorings are added.
### Table 12

**Parts of Herbs and Spices Used in Culinary Products**

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<td>Mustard, white</td>
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<tr>
<td>Mustard, black</td>
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<td>Rue</td>
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<tr>
<td>Safflower (false saffron)</td>
<td>x</td>
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</tbody>
</table>
### Table 12 (Continued)

**PARTS OF HERBS AND SPICES USED IN CULINARY PRODUCTS**

<table>
<thead>
<tr>
<th>Part Used</th>
<th>Plant</th>
<th>Leaves</th>
<th>Stalks</th>
<th>Flowers</th>
<th>Blossom</th>
<th>Seeds</th>
<th>Buds</th>
<th>Bulb</th>
<th>Cloves</th>
<th>Mistletoe</th>
<th>Stems</th>
<th>Flowers</th>
<th>Roots</th>
<th>Tips</th>
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<tbody>
<tr>
<td>Saffron</td>
<td>x</td>
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<tr>
<td>Sage</td>
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<td>Summer savory</td>
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<tr>
<td>Winter savory</td>
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<td>Shallot</td>
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<td>Shillefret</td>
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<td>Sorrel</td>
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<tr>
<td>Thyme</td>
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<tr>
<td>Woodruff</td>
<td>x</td>
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<tr>
<td>Wormwood</td>
<td>x</td>
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</tbody>
</table>

#### Oil Catsup Spice MF 157

Mix the following oils:

- 571.65 gm. cloves
- 99.0 gm. cassia
- 79.20 gm. nutmeg
- 99.0 gm. pimenta berries
- 79.20 gm. mace
- 4.95 gm. mustard
- 67.0 gm. celery seed

**Total**

1000.00 gm.

#### MAYONNAISE AND SALAD DRESSING

**Definition by Government Specifications**

A. Mayonnaise is defined by government specifications as an emulsified, semi-solid food containing:

1. At least 65 per cent by weight of edible vegetable oils.\(^1\)
2. Vinegar of not less than 2.5 per cent acidity by weight, or vinegar mixed with citric acid, lime, or lemon juice, provided the acid does not account for more than 25 per cent of the weight of the vinegars calculated as acetic acid.
3. Liquid or frozen egg yolks, either mixed with liquid or frozen egg whites.
4. Salt, sugar, dextrose, corn syrup, honey, other syrups, mustard,

\(^1\)Olive oil has been found unsuited for use in commercial salad dressing or mayonnaise.
paprika, other spices or spice oils, monosodium glutamate, and any suitable harmless food flavoring provided they do not simulate egg yolk color.

B. Salad Dressing is defined as an emulsified semi-solid food containing:

(1) At least 30 per cent by weight of edible vegetable oils.

(2) Vinegar or vinegar-water mixture, or vinegar-citric acid mixture, lime, or lemon juice. (See A-2)

(3) Starch paste prepared with a food starch, tapioca flour, wheat, or rye flour and water.

(4) Liquid or frozen egg yolks, liquid or frozen whole eggs, or any of these mixed with liquid or frozen egg whites in an amount up to at least four per cent by weight of liquid egg yolks.

(5) Salt, sugar, dextrose, corn syrup, honey, other syrups, mustard, paprika, other spices, spice oils, spice extracts, monosodium glutamate, and any suitable food flavoring other than imitations imparting or simulating egg yolk color.

(6) Gum acacia (arabic), locust bean gum; gum guar, gum karaya, gum tragacanth, Irish moss extract, pectin, propylene glycol, ester of alginic acid, sodium carboxymethyl cellulose, all of them not exceeding 0.75 per cent of the finished dressing.

C. Prohibited ingredients in mayonnaise and salad dressing: Antioxidants, tartaric acid, ascorbic acid, mineral oil, dried egg yolk products, milk, milk solids, non-fat dry milk solids, or cream.

Oil Mayonnaise Spice MF 158

Mixture of the following oils:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>101.2 gm. black pepper</td>
<td>101.2 gm.</td>
</tr>
<tr>
<td>99.0 gm. nutmeg</td>
<td>99.0 gm.</td>
</tr>
<tr>
<td>105.6 gm. celery</td>
<td>105.6 gm.</td>
</tr>
<tr>
<td>298.0 gm. lemon</td>
<td>298.0 gm.</td>
</tr>
<tr>
<td>396.2 gm. mustard</td>
<td>396.2 gm.</td>
</tr>
<tr>
<td>Total</td>
<td>1000.0 gm.</td>
</tr>
</tbody>
</table>

FLAVOR TEST AND EVALUATION OF BOTANICAL INGREDIENTS AND ESSENTIAL OILS IN FOOD

For spices a white sauce is prepared consisting of 7 per cent wheat flour, 0.5 per cent salt, 0.4 per cent sugar, and 92.1 per cent water, the spice flavorings are then added and the mixture is cooked.

For spice oils, prepare a white sauce consisting of 6.44 per cent wheat flour, 0.46 per cent salt, 0.37 per cent sugar, 84.73 per cent water, 6.00 per cent vegetable oil, and 2.00 per cent food grade glyceryl monostearate
and cool this mixture. It is an oil-in-water emulsion in which spice oil disperses easily.

For capsicum, caraway, coriander, ginger, mustard, paprika, pepper, and sage, prepare a cream sauce consisting of 17 per cent butter, 13 per cent flour, 1.1 per cent salt, 0.4 per cent sugar, and 68.5 per cent water.

For cassia, cloves, mace, and nutmeg, prepare an eggnog consisting of 84.5 per cent homogenized milk, 12 per cent whole egg, 3.3 per cent sugar, and 0.2 per cent salt.

For flavor and color of spice extracted by an alcoholic menstruum, prepare a sugar syrup consisting of 20 per cent sugar, 0.3 per cent salt, and 79.7 per cent water.

For spice used in pickling, prepare cabbage relish consisting of 90 per cent raw, finely chopped white cabbage, 1.0 per cent salt, 3.0 per cent sugar, 1.0 per cent glacial acetic acid, and 5.0 per cent water.

Flavor stability of a meat mixed with spices is tested with ground, cooked meat and the test food should not contribute any flavor of its own.

Aspic Extract MF 159

Extraction of comminuted botanical ingredients:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount (gm.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>laurel</td>
<td>1.65</td>
</tr>
<tr>
<td>clove</td>
<td>6.65</td>
</tr>
<tr>
<td>pepper</td>
<td>33.35</td>
</tr>
<tr>
<td>leek</td>
<td>41.65</td>
</tr>
<tr>
<td>parsley</td>
<td>41.65</td>
</tr>
<tr>
<td>celery</td>
<td>41.65</td>
</tr>
<tr>
<td>Total</td>
<td>166.60</td>
</tr>
</tbody>
</table>

and menstruum consisting of:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount (gm.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>alcohol</td>
<td>842.00</td>
</tr>
<tr>
<td>water</td>
<td>158.00</td>
</tr>
</tbody>
</table>

Recommended Use.—One oz. av. for one gallon jelly or tomato juice.

Oil Spice for Barbecue Sauce MF 160

Mix:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount (gm.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>sweet marjoram</td>
<td>13.2</td>
</tr>
<tr>
<td>bay leaves 55/60 phenol</td>
<td>24.2</td>
</tr>
<tr>
<td>oil of thyme, white</td>
<td>24.2</td>
</tr>
<tr>
<td>coriander</td>
<td>35.2</td>
</tr>
<tr>
<td>black pepper</td>
<td>88.0</td>
</tr>
<tr>
<td>oil of pimenta leaf</td>
<td>59.4</td>
</tr>
<tr>
<td>nutmeg</td>
<td>59.4</td>
</tr>
<tr>
<td>cloves</td>
<td>178.2</td>
</tr>
<tr>
<td>oleoresin of capsicum</td>
<td>94.6</td>
</tr>
<tr>
<td>Ingredient</td>
<td>Weight</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>oleoresin of ginger</td>
<td>94.6 gm.</td>
</tr>
<tr>
<td>oil of onion or garlic</td>
<td>70.4 gm.</td>
</tr>
<tr>
<td>pyroligneous acid, purified</td>
<td>116.6 gm.</td>
</tr>
<tr>
<td>oil of cade</td>
<td>142.0 gm.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1000.0 gm.</strong></td>
</tr>
</tbody>
</table>

**Long Bologna Spice Oil**  
**MF 161**

Mix:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>oil of coriander</td>
<td>17.5 gm.</td>
</tr>
<tr>
<td>oil of black pepper</td>
<td>195.0 gm.</td>
</tr>
<tr>
<td>oil of cloves</td>
<td>325.0 gm.</td>
</tr>
<tr>
<td>oil of nutmeg</td>
<td>150.5 gm.</td>
</tr>
<tr>
<td>oleoresin capsicum</td>
<td>312.0 gm.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1000.0 gm.</strong></td>
</tr>
</tbody>
</table>

Shake well.

**Oil Spice for Braunschweiger Liverwurst**  
**MF 162**

Mix:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>oil of ginger</td>
<td>8.6 gm.</td>
</tr>
<tr>
<td>oil of cinnamon, Ceylon</td>
<td>11.0 gm.</td>
</tr>
<tr>
<td>oil of sweet marjoram</td>
<td>30.8 gm.</td>
</tr>
<tr>
<td>oil of cardamom</td>
<td>52.8 gm.</td>
</tr>
<tr>
<td>oil of coriander</td>
<td>92.4 gm.</td>
</tr>
<tr>
<td>oil of black pepper</td>
<td>209.0 gm.</td>
</tr>
<tr>
<td>oil of nutmeg</td>
<td>241.0 gm.</td>
</tr>
<tr>
<td>oleoresin of celery 5-fold</td>
<td>4.4 gm.</td>
</tr>
<tr>
<td>oleoresin ginger, alcoholic</td>
<td>66.0 gm.</td>
</tr>
<tr>
<td>oleoresin capsicum</td>
<td>286.0 gm.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1000.0 gm.</strong></td>
</tr>
</tbody>
</table>

Shake well.

**Caper Flavor**  
**MF 163**

Mix:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>oil of garlic</td>
<td>0.25 fl. oz.</td>
</tr>
<tr>
<td>oil of dillseed</td>
<td>0.25 fl. oz.</td>
</tr>
<tr>
<td>oil of mustard</td>
<td>4.00 fl. oz.</td>
</tr>
<tr>
<td>alcohol, 95 per cent</td>
<td>32.00 fl. oz.</td>
</tr>
<tr>
<td>propylene glycol</td>
<td>91.50 fl. oz.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>128.00 fl. oz.</strong></td>
</tr>
</tbody>
</table>
Chicken Spice Seasoning  \( \text{MF 164} \)

Mix:

\[
\begin{align*}
7 \text{ oz. av. oleoresin of capsicum, and} \\
6 \text{ oz. av. oleoresin of celery, and} \\
12 \text{ lbs. monosodium glutamate} \\
8 \text{ lbs. meatloaf flour} \\
79 \text{ lbs. & 1 oz. av. salt}
\end{align*}
\]

Total 100 lbs. chicken spice seasoning

Recommended Use.—One pound of seasoning per 100 lbs. of meat.

Oil Spice for Chicken Loaf  \( \text{MF 165} \)

Mix:

\[
\begin{align*}
57.2 \text{ gm. oil of parsley leaves} \\
30.8 \text{ gm. oil of sweet marjoram} \\
41.8 \text{ gm. oil of celery seed} \\
83.6 \text{ gm. oleoresin celery} \\
79.2 \text{ gm. oil of cloves} \\
22.0 \text{ gm. oil of caraway} \\
99.0 \text{ gm. oil of pimento berries} \\
17.6 \text{ gm. oil of bay leaves 55/60 per cent} \\
8.8 \text{ gm. oil of nutmeg} \\
17.6 \text{ gm. oil of carrot seed} \\
22.0 \text{ gm. oleoresin capsicum} \\
520.4 \text{ gm. oil of black pepper}
\end{align*}
\]

Total 1000.0 gm.

Chicken Soup Spice  \( \text{MF 166} \)

Mixtire of:

\[
\begin{align*}
10.00 \text{ lbs. monosodium glutamate} \\
1.75 \text{ lbs. onion powder} \\
40.00 \text{ lbs. salt} \\
14.00 \text{ lbs. Paygel wheat starch} \\
25.50 \text{ lbs. cerelose} \\
2.00 \text{ lbs. celery creme of spice (sugar base) of Wm. J. Stange Co.} \\
1.75 \text{ oz. av. paprika} \\
4.00 \text{ oz. av. turmeric} \\
1.00 \text{ oz. av. powdered caramel}
\end{align*}
\]

Total 100.00 lbs.
Curry Powder  

Mix of comminuted spices:

- 228.0 gm. turmeric
- 200.0 gm. coriander seed
- 100.0 gm. black pepper
- 100.0 gm. cumin seed
- 90.0 gm. Jamaica ginger
- 90.0 gm. fennugreek seed
- 45.0 gm. cloves
- 45.0 gm. celery seed
- 22.5 gm. caraway seed
- 10.5 gm. garlic powder
- 9.0 gm. mace

Total 1000.0 gm.

Oil Dill Spice  

Mix:

- 84.50 gm. oil of dillweed
- 1.75 gm. oil of garlic
- 3.75 gm. oleo of capsicum
- 2.50 gm. oil of cassia
- 2.50 gm. oil of cloves
- 2.50 gm. oil of pimento berries
- 1.25 gm. oil of mustard
- 1.25 gm. oil of bay leaves

Total 100.00 gm.

Kosher Dill Pickle Spice Oil  

Mix:

- 44.00 gm. oil of cloves
- 20.00 gm. oil of pimento berries
- 6.75 gm. oleoresin of capsicum
- 2.25 gm. oil of black pepper
- 3.25 gm. oil of garlic
- 843.85 gm. oil of dillweed

Total 1000.00 gm.

To flavor garlic type dill pickles and to eliminate the use of garlic chips, garlic juice, or fresh garlic, it is recommended to use one ounce of Kosher dill pickle spice oil per 5 gal. cask of pickles.
Fish Seasoning  \text{MF 170}

Mix:
\begin{itemize}
  \item 80 gm. oil of cloves
  \item 140 gm. oil of pimenta berries
  \item 40 gm. oil of cassia
  \item 10 gm. oleoresin of ginger
  \item 30 gm. oleoresin of capsicum
  \item 210 gm. propylene glycol
  \item 490 gm. Tween 80
\end{itemize}

Total
1000 gm.

Frankfurter Seasoning Oil  \text{MF 171}

Mix:
\begin{itemize}
  \item 1.650 gm. oil of cumin
  \item 3.300 gm. oil of mustard
  \item 3.300 gm. oil of celery
  \item 5.225 gm. oil of ginger
  \item 14.300 gm. oil of cloves
  \item 17.600 gm. oil of sweet marjoram
  \item 17.600 gm. oil of coriander
  \item 22.000 gm. oil of pimenta berries
  \item 43.725 gm. oil of black pepper
  \item 372.300 gm. oleoresin capsicum
  \item 500.000 gm. oil of nutmeg
\end{itemize}

Total
1000.00 gm.

Bismarck Herring Flavor  \text{MF 172}

Mix the following oils:
\begin{itemize}
  \item 3.30 gm. mustard
  \item 9.90 gm. sweet marjoram
  \item 14.30 gm. black pepper
  \item 26.40 gm. laurel leaves
  \item 28.60 gm. pimenta leaves
  \item 35.20 gm. cassia, rectified
  \item 70.40 gm. cloves
  \item 105.0 gm. oregano, Spanish
  \item 52.80 gm. estragon
  \item 653.50 gm. dillweed
\end{itemize}

Total
1000.00 gm.
Oil Sausage Spice for Liverwurst    MF 173

Mix:

- 500.0 gm. oil of nutmeg
- 150.0 gm. oil of sweet marjoram
- 100.0 gm. oil of pimenta berries
- 12.5 gm. oil of mustard
- 37.5 gm. oil of thyme white
- 50.0 gm. oil of black pepper
- 25.0 gm. oil of cloves
- 75.0 gm. oleoresin of capsicum
- 50.0 gm. oleoresin of ginger, alcoholic

Total
1000.0 gm.

Shake well.

Maple Syrup—Sevenfold—(Fortified?)    MF 174

Mixture of:
- 312 lbs. and 7 oz. av. maple syrup
- 15 lbs. and 0 oz. av. syrup 74.9° Brix
- 4 oz. av. coffee flavoring extract, formula MF 61
- 14 oz. av. fenugreek tincture 1 per cent. (fenugreek solid extract dissolved in water)
- 8 oz. av. lovage essence 1 per cent. (oil of lovage dissolved in alcohol, 95 per cent)
- 1 oz. av. racemic acid, formula MF 191
- 14 oz. av. caramel

Total
330 lbs. maple syrup—sevenfold, fortified

Minced Ham Seasoning    MF 175

(a) Flavoring
Mixture consisting of:
- 300.0 gm. oil of caraway
- 110.0 gm. oil of coriander
- 60.0 gm. oil of marjoram
- 300.0 gm. oleoresin of dillweed
- 230.0 gm. oleoresin of celery

Total
1000.0 gm.

Recommended Use.—One ounce of (a) per 100 lbs. seasoning mixture (b) consisting of:

(b) 6.25 lbs. red pepper
25.00 lbs. paprika

For use in smoked Virginia ham and other meat products.
240  

FOOD FLAVORINGS

44.75 lbs. dextrose
21.50 lbs. salt
2.50 lbs. tricalcium phosphate (conditioner)

Total
100.00 lbs. minced ham seasoning

Mince Meat Flavor  MF 176  
(Rum flavor)

Mixture of:
42.0 fl. oz. Jamaica rum flavor—formula MF 127
84.0 fl. oz. raisin concentrated extract—formula MF 27,
42.0 fl. oz. wine bitter aperitif flavor—formula MF 263

Total
128.0 fl. oz. flavor

Recommended Use.—16 to 32 fl. oz. per 1000 lbs.

Mince Meat Flavor  MF 177  
(Brandy flavor)

Mix:
20.0 fl. oz. brandy flavor imitation—formula MF 73,
20.0 fl. oz. alcohol, 95 per cent
26.0 fl. oz. sherry flavor—formula MF 31,
12.0 fl. oz. raisin true fruit concentrated extract—formula MF 27,
50.0 fl. oz. wine bitter aperitif flavor—formula MF 263

Total
128.0 fl. oz. flavor

Recommended Use.—16 to 32 fl. oz. per 1000 lbs.

Onion Flavor  MF 178

Mix:
0.6 gm. oil of onion
6.4 gm. alcohol, 95 per cent
30.0 gm. Tween No. 80
30.0 gm. propylene glycol
33.0 gm. sorbitol
900.0 gm. water

Total
1000.0 gm.

Oil Sweet Pickle Spice  MF 179

Mix the following oils:
2.5 gm. ginger
5.0 gm. calamus
### Oil Spice for Salami  MF 180

**Mix:**
- 375.55 gm. oil of black pepper
- 624.45 gm. oleoresin of capsicum

**Total**
1000.00 gm.

Shake well.

### Sausage Spice Oil  MF 181

**Mix:**
- 600.0 gm. oil of nutmeg
- 17.0 gm. oil of mustard
- 135.0 gm. oil of black pepper
- 40.0 gm. oil of cloves
- 100.0 gm. oil of coriander
- 8.0 gm. oil of bay leaves, 55/60 per cent phenol content
- 100.0 gm. oleoresin of capsicum

1000.0 gm.

### Oil Sausage Spice for Pork  MF 182

**Mix:**
- 60.00 gm. oil of black pepper
- 90.00 gm. oleoresin of capsicum
- 90.00 gm. oil of sage, Dalmatian
- 15.00 gm. oil of thyme, white
- 90.00 gm. oil of cloves
- 60.00 gm. oleoresin of ginger
- 3.75 gm. oil of mustard
- 30.00 gm. oil of ginger
- 60.00 gm. oil of bay leaves 55/60 per cent phenol content
- 5.0125 gm. oil of nutmeg

1000.00 gm.
Oil Spice for Smoked Meat Flavor \hspace{1cm} MF 183

Mix:

687.5 gm. oil of cade
187.5 gm. oleoresin of capsicum
125.0 gm. oil of black pepper

Total

1000.0 gm.

Shake well.

Spaghetti Sauce Seasoning \hspace{1cm} MF 184

Mix:

33.0 oz. av. oleoresin of celery
14.0 oz. av. oleoresin of cloves
4.0 oz. av. oil of pimenta leaves
2.0 oz. av. oil of bay leaves
and
96 lbs. 1.0 oz. av. salt

Total

100 lbs.

Recommended Use.—One pound per 100 lbs. sauce.

Tarragon Flavor \hspace{1cm} MF 185

Mix:

40.0 gm. oil of anis
5.0 gm. oil of coriander
2.5 gm. oil of dillweed
320.0 gm. alcohol, 95 per cent
632.5 gm. propylene glycol

Total

1000.0 gm.
EMULSIONS

Property of Emulsion

Emulsions are intimate mixtures of two immiscible liquids, one being dispersed in the other in the form of small droplets. If two miscible liquids, such as water and alcohol, are mixed they do not produce an emulsion. But if immiscible liquids are mixed, such as water and oil, these two liquids produce a turbid conglomerate, and separate in a very short time; the two liquids arrange themselves as they were originally, according to their specific gravities, oil at the top, water at the bottom. However, if a small amount of a third substance is introduced as an aid to form a mixture and shaken again, the result is entirely different. Instead of two separate layers of liquid, a milky fluid is created which is quite uniform. This mixture of two immiscible liquids is an emulsion. Thus three constituents ordinarily are necessary to form an emulsion, two immiscible liquids, and a third substance which promotes the emulsification and keeps the emulsion stable after formation. This third substance is called an emulsifying agent or emulsifier.

The emulsion has the appearance of a uniform liquid. However, an examination of the emulsion under the microscope shows that it is by no means uniform. A multitude of small globules is seen floating around in a liquid medium. The globules are nearly spherical in shape and vary in size.

The Emulsion Phases

A phase is a physically distinct part of a system, which can be separated by mechanical means. Each liquid, by itself, is a one-phase system. After emulsification, one liquid is dispersed in the other in the form of fine droplets; thus the emulsion is a two-phase system.

One of the liquids in the emulsion appears in the form of separate globules and is called the "discontinuous" phase. The other liquid, which surrounds the droplets, remains uninterrupted, or continuous, and is referred to as the "continuous" phase. The discontinuous phase is at the interior of the continuous phase and is also called the internal phase; the continuous phase, accordingly, becomes the external phase.

In emulsions, one of the two phases consists of water or of water solutions of various salts, organic, or colloidal substances. This phase is re-
ferred to as the water phase. The other phase which is immiscible with the first phase, is called the oil phase. Any substance that behaves toward water like oil can form the oil phase. The ingredients of the water phase are called hydrophilic or water-loving substances. The other substances, which show a marked affinity for oil or oil-like liquids, are called hydrophobic or water-fearing substances. Hydrophobic substances are sometimes called oleophilic or lipophilic. Hydrophilic substances are also called oleophobic or lipophobic.

Two types of emulsions can be formed. One type, in which the oil is emulsified in the water, is called an oil-in-water emulsion, conventionally abbreviated O/W emulsion. Examples of substances to prepare oil in water emulsions are egg yolks, albumin, casein, lecithin, agar, gum tragacanth, gelatin, Irish moss, starch, dextrin, alkalies, condensed milk, and sugar. The other type of emulsion, in which the water is emulsified in the oil, is called a water-in-oil emulsion, or W/O emulsion.

The general properties of an emulsion are determined mainly by the external phase. The O/W emulsion has water as external phase and acts like water. It can be diluted with water, but not with oil. It will conduct an electric current and it can be colored by water-soluble dyes. The opposite is the case with the W/O emulsion. Here the oil is the external phase and the physical behavior is that of an oil system. It can be thinned down with oil or oil-like fluids, but not with water; if water is added to an emulsion of the W/O type, it will enter the internal phase and increase its viscosity. A W/O emulsion will not conduct an electric current as readily as an O/W emulsion, and water-soluble dyes will not develop their tinting strength. Water-in-oil emulsions are of less importance in ice cream, sherbets, and ices than are oil-in-water emulsions.

Emulsions may be broken either by chemical destruction, such as by addition of acid or salt, or by mechanical force, such as churning, heating, centrifuging, or freezing.

Stabilizers in Ice Cream, Sherbets, Ices, and in Other Food Products

Stabilizers are applied to ice cream, ice milk, sherbets, ices, and vegetable fat based desserts to promote smoothness, to give the product more body or chewiness and to increase the resistance to heat shock.

The stabilizer in ice or sherbet has the same properties as that in ice cream; it assists in the formation of a smooth texture and firm body and aids in controlling overrun. However a stabilizer for water ices and sherbets should not be impaired by acid or calcium salts, should disperse in water, and should impart desirable melt-down characteristics.
Stabilizers also are used in chocolate drinks and syrups to prevent sedimentation; they serve to homogenize salad dressings; they give sparkling clarity to fruit tarts as well as stiffness to merengues. Stabilizers used with starch improve appearance and eating quality of fruit and custard pie fillings.

**Stabilizer of Animal Origin**

**Gelatin.**—Gelatin is made from the protein, collagen, by extraction from the connective tissues of skin and bone of animals.

The value of gelatin in ice cream is due to the formation of a gel during the freezing process and gives ice cream resistance, which aids in keeping it in a firm state when the temperature rises. Edible gelatin has no detrimental effect on flavor or color of ice cream.

Gelatin gives a fast, smooth melt down, but is low in heat shock resistance. Level of use of gelatin averages 0.3 per cent based on weight of mix. It is put in before pasteurization.

The gel strength of gelatin is determined by test with the Bloom gelometer, named for its inventor. The higher the Bloom test, the higher the gel strength of the gelatin and, therefore, the smaller the amount that will be needed in the ice cream. To determine the proper amount of gelatin to be used in a mix, requires the determination of the amount of a gelatin necessary to form a slight gel in skim milk. The percentage of gelatin necessary for the ice cream is calculated by the formula:

\[
\text{Per cent gelatin required} = \frac{\text{Per cent water in mix}}{\text{Per cent water in skim milk}}
\]

Allowances must be made for factors affecting the amount of gelatin, such as cooling procedure, method of freezing, and drawing temperature. Trial batches should be made up to arrive at the exact amounts of the stabilizer to be used.

Gelatin is often preferred for use in water ices and sherbets. Because of the difficulty of controlling overrun, it is often used with pectin or oat gum. The gelatin should be dissolved in about ten times its weight of water and heated to 160°F., then added to the base mix in a fine stream while the mixture is well agitated.

**Stabilizers of Botanical Origin**

Stabilizers of plant or vegetable origin are for the most part hemicelluloses, and because of their hydrophilic properties may be classed as gums. They have a high affinity for water. Some have antioxidant properties. Gums are used extensively in ices and sherbets, in which their water binding properties are particularly useful in producing a smooth texture.
and proper viscosity of the unfrozen mass. Gums are present in the leaves, roots, seeds, or stems of plants growing both on land and in water. Sodium alginate, agar-agar, and Irish moss are derived from seaweed. Gum tragacanth, karaya gum, oat gum, and quince seed gum are derived from plants growing on land.

**Pectin.**—Pectin is a derivative of the citrus fruits and apple wastes. Apple pomace contains 15 to 18 per cent pectin; lemon pulp, 30 to 35 per cent; and orange pulp, 30 to 40 per cent. Pectins are colloidal carbohydrates. Pectin is slightly sensitive to heat but loses part of its strength when boiled in the presence of an organic acid. Commercial pectin stabilizers are used from 2 to 4 ounces per 5 gallons of mix. For use in ice or sherbet, pectin stabilizer is to be mixed with a portion of the sugar and then dissolved in boiling water. The solution is added to the mix.

Pectin in combination with gelatin produces good results. Mixes containing pectin alone show protein separation and whip more slowly than the all gelatin mixes. Pectin is also used in the making of jams and jellies.

**Agar-agar.**—Agar-agar is derived from red marine plants belonging to a class of algae known as *Rhodophyceae*. It is insoluble in cold water but swells and absorbs large quantities of it. It has no food value, is tasteless and colorless.

**Carob Bean Derivatives.**—Derivatives of carob bean, locust bean, or St. John’s bread seeds are used in ice cream as stabilizers. Combined with gelatin they retard whipping to a greater extent than does gelatin.

Locust bean gum provides a chewy ice cream with slow meltdown and good heat shock resistance. It must be restirred before freezing otherwise it will cause the mix to separate or whey off. This separation may be overcome by adding a small amount of Irish moss extract along with the locust bean gum. Locust bean gum is used at about 0.12 per cent of the mix, and the Irish moss at about 0.015 per cent. They are added to the mix before heating.

**Dariloid.**—Dariloid is the trade name of one brand of an edible colloidal carbohydrate found in the Pacific Coast kelp, *Macrocystis pyrifera*. The kelp is cut into fine pieces, then thoroughly washed with hot water and sodium carbonate to convert the algin into a water soluble form, the so-called sodium alginate.

Sodium alginate is a gum which produces an ice cream that is smooth, shows good heat shock resistance, and has good melt-down properties. About 0.09 per cent is employed, along with calcium salts as a buffer. Sodium alginate does not contribute any flavor to ice cream.

Sodium alginate can also be used to stabilize a water ice. The presence of calcium or acid in the water of dispersion makes the use of algin stabilizers in sherbets impracticable.
Irish Moss.—Irish moss is a derivative of a marine plant, *Chondrus crispus*, or carrageen. Irish moss used by itself as a stabilizer has the disadvantage of imparting high viscosity to a mix.

The largest single use of Irish moss extract is in chocolate milk. The extract forms a slight gel, increases viscosity, and causes cocoa to remain suspended. Prepared chocolate powders contain cocoa, flavor, and 0.03 to 0.04 per cent Irish moss, based on weight of milk.

Irish moss is also used in chocolate syrup toppings. The gum gives a smooth creamy body, prevents cocoa from settling, and helps keep the cocoa fat emulsified. Irish moss is used in clarifying beer. Gum arabic is used as a foam stabilizer. Irish moss extracts and propylene glycol alginate have been useful to emulsify and thicken French dressing.

Guar Gum.—Guar gum is used in flash pasteurized ice cream mixes. It is mixed with Irish moss to prevent wheying off. Rate of use is the same as with locust bean gum. Guar gum and locust bean gum can be used as "cloud stabilizer" in citrus drinks.

Karaya Gum.—Karaya gum is obtained from East Indian trees of the genus *Sterculia*. It has been used as a substitute for tragacanth. Purified karaya gum is used in combination with other products in the manufacture of stabilizers. Ices on a stick are stabilized with gum karaya.

Avenex.—Avenex is used in ice cream primarily to prevent the development of stale, metallic flavors. It can be used to reduce the amount of the regular stabilizer.

Oat Gum or Aveeno.—Oat gum or Aveeno is one of the newest gum type stabilizers to be used in ice cream. It is a derivative of oat grain. In conjunction with gelatin, it can be used in stabilizing ices and sherbets. It has antioxidant properties.

Kragel.—Kragel is a modified Irish moss stabilizer. Only 0.20 per cent is used in ice cream. Mixes containing Kragel compare favorably in whipping quality with those containing gelatin.

Quince Seed Extract.—Quince seed extract is water soluble. It contains cellulose or hemicellulose with a polysaccharide which produces arabinose and zylose on hydrolysis. Mixes stabilized with quince seed extract develop much less viscosity and do not melt down as uniformly as those containing gelatin.

Gum Tragacanth.—Gum tragacanth is obtained from various Asiatic or east European species of *Astragalus*, especially *Astragalus gummifer labillardiere*. It consists of starch granules, cellulose, gum acids, nitrogenous matter, and minerals.

Gum Arabic or Gum Acacia.—Gum arabic is obtained from several species of acacia. The best product comes from *Acacia senegal*. The
acacia gums are composed chiefly of the calcium, magnesium, and potassium salts of arabin acid.

Gum acacia mixed with gelatin, Irish moss, agar-agar, or gum tragacanth, stabilizes an emulsion. A mixture of one part gum tragacanth and three parts acacia yields a better emulsion than either used alone. The mixture of these gums will make the emulsion whiter than with gum tragacanth alone and will be less creamy than an emulsion made with gum acacia.

Gum arabic is combined with agar-agar in proportions of about 0.4 per cent and 0.3 per cent of agar-agar. Approximately 0.2 to 0.3 per cent of gums tragacanth or karaya will be sufficient to mix with 0.5 to 0.75 per cent agar-agar.

Cellulose Derivatives—Sodium Carboxymethylcellulose.—By treating alpha cellulose, from cotton or wood, with an alkali (sodium hydroxide) and then with dimethyl sulfate or methyl chloride, methylcellulose is formed. Upon washing with water it has definite emulsifying properties. Its main advantages are its lack of taste, neutrality, nonfermentability, and ability to dry without becoming sticky.

Sodium carboxymethylcellulose is a cellulose derivative obtained in the same manner as methylcellulose. It is soluble in both hot and cold water, forming solutions stable to heat. Sodium carboxymethylcellulose is compatible with gum arabic and tragacanth, sodium alginate, gelatin, pectin, and Irish moss. Because of its compatibility with other types of stabilizers, sodium carboxymethylcellulose can be used in ice cream in combination with gelatin or gum, a whipping agent, and corn sugar. Powdered mixes for frozen desserts at home may be stabilized with sodium carboxymethylcellulose.

Diacid Glycerides.—Diacid glycerides of plant or animal origin are used in conjunction with a stabilizer such as gelatin. A mixture of 0.06 per cent of monoglyceride and 0.30 per cent of gelatin will shorten the whipping time and improve the body of the ice cream.

Glycerides have the ability to adjust themselves and to increase the permanence of the oil-in-water emulsion as well as the stability of the foam which is formed during whipping. They mix faster and the air cells are smaller and more numerous, causing drier appearance of the ice cream.

Vestirine.—Vestirine is a trade product consisting of a mixture of monoglyceride and gelatin. Mixes containing Vestirine have superior whipping qualities, however, develop viscosity in the same manner as with plain gelatin.
**Ice Cream**

Ice cream is a whipped and frozen food. Its composition is a mixture of butterfat, normal milk solids-not-fat, abnormal milk solids-not-fat, milk solids-non-fat, that are concentrated, sugar or syrup, flavoring, coloring, and a stabilizer.

**Sherbets and Ices**

Sherbets and ices are frozen products made from sugar, fruit acid, fruit, fruit flavoring, water, and stabilizer. Sherbet contains, in addition, milk solids.

**Flavors of Sherbet and Ice.**—Fruit flavored ice creams, sherbets, and ices are very popular. Fruit flavors are added to ice cream in the following forms: fresh whole fruit, frozen pack whole fruit, canned whole fruit, whole fruit preserves, full flavor fruit juices, fruit flavoring extract, and full aromatic fruit flavors.

The use of synthetic flavors should be restricted to terpene-free aromatics. Imitation flavors should consist of a mixture of ten per cent true fruit flavorings, and aromatic chemicals with terpenes removed.

Eight to twelve pounds of fruit will flavor five gallons of sherbet or ice mixes. One gallon of expressed fruit juice or two pints of full flavor concentrated juice of 42° Brix or one pint of full flavor concentrated juice of 68° Brix will also flavor five gallons of sherbet or ice mixes. However, 8 to 12 oz. of full aromatic fruit flavors are sufficient to flavor 5 gal. of sherbet or ice mix. The proportion of fruit flavors with other natural flavors and slices of fruit require 4 to 8 oz. per 5 gal. of mix, while true fruit and imitation flavor compounds vary from 1 to 12 ounces per 5 gallons of ice mixes.

**Acidifiers of Ices and Sherbets.**—Citric acid is used to produce tartness in ice and sherbet. The amount needed varies with the amount of sugar and of fruit acid in the flavoring material. A total of 0.30 to 0.40 per cent of citric acid is needed to give satisfactory results when 28 to 32 per cent sugar is used. When a fruit flavoring containing acid is added, allowance should be made for the acid content of the added fruit flavor. Sherbets require more acid than water ices. Citric acid has a molecular weight of 192 and is trivalent, 1 ml. of 0.1 N alkali equals 0.0064 gm. of citric acid. The acidity of an ice is determined by the following formula:

\[
\text{Per cent citric acid} = \frac{100 \times \text{ml. of 0.1 N alkali} \times 0.0064}{\text{Weight of sample}}
\]
Citric acid is usually prepared as about a 45 per cent solution for use in the dairy plant by mixing equal parts by weight of water and acid. The acid contains 8.6 per cent water of crystallization. The crystals are dissolved in hot water and stored in a stoppered glass bottle. Other acids were found to be satisfactory, such as lactic, phosphoric, tartaric, acetic, hydrochloric, and combinations of hydrochloric or phosphoric with one or more of the organic acids, such as tartaric, acetic, lactic, and citric.

Hydrochloric and phosphoric acid alone are not suitable as acidifiers. Precaution should be taken to make sure the acids used are suitable for food purposes. The acid should be added to the ice or sherbet in the freezer after the temperature has been reduced below 30°F.

Acidifier MF 186
Mixture of:
1.2 lbs. citric acid
0.5 lbs. tartaric acid
1.0 lbs. lactic acid
4.8 lbs. phosphoric acid

Dissolve in sufficient water to obtain a yield of one gallon acidifier.

Classifications of Ice Cream and Ices

The general classification is as follows:
Plain ice cream is made from a basic mix to which a single flavor has been added.
Vanilla is the most popular ice cream flavor. The quality of the vanilla flavor is more important in ice cream than in any other food. In ice cream the aroma of the vanilla predominates and overshadows the milder delicate flavor of the milk products.
Other ice cream varieties are:
Fruit ice cream is made from a basic ice cream mix to which fruit and fruit flavoring has been added.
Nut ice cream is made with nut meats, coloring, and flavoring added.
Confection ice cream is flavored with confectionery products.
Bisque ice cream is flavored with grapenuts, cake, or macaroons.
Pudding is ice cream made from an ice cream mix with a high fat content with fruits, nut meats, spices, and liquors added.
Parfait is also called New York ice cream. It is a rich ice cream and contains nut meats, fruits, and fruit flavorings.
Mousse is a frozen confection made with whipped cream, sugar, and flavoring.
Custard ice cream is a cooked mixture of milk and eggs which is added to ice cream.
Water ices are made from sugar, water, organic acids, fruit flavoring, and a stabilizer. No milk is added.

Sherbet is a frozen mixture of fruit juice or fruit flavorings, water, sugar, cream or milk, and citric acid.

**Fruit Flavors and Fruit**

**Cherry Fruit and Fruit Flavor**   MF 187

Mixture of:
56.0 lbs. partly defrosted, whole or loosely comminuted Morello cherries, without pits,
10.2 lbs. or 1.5 gal. alcohol 95 per cent
33.8 lbs. full flavor Morello cherry concentrated juice of 68° Brix of formula MF 18

Total
100.0 lbs. cherry fruit and fruit flavor

*Recommended Use.*—4 fl. oz. flavor per 5 gal. ice cream, sherbet, and ice mix.

**Raspberry Fruit and Fruit Flavor**   MF 188

Mixture of:
64.0 lbs. partly defrosted red raspberries
11.0 lbs. or .75 gal. alcohol, 95 per cent
25.0 lbs. full flavor black raspberry concentrated juice of 68° Brix, formula MF 30.

Yield
100.0 lbs. raspberry fruit and fruit flavor

Use 4 oz. per 5 gal. ice cream, sherbet, and ice mixes.

**Strawberry Fruit and Fruit Flavor**   MF 189

Mixture of:

(a) 43.2 lbs. partly defrosted Marshall strawberries and sugar (4 plus 1)

6.8 lbs. or 1 gallon alcohol, 95 per cent; the fruit-alcohol mixture is to be loosely comminuted to mash without pulverizing the seeds of the strawberries.

(b) Mixture of the mash of (a) and

50.0 lbs. full aromatic strawberry fruit flavor of formula MF 35.

Total
100.0 lbs. strawberry fruit and fruit flavor.

Use 4 oz. flavor per 5 gal. ice cream, sherbets, or ice mix.
Cherry Frozen Juice Flavor MF 190

Mixture of:
- 97.0 gal. cherry full flavor concentrated juice 68° Brix, formula MF 18,
- 3.0 gal. cherry pit flavor distillate, 76 per cent alcohol, formula MF 19,

Total 100.0 gal.

Black Raspberry Frozen Juice Flavor MF 191

Mixture of:
- 95.0 gal. black raspberry full flavor concentrated juice 68° Brix, formula MF 30,
- 5.0 gal. raspberry flavor distillate, 50 per cent alcohol, formula MF 29,

Total 100.0 gal.

Fruit Juice Mix MF 192

Mixture of:
- 1.00 gal. full flavor concentrated juice and flavor distillate of MF 190 or MF 191
- 10.00 gal. syrup 74.9° Brix (40° Be)
- 2.00 lbs. stabilizer, formula MF 199
- 0.25 lbs. tartaric or citric acid 50 per cent; add water to make:

Total 60.00 gal. fruit juice mix.

Fruit Ice Flavors

Cherry Fruity Ice Pop Flavor MF 139
(True Fruit and Imitation)

Mixture of:
- 4.00 gm. cherry flavor imitation—formula MF 83 or MF 84
- 100.00 gm. cherry full aromatic true fruit flavor—formula MF 20
- 21.35 gm. water
- 1.90 gm. FD&C Red no. 2 (184 amaranth) certified color
- 10.00 gm. salt
- 1.00 gm. sodium benzoate
- 1.75 gm. acid, citric, 50 per cent
- 860.00 gm. syrup—74.9° Brix (40° Be)

Total 1000.00 gm. cherry fruity ice pop flavor

Recommended Use.—One gallon flavor per 60 gallons fruity ice pop mix—formula MF 198.
Grape Fruity Ice Pop Flavor  MF 194
(True Fruit and Imitation)

Mixture of:

- 4.00 gm. Concord grape flavor imitation, formula MF 103
- 100.00 gm. Concord grape full flavor concentrated juice 72° Brix, formula MF 22
- 1.00 gm. FD&C blue no. 1 (brilliant blue F.C.F.) certified color
- 3.25 gm. FD&C red no. 2 (184 Amaranth), certified color,
- 6.75 gm. salt,
- 1.35 gm. acid citric, 50 per cent
- 1.00 gm. sodium benzoate
- 23.50 gm. water
- 860.00 gm. syrup—74.9° Brix (40° Bé)

Total
1000.00 gm. cherry fruity ice pop flavor

Recommended Use.—One gallon flavor per 60 gallons fruity ice pop mix—formula MF 198.

Orange Fruity Ice Pop Flavor  MF 195
(True Fruit)

Mixture of:

- 28.5 gm. alcohol, 95 per cent
- 2.5 gm. oil of orange, cold pressed, California, ten-fold, terpenes removed by vacuum distillation,
- 1.5 gm. oil of orange, cold pressed, Florida, ten-fold, terpenes removed by vacuum distillation,
- 2.0 gm. oil of tangerine,
- 1.0 gm. oil of lemon, cold pressed,
- 3.5 gm. FD&C yellow no. 6 (Sunset yellow F.C.F.),
- 50.0 gm. orange juice,
- 33.0 gm. water
- 1.0 gm. acid citric, 50 per cent
- 1.0 gm. benzoate of soda
- 4.0 gm. salt
- 870.00 gm. syrup—74.9° Brix (40° Bé),

Total
1000.00 gm. orange fruity ice pop flavor.

Recommended Use.—One gallon flavor per 60 gallons fruity ice pop mix, formula MF 198

Raspberry Fruity Ice Pop Flavor  MF 196
(True Fruit and Imitation)

Mixture of:

- 4.00 gm. raspberry flavor imitation, formula MF 123
- 100.00 gm. raspberry fruit flavor, formula MF 28
FOOD FLAVORINGS

1.75 gm. FD&C red no. 2 (184 Amaranth) certified color
8.00 gm. salt
24.50 gm. water
0.75 gm. acid citric, 50 per cent
1.00 gm. sodium benzoate
860.00 gm. syrup, 74.9° Brix (40° Bé)

Total
1000.00 gm. raspberry fruity ice pop flavor.

Recommended Use.—One gallon flavor per 60 gallons fruity ice pop mix—formula MF 198.

Strawberry Fruity Ice Pop Flavor    MF 197
(True Fruit and Imitation)

Mixture of:

4.00 gm. strawberry flavor imitation—formula MF 129
100.00 gm. strawberry true fruit flavor—formula MF 34
17.00 gm. water
10.00 gm. salt
0.50 gm. acid citric 50 per cent
1.00 gm. FD&C red no. 4 (Ponceau SX), certified color
0.25 gm. FD&C red no. 2 (184 Amaranth), certified color
1.00 gm. sodium benzoate
860.00 gm. syrup—74.9° Brix (40° Bé)

Total
1000.00 gm. strawberry fruity ice pop flavor

Recommended Use.—One gallon flavor per 60 gallons fruity ice pop mix—formula MF 198.

Fruity Ice Pop Mix    MF 198

Ingredients

72 lbs. cane sugar
22 lbs. corn sugar
1 gal. fruity ice pop flavor,
30 oz. av. stabilizer, formula MF 199 (below)
48 fl. oz. acid citric solution formula MF 200; add sufficient water to make 60 gal. finished ice pop mix.

Procedure.—Mix sugar and stabilizer; dissolve the sugar in 26 gal. of water; add one gallon of flavor and agitate mixture; keep agitating while adding the citric acid solution and sufficient water to make 60 gal. of ice pop mix and to yield 30 to 40 per cent overrun.

For fruity ice pop confections run the mix into molds and freeze, stirring the mix each time the mold is filled; fill each cavity of the mold up to $\frac{3}{16}$ inch measured from the top, to allow for expansion.
Stabilizer  MF 199

Mixture of:
- 320 lbs. cellulose gum (sodium carboxymethylcellulose)
- 80 lbs. Irish moss
- 300 lbs. sugar
- 300 lbs. dextrose

1000 lbs.

Acid Citric Solution  MF 200

One gallon standard citric acid solution is prepared by placing four pounds acid citric in a gallon measure and filling with hot water; the mixture is agitated to dissolve the acid.

Ice Pop Flavor Emulsions

Cherry Flavor Emulsion  MF 201

(True Fruit and Imitation Flavor)

Disperse in:
- 16,000 fl. oz. propylene glycol
- 2,000 oz. av. gum tragacanth, or:
  - 1.0 oz. av. gum tragacanth and 6.0 oz. av. gum acacia,
   then add:
  - 2,000 fl. oz. cherry flavor imitation—formula MF 83 or MF 84
  - 64,000 fl. oz. water, agitate rapidly and mix with a prepared color solution consisting of:
  - 30,000 fl. oz. water
  - 3,000 oz. av. FD&C red no. 2 (184 Amaranth) certified color,
  - 16,000 fl. oz. Morello cherry fruit flavor, formula MF 15,
  - 0.125 oz. av. benzoate of soda

Yield: One gallon cherry flavor emulsion

Recommended Use.—1.0 fl. oz. flavor per 5 gal. ice pop mix or 0.25 fl. oz. per 32 gallons.

Grape Flavor Emulsion  MF 202

(True Fruit and Imitation Flavor)

Disperse in:
- 16,000 fl. oz. propylene glycol
- 2,000 oz. av. gum tragacanth, or:
  - 1.0 oz. av. gum tragacanth and 6.0 oz. av. gum acacia; then add
  - 2,000 fl. oz. grape flavor imitation, formula MF 102, or MF 103
- 64,000 fl. oz. water; agitate rapidly and mix with a prepared color solution consisting of:
30.000 fl. oz. water and
3.000 oz. av. FD&C red no. 2 (184 Amaranth), certified color,
0.1875 oz. av. FD&C blue no. 1 (brilliant blue F.C.F.)
16.000 fl. oz. grape fruit flavor, formula MF 22,
0.1250 oz. av. benzoate of soda

Yield: One gallon grape flavor emulsion

**Recommended Use.**—1.0 fl. oz. flavor per 5 gal. ice pop mix, or 6.25 fl. oz. per 32 gal.

### Lemon and Lime Ice Emulsion  
**MF 203**

**Disperse in:**

<table>
<thead>
<tr>
<th>16.000 fl. oz.</th>
<th>propylene glycol</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.000 oz. av.</td>
<td>gum tragacanth, or:</td>
</tr>
<tr>
<td>1.0 oz. av.</td>
<td>gum tragacanth and</td>
</tr>
<tr>
<td>6.0 oz. av.</td>
<td>gum acacia; then add:</td>
</tr>
<tr>
<td>0.750 fl. oz.</td>
<td>oil of lemon, cold pressed—ten-fold—(terpenes have been removed by vacuum distillation)</td>
</tr>
<tr>
<td>2.000 fl. oz.</td>
<td>oil of limes, distilled</td>
</tr>
<tr>
<td>0.100 gm.</td>
<td>antioxidant;</td>
</tr>
<tr>
<td>then add:</td>
<td></td>
</tr>
<tr>
<td>80.000 fl. oz.</td>
<td>water; agitate rapidly and mix with prepared color solution consisting of:</td>
</tr>
<tr>
<td>32.000 fl. oz.</td>
<td>water</td>
</tr>
<tr>
<td>4.000 oz. av.</td>
<td>FD&amp;C yellow no. 5 (640 tartrazine) certified color,</td>
</tr>
<tr>
<td>2.000 oz. av.</td>
<td>FD&amp;C blue no. 1 (brilliant blue F.C.F.) certified color,</td>
</tr>
<tr>
<td>0.125 oz. av.</td>
<td>benzoate of soda</td>
</tr>
</tbody>
</table>

Yield: One gallon lemon and lime emulsion

**Recommended Use.**—1.0 fl. oz. flavor per 5 gal. ice pop mix, or 0.25 fl. oz. per 32 gal.

### Pineapple Flavor Emulsion  
**MF 204**

(True Fruit and Imitation Flavor)

**Disperse in:**

<table>
<thead>
<tr>
<th>16.000 fl. oz.</th>
<th>propylene glycol</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.000 oz. av.</td>
<td>gum tragacanth or:</td>
</tr>
<tr>
<td>1.0 oz. av.</td>
<td>gum tragacanth and</td>
</tr>
<tr>
<td>6.0 oz. av.</td>
<td>gum arabic; then add:</td>
</tr>
<tr>
<td>2.000 fl. oz.</td>
<td>pineapple flavor imitation, formula MF 118,</td>
</tr>
<tr>
<td>64.000 fl. oz.</td>
<td>water; agitate rapidly and mix with a prepared color solution consisting of:</td>
</tr>
<tr>
<td>30.000 fl. oz.</td>
<td>water</td>
</tr>
<tr>
<td>1.500 oz. av.</td>
<td>FD&amp;C yellow no. 5 (640 tartrazine) certified color,</td>
</tr>
<tr>
<td>16.000 fl. oz.</td>
<td>pineapple fruit flavor, formula MF 43,</td>
</tr>
<tr>
<td>0.125 oz. av.</td>
<td>benzoate of soda</td>
</tr>
</tbody>
</table>

Yield: One gallon pineapple emulsion
Recommended Use.—1.0 fl. oz. flavor per 5 gal. ice pop mix, or 6.25 fl. oz. per 32 gal.

**Table 13**

<table>
<thead>
<tr>
<th>Fold</th>
<th>Vanilla Beans, Oz.</th>
<th>Added Vanillin, Oz.</th>
<th>Per 5 Gallons Ice Cream Mix Fl. Oz.</th>
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</thead>
<tbody>
<tr>
<td>Vanilla extract Single</td>
<td>13.35</td>
<td>0</td>
<td>3-4</td>
</tr>
<tr>
<td>Vanilla extract Two</td>
<td>26.7</td>
<td>0</td>
<td>1½-2</td>
</tr>
<tr>
<td>Vanilla extract Four</td>
<td>53.4</td>
<td>0</td>
<td>3/4-1</td>
</tr>
<tr>
<td>Vanilla-vanillin Two</td>
<td>13.35</td>
<td>1</td>
<td>1½-2</td>
</tr>
<tr>
<td>Vanilla-vanillin Four</td>
<td>26.7</td>
<td>2</td>
<td>3/4</td>
</tr>
<tr>
<td>Vanillin-vanilla Four</td>
<td>13.35</td>
<td>3</td>
<td>3/4-1</td>
</tr>
<tr>
<td>Imitation vanilla Single</td>
<td>0</td>
<td>1</td>
<td>3-4</td>
</tr>
<tr>
<td>Imitation vanilla Ten</td>
<td>0</td>
<td>10</td>
<td>1½-1/2</td>
</tr>
</tbody>
</table>

Preparation of Emulsion Base for Overall Use  

MF 205

30.27 gm. ribbon gum tragacanth (has better aroma than powdered product),
15.13 gm. powdered gum arabic,
8.80 gm. pectin, grade no. 150,
3.68 gm. benzoic acid,
3768.20 gm. or 1 gallon water

Procedure

1. Add the gum tragacanth to 96 fl. oz. cold water; agitate and remove impurities with strainer; then leave to soak;
2. Mix gum arabic and pectin thoroughly together;
3. Boil 32 fl. oz. water, then
4. Use 28 fl. oz. (vol.) of the boiling water of (3) to add slowly to the gum arabic and pectin mixture, while agitating it;
5. Dissolve benzoic acid in 4 fl. oz. boiling water of (3) and mix it with (4);
6. Agitate mixture of ribbon gum of (1) until entirely dissolved, which takes about one hour;
7. Agitate occasionally the mixture of gum arabic, pectin, arabic, pectin, benzoic, to avoid formation of lumps;
8. Put both mixtures of (6) and (7) together and agitate for half an hour.
9. Store the finished emulsion base in tank or jars for later use.
THE MANUFACTURE OF CARBONATED BEVERAGES

Carbonated beverages are commonly called soft drinks or soda. The ingredients of carbonated beverages are sugar syrup, water, small amounts of a suitable acid, and flavor. The mixture is blended and a measured amount, called throw, drawn into a glass bottle which is then filled with purified water that has been carbonated or saturated with carbon dioxide gas.

Syrup

Syrups are made by dissolving high quality sugars in purified water. To the syrup, flavorings are then added to characterize the beverage. They are either alcoholic or non-alcoholic flavors and emulsions which are made from fruit, essential oils, vegetable plants, or aromatic chemicals.

A finished beverage contains from 6 to 16 per cent of sugar by weight, depending on the type and flavor of beverage.

Flavoring Material

In the bottling trade an extract is defined as flavoring extracted from fruit or roots, etc., or as an essence consisting of essential oils or aromatic chemicals dissolved in a solvent.

Alcoholic extracts of essential oils and aromatic chemicals usually have a strength of 1 to 2 oz. to a gallon of syrup. The extracts may or may not contain added coloring materials. Emulsion flavors are generally employed to disperse the oily ingredients into minute drops so that the surface tension is great enough to prevent these oils from combining and forming oily droplets that will float to the surface. In a fruit concentrate such as orange, an emulsion is usually added to give a permanent cloudy appearance. Sometimes a fruit pulp is added to the concentrate.

If essential oils are used, either alone or in mixtures with fruit juices, in flavorings for beverages, they should be made terpene-free to achieve superior quality. Excess use of artificial coloring is to be avoided.

Acidulants

Acids in soft drinks have three different purposes; to impart a sour or tart taste, to modify the sweetness of sugar, and to act as a preservative. Citric, tartaric, phosphoric, and lactic acids are most commonly used.
Citric acid is most widely used. Phosphoric acid is used for cola drinks. Tartaric acid is used for grape drinks.

Citric acid usually is used at 50 per cent strength. The 50 per cent citric acid solution consists of five pounds of citric acid crystals to one gallon of final solution. Citric acid crystals U.S.P. contain 91.42 per cent acid and 8.58 per cent water.

Tartaric acid is identical in appearance. It is often mistaken for citric acid. There is a simple test for determining these acids by placing a small amount of the unknown acid on the end of a knife and holding over a gas flame. If the acid is tartaric, the burning mass forms a small ball and burns with a blue flame. The mass will shrink in size leaving only the carbon residue. If it is citric, it will spread out on the knife, remaining in a liquid state while burning with a yellow flame. Citric acid also will sputter while burning. A final brownish-black residue remains.

Phosphoric acid is sold in a liquid form in standard grades of 50, 75, or 85 per cent strength. It is colorless, odorless, and has a very acid taste.

Lactic acid may be obtained in 40 to 50 per cent and 86 to 90 per cent concentration. It is almost colorless and quite sour in taste.

### Equivalent Acidity Values

<table>
<thead>
<tr>
<th></th>
<th>Amount of Acid Required to Make One Gallon of Solution</th>
<th>Final Concentration of Acid Solution, Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citric acid crystals</td>
<td>5 lbs.</td>
<td>50</td>
</tr>
<tr>
<td>Tartaric acid crystals</td>
<td>3 lbs.</td>
<td>50</td>
</tr>
<tr>
<td>85 per cent phosphoric acid (syrup)</td>
<td>20 fl. oz.</td>
<td>28</td>
</tr>
<tr>
<td>85 per cent lactic acid (syrup)</td>
<td>115 fl. oz.</td>
<td>76</td>
</tr>
</tbody>
</table>

**pH Test.**—The pH is a convenient medium for checking the acidity in fruit flavor, beverages, frozen dessert, in bakery goods, gelatin dessert powder, and in other products where acidity influences palatability. The lower the pH number the higher is the acidity. However, the pH is affected by preservatives, such as benzoate of soda; buffers such as sodium chloride, which is added to bring out the flavor; carbonates, which are used to aid effervescence; and citrates, which are employed to retain freshness. All these salts are alkaline and raise the pH of beverages.

The substitute sugars, such as saccharin, and the cyclamates have little effect on the acidity and pH of drinks.

**Water**

The water used in the manufacture of bottled soft drinks is always obtained from a supply which has been approved by local or state health
authorities as a source of drinking water. However, water is generally treated in such manner as to improve the appearance, taste, and odor and to eliminate certain minerals and salts which are naturally present in the water in different localities.

To reduce excessive alkalinity and hardness, lime is often used in conjunction with coagulation-settling processes for the removal of suspended matter. The lime removes hardness by changing soluble calcium bicarbonate to insoluble calcium carbonate, which in turn precipitates along with the floc produced by the coagulation chemical used.

<table>
<thead>
<tr>
<th>Flavor</th>
<th>pH</th>
<th>Strength</th>
<th>Sugar Brix</th>
<th>CO₂ Volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birch beer</td>
<td>4.0</td>
<td>11.5</td>
<td></td>
<td>2.5</td>
</tr>
<tr>
<td>Cocoa cream</td>
<td>4.3</td>
<td>12.5</td>
<td></td>
<td>2.0</td>
</tr>
<tr>
<td>Cream soda</td>
<td>3.9</td>
<td>12.5</td>
<td></td>
<td>2.5</td>
</tr>
<tr>
<td>Cherry</td>
<td>3.0</td>
<td>11.5</td>
<td></td>
<td>2.5</td>
</tr>
<tr>
<td>Cola</td>
<td>2.4</td>
<td>10.0</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>Ginger ale (pale dry)</td>
<td>2.7</td>
<td>9.0</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>Grape</td>
<td>3.0</td>
<td>13.5</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Grapefruit</td>
<td>3.0</td>
<td>10.5</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Lemon</td>
<td>2.9</td>
<td>10.0</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Lemon and lime</td>
<td>3.1</td>
<td>10.0</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td>3.2</td>
<td>13.5</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Peach</td>
<td>2.9</td>
<td>11.5</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Quinine</td>
<td>2.5</td>
<td>9.5</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>Raspberry</td>
<td>3.1</td>
<td>11.5</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Root beer</td>
<td>4.0</td>
<td>11.0</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>Sarsaparilla</td>
<td>4.0</td>
<td>11.5</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Strawberry</td>
<td>3.0</td>
<td>12.0</td>
<td>2.5</td>
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</tr>
<tr>
<td>Club soda</td>
<td>4.7</td>
<td></td>
<td></td>
<td>3.5</td>
</tr>
</tbody>
</table>

**Carbonation**

The carbon dioxide in the beverage, or carbonation, furnishes its identifying characteristic. The amount of carbonation which is most desirable in beverages depends on the type or flavor of the beverage and the manner in which it is to be used. The carbonation is important because of the pungent acidic taste it gives to the beverage. The amount of carbon dioxide gas forced into the water is expressed as volumes.

Maintenance of the correct volume of gas is important for the purpose of bringing out the flavor. A well carbonated beverage should contain from 3 to 4.5 volumes when bottled, depending on the type of beverage.

**Black Cherry Concentrated Fruit Flavor**¹  
**MF 206**  
(With Other Natural Flavors or WONF)

Mixture of:

37.5 gal. desugared grape extract, non-alcoholic, imported from Italy

¹ For use in carbonated beverages of franchise plants.
Table 15

<table>
<thead>
<tr>
<th>Degrees Baumé 68°F.</th>
<th>Degrees Brix 68°F.</th>
<th>Pounds Sugar Per Gal.</th>
<th>Pounds Water Per Gal.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>0.9</td>
<td>0.07</td>
<td>8.28</td>
</tr>
<tr>
<td>1.0</td>
<td>1.8</td>
<td>0.15</td>
<td>8.23</td>
</tr>
<tr>
<td>1.5</td>
<td>2.7</td>
<td>0.23</td>
<td>8.18</td>
</tr>
<tr>
<td>2.0</td>
<td>3.6</td>
<td>0.30</td>
<td>8.14</td>
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<tr>
<td>2.5</td>
<td>4.5</td>
<td>0.38</td>
<td>8.09</td>
</tr>
<tr>
<td>3.0</td>
<td>5.4</td>
<td>0.46</td>
<td>8.04</td>
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<td>3.5</td>
<td>6.3</td>
<td>0.54</td>
<td>7.99</td>
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<td>7.2</td>
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<td>7.95</td>
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<td>4.5</td>
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<td>0.69</td>
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<td>1.96</td>
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<td>6.47</td>
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<td>32.6</td>
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<td>26.5</td>
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<td>5.24</td>
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<td>28.5</td>
<td>52.3</td>
<td>5.42</td>
<td>4.94</td>
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</table>
Table 15 (continued)

<table>
<thead>
<tr>
<th>Degrees Baumé 68°F</th>
<th>Degrees Brix 68°F</th>
<th>Pounds Sugar Per Gal</th>
<th>Pounds Water Per Gal</th>
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<tbody>
<tr>
<td>29.0</td>
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<td>5.55</td>
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<td>4.70</td>
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<td>30.5</td>
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<td>4.62</td>
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<td>57.1</td>
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<td>4.54</td>
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<td>63.0</td>
<td>6.85</td>
<td>4.05</td>
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<td>63.9</td>
<td>6.98</td>
<td>3.94</td>
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<td>64.9</td>
<td>7.12</td>
<td>3.85</td>
</tr>
<tr>
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<td>3.76</td>
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<td>67.9</td>
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<td>3.57</td>
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<td>3.48</td>
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<tr>
<td>37.5</td>
<td>69.9</td>
<td>7.85</td>
<td>3.38</td>
</tr>
<tr>
<td>38.0</td>
<td>70.9</td>
<td>8.00</td>
<td>3.28</td>
</tr>
<tr>
<td>38.5</td>
<td>71.9</td>
<td>8.15</td>
<td>3.18</td>
</tr>
<tr>
<td>39.0</td>
<td>72.9</td>
<td>8.30</td>
<td>3.09</td>
</tr>
<tr>
<td>39.5</td>
<td>73.9</td>
<td>8.45</td>
<td>2.99</td>
</tr>
<tr>
<td>40.0</td>
<td>74.9</td>
<td>8.61</td>
<td>2.88</td>
</tr>
</tbody>
</table>

14.0 gal. caramel, acid proof,
25.0 gal. full aromatic Morello cherry fruit flavor—15 per cent alcohol content, formula MF 20,
7.0 gal. wild cherry flavoring extract, formula MF 12,
5.0 gal. pit flavor distillate, 60 per cent alcohol content—formula MF 207
0.5 gal. two-fold vanilla extract—formula MF 64,
11.0 gal. alcohol, 95 per cent

Total
100.0 gal. finished flavor

**Use and Storage Conditions**

1. Use 2 gal. per 100 gal. syrup;
2. Use 4 lbs. citric acid and 2 pounds and 5.3 oz. av. benzoate of soda;
3. Store flavor between 70°F and 80°F;
4. Use flavor within three months;
5. Do not expose to prolonged sunlight.

**Pit Flavor Distillate**

Slow distillation at atmospheric pressure of the following mixture:

- 128 fl. oz. wild cherry bark flavor distillate, formula MF 14, and
- 2 lbs. oil of bitter almond, free from Prussic acid, and
- 32 fl. oz. water
to obtain a distillation yield of:

128 fl. oz. pit flavor distillate of approx. 75 per cent alcohol content.

The distillation yield should always be analyzed after each batch to determine the content of benzaldehyde, in order to preserve uniformity of flavor by adjusting the quantity which is to be added to cherry flavor mixtures.

**Cherry Fruit Flavor MF 208**

(With other Natural Flavorings—WONF)

This compound is prepared by weight to secure uniformity of flavor.

Dissolve:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Component</th>
<th>Weight/Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.75 lbs.</td>
<td>acid citric in</td>
<td>water (weight: 8.3 lbs. = 1 gal.); then mix with:</td>
</tr>
<tr>
<td>2.50 gal.</td>
<td></td>
<td>Enocianina—desugared grape extract, nonalcoholic, fruit color (weight: 9 lbs. = 1 gal.).</td>
</tr>
<tr>
<td>25.00 gal.</td>
<td>wild cherry flavoring extract, formula MF 12, 15 per cent alcohol content (weight: 9.25 lbs. = 1 gal.)</td>
<td></td>
</tr>
<tr>
<td>18.75 gal.</td>
<td>Morello cherry full aromatic fruit flavor—formula MF 20 or MF 15, 15 per cent alcohol content (weight 8.75 lbs. = 1 gal.),</td>
<td>caramel, acid proof (weight 11.375 lbs. = 1 gal.).</td>
</tr>
<tr>
<td>12.50 gal.</td>
<td></td>
<td>wild cherry bark flavor distillate 63.65 per cent alcohol content—formula MF 14, (weight 7.3 lbs. = 1 gal.)</td>
</tr>
<tr>
<td>6.65 gal.</td>
<td></td>
<td>Dalmatian cherry fruit flavor—formula MF 13, 15 per cent alcohol content (weight: 9.125 lbs. = 1 gal.),</td>
</tr>
<tr>
<td>4.00 gal.</td>
<td></td>
<td>alcohol 95 per cent (weight: 6.8 lbs. = 1 gal.)</td>
</tr>
<tr>
<td>70.50 oz.</td>
<td></td>
<td>oil of bitter almond, free from prussic acid,</td>
</tr>
<tr>
<td>100.75 gal.</td>
<td></td>
<td>finished flavor of 15 per cent alcohol content, less:</td>
</tr>
<tr>
<td>0.75 gal.</td>
<td></td>
<td>allowed for sedimentation</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100.00 gal.</td>
</tr>
</tbody>
</table>

**Recommended Use.**—3 to 5 gal. flavor per 100 gal. syrup, to which are added 1 to 1.25 gal. citric acid 50 per cent according to required taste.

**Cola Flavor Base MF 209**

Dissolve the following oils:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.80 gm.</td>
<td>lemon, California, cold pressed,</td>
</tr>
<tr>
<td>14.20 gm.</td>
<td>limes, distilled,</td>
</tr>
<tr>
<td>10.65 gm.</td>
<td>cassia or cinnamon</td>
</tr>
<tr>
<td>3.50 gm.</td>
<td>nutmeg</td>
</tr>
<tr>
<td>0.01 gm.</td>
<td>neroli (can be omitted)</td>
</tr>
<tr>
<td>24.84 gm.</td>
<td>orange</td>
</tr>
</tbody>
</table>

**Total**

100.00 gm. in:

11.00 fl. oz. alcohol, 95 per cent, agitate and add:
5.00 fl. oz. water; put the mixture into separator; it is left there to stay for 24 hours at temperature of 60°F. for separation of terpenes; the clear mixture is taken off and filtered if necessary.

Phosphoric Acid Dilution for Cola Syrup   MF 210

Mixture of:

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 fl. oz. phosphoric acid U.S.P. 85 per cent</td>
<td>and</td>
</tr>
<tr>
<td>3.5 fl. oz. water</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>4.0 fl. oz. phosphoric acid dilution</td>
</tr>
</tbody>
</table>

Recommended Use.—One half fl. oz. per one gallon syrup.

Cola Nut Extract   MF 211

(a) Extraction of:

- 125.0 lbs. cola nuts, comminuted, with
- 207.5 lbs. or 25 gal. warm water of 122°F.; after one hour extraction, mix with:
- 170.0 lbs. or 25 gal. alcohol, 95 per cent; circulate menstruum twice daily; after 3 days take off
- 31.0 gal. flavoring extract.

(b) The remaining mash is then extracted with:

- 157.7 lbs. or 19 gal. water for 2 days; agitate twice daily; then take off
- 19.0 gal. flavoring extract.

(c) Mix:

- 31.0 gal. flavoring extract of (a) with
- 19.0 gal. flavoring extract of (b)

Yield

- 50.0 gal. cola nut extract.

Cola Flavor   MF 212

Mix:

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.0 fl. oz. cola nut extract, formula MF 211</td>
<td>and</td>
</tr>
<tr>
<td>2.0 fl. oz. vanilla extract two-fold, formula MF 64</td>
<td>and solution of:</td>
</tr>
<tr>
<td>2.0 oz. av. caffeine and</td>
<td></td>
</tr>
<tr>
<td>10.0 fl. oz. water,</td>
<td></td>
</tr>
<tr>
<td>16.0 fl. oz. glycerin</td>
<td></td>
</tr>
<tr>
<td>32.0 fl. oz. lime juice</td>
<td></td>
</tr>
<tr>
<td>32.0 fl. oz. caramel, acid proof</td>
<td></td>
</tr>
<tr>
<td>12.0 fl. oz. cola flavor base of formula MF 209</td>
<td></td>
</tr>
<tr>
<td>12.0 fl. oz. alcohol, 95 per cent</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>128.0 fl. oz. or one gallon cola flavor.</td>
</tr>
</tbody>
</table>

Recommended Use.—4 fl. oz. flavor and add one-half fl. oz. of phosphoric acid dilution, formula MF 210, per gallon of syrup.
Cream Soda Flavor  MF 213

Mix of:

- 0.55 gm. ionone, beta
- 2.20 gm. benzaldehyde
- 17.60 gm. aldehyde C-16
- 8.80 gm. amyl acetate
- 44.00 gm. ethyl acetate
- 35.20 gm. oil of lemon, terpeneless
- 452.00 gm. vanillin
- 439.65 gm. alcohol, 95 per cent

Total
1000.00 gm. cream soda flavor

Ginger Ale Flavor  MF 214

Mixture of:

- 4.0 lb. oleoresin of ginger, formula MF 215
- 1.0 lb. oil of limes, expressed
- 1.0 lb. oil of limes, distilled
- 1.0 lb. oil of lemon, cold pressed, California
- 1.0 lb. oil of orange, cold pressed
- 27.2 lbs. alcohol, 95 per cent
- 41.5 lbs. water

Total
76.7 lbs. or 10 gal. ginger ale flavor

Agitate well and let stay for separation of terpenes; then decant.

Oleo Resin of Ginger  MF 215

Ginger is cultivated in the West Indies, Africa, and Japan. Ginger contains up to three per cent of greenish-yellow volatile oil which is responsible for the aroma but not for the pungency of ginger. The oil consists of a sesquiterpene called zingiberene together with traces of another sesquiterpene called bisabolene. The pungent properties of ginger are attributable to the presence of gingerol, a yellowish oily substance possessing phenolic properties. It dissolves in warm aqueous potassium hydroxide and loses the pungent property. Oleo-resin or ginger, or gingerin, is prepared by percolating powdered ginger with acetone or alcohol until completely exhausted, distilling off most of the solvent from the percolate and drying the residue on a water-bath until it forms a brownish mass of syrupy consistency.

Pale Dry Ginger Ale Extract  MF 216

Mixture of:

- 1.500 fl. oz. oleoresin ginger
- 0.125 fl. oz. oleoresin capsicum
- 0.250 fl. oz. oil of ginger
- 0.250 fl. oz. oil of orange, cold pressed
0.250 fl. oz. oil of limes, distilled,
0.500 dram oil of mace,
0.500 dram oil of coriander,
32,000 fl. oz. alcohol 95 per cent
64,000 fl. oz. propylene glycol,
2,000 ozs. av. magnesium carbonate,
32,000 fl. oz. water

Procedure
(a) Mix oleo resins with 22 fl. oz. alcohol, 95 per cent, and 32 fl. oz. propylene glycol; add 2 oz. av. magnesium carbonate, mix one hour, and then let stand overnight; decant and filter.
(b) Mix the oils with 10 fl. oz. alcohol 95 per cent and then with the filtered mixture of (a); afterward add to it 32 fl. oz. propylene glycol and 32 fl. oz. water to make one gallon flavor.
(c) A few drops of oil of rose are sometimes added to the essential oil mixture to give it a distinctive character.

Ginger Flavoring Extract  MF 217

Extraction of:
(a) 132.0 lbs. Jamaica ginger, comminuted, with:
481.4 lbs. or 58 gal. heated water of about 194°F.; circulate the liquid over the ginger for 10 minutes, then let the mixture stay for 24 hours to cool;
(b) to the mash of (a) is then added:
285.6 lbs. or 42 gal. alcohol, 95 per cent; the menstruum is to be circulated for 10 minutes to obtain uniform alcohol content of 40 per cent strength;
(c) after 3 days extraction during which the menstruum has been circulated twice daily, the liquid is drained off and yields approx.
672.0 lbs. ginger extract; it is used in (e);
(d) 227.0 lbs. remaining mash is mixed with:
150.0 lbs. water, and distilled at atmospheric pressure, to yield:
110.0 lbs. flavor distillate of about 25 per cent alcohol content; it is used in (e).
(e) Mix:
672.0 lbs. ginger extract of (e), with
110.0 lbs. flavor distillate of (d), to yield:

Total
782.0 lbs. or 100 gal. ginger flavoring extract.

Concord Grape Fruit Flavor  MF 218

Mixture of:
32.0 fl. oz. desugared grape extract, imported from Italy;
64.0 fl. oz. Concord grape full flavor concentrated juice, 72° Brix; formula MF 22
2.0 fl. oz. Concord grape recovered flavor essence 100-fold;
20.0 fl. oz. alcohol, 95 per cent

Total
128.0 fl. oz. Concord grape fruit flavor.

Recommended Use.—Five gallons flavor per 100 gal. syrup; a solution of citric and tartaric acid is added according to required taste.

Black Raspberry Fruit Flavor  MF 219
(For use in syrup and carbonated beverages)

Mix:
1.0 gal. full flavor black raspberry concentrated juice of 70.5° Brix—non-alcoholic, formula MF 30,
0.3 gal. raspberry flavor distillate of 50 per cent alcohol content, formula MF 29,
3.7 gal. red raspberry fruit flavor, formula MF 28,

Total
5.0 gal. black raspberry fruit flavor of 15 per cent alcohol content.

Recommended Use.—three to five gal. flavor in 100 gal. syrup to make 700 gal. carbonated black raspberry soda; acid citric solution is added according to required taste.
GELATIN DESSERT

Gelatin desserts are generally composed of various sugars, gelatin, organic acid, flavor, color, and a salt of an edible acid. These ingredients are mixed together to form a dry powder which is marketed in packages of about 3 oz. net to go with one pint of water.

All of the powders used such as the acid, buffer salt, sugar, and gelatin should be approximately the same mesh in order to minimize any separation during packaging and storage, and to insure uniform mixing during the preparation of the dessert powder. All of the ingredients should be of pure food quality and should be free of any objectionable odors or insoluble particles.

Sugar

The purpose of sugar is to impart sweetness to the dessert and to act as an absorbent for liquid flavor and color. Granulated cane sugar is ordinarily used.

Anhydrous Cerelose

Cerelose is a trade name for dextrose. This material is sometimes added in place of some of the cane sugar. Due to its anhydrous character it quickly absorbs the liquids, promotes faster drying during the mixing, and tends to produce a free flowing dessert with less tendency to cake in the package.

Anhydrous Acid

The acids generally used are citric acid, tartaric acid, malic acid, and lately, fumaric acid. Acid imparts a desirable tartness to the dessert. Excess of acid will seriously affect the jelling power of the dessert and at the same time impart an excessive tartness. If too little is used tartness will be lacking, causing dessert to have a flat taste.

Citric and Tartaric Acids.—Citric acid is completely metabolized in the human body. Its hydrous form contains 8.5 per cent water of crystallization. Anhydrous citric acid has no water; it is 100 per cent acid and has a melting point of 302°F. Tartaric acid also crystallizes without water of crystallization. It has a melting point of 338°F. Both acids have no by-taste, but the acid taste of citric acid is softer. Citric acid is not so hygroscopic as tartaric acid or citric acid hydrous.
Fumaric Acid.—Fumaric acid is an unsaturated dibasic acid of an extremely low order of toxicity. It is used presently by one large gelatin dessert manufacturer by patent.

**Table 16**

**Physical Properties of Fumaric Acid**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formula</td>
<td>$\text{H}_2\text{C}_2\text{H}_4\text{O}_4$</td>
</tr>
<tr>
<td>Appearance</td>
<td>White crystalline powder</td>
</tr>
<tr>
<td>Specific gravity at $68^\circ/7.2^\circ \text{F.}$</td>
<td>1.635</td>
</tr>
<tr>
<td>Melting point</td>
<td>$514.8^\circ \text{F.}$ (Scaled tube)</td>
</tr>
<tr>
<td>Boiling point</td>
<td>$522^\circ \text{F.}$ (Scaled tube)</td>
</tr>
<tr>
<td>Solubility in water at $77^\circ \text{F.}$</td>
<td>0.7 Gm./100 ml.</td>
</tr>
</tbody>
</table>

The relative insolubility of fumaric acid limits its use up to 0.7 gm. of acid per 100 ml. of water at $77^\circ \text{F.}$ For higher concentrations, it is necessary to raise the water temperature accordingly.
Buffer

When acid is used sodium citrate or other buffer is added, this substance tends to maintain gel strength and quick set without materially diminishing the tartness. The acid and buffer salt should be of granular type of about the same mesh as sugar.

Gelatin

The gelatin should be of pure food quality and free of any objectionable odors or insoluble sediment. It should not impart any haze or cloudiness to the dessert solution.

<table>
<thead>
<tr>
<th>Grams Acid in 100 Ml. water at 77 °F.</th>
<th>pH of Acid Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fumaric</td>
<td>Citric</td>
</tr>
<tr>
<td>0.05</td>
<td>2.9</td>
</tr>
<tr>
<td>0.1</td>
<td>2.7</td>
</tr>
<tr>
<td>0.2</td>
<td>2.5</td>
</tr>
<tr>
<td>0.4</td>
<td>2.3</td>
</tr>
<tr>
<td>0.6</td>
<td>2.2</td>
</tr>
<tr>
<td>0.7</td>
<td>2.1</td>
</tr>
<tr>
<td>1.0</td>
<td>...</td>
</tr>
<tr>
<td>2.0</td>
<td>...</td>
</tr>
<tr>
<td>5.0</td>
<td>...</td>
</tr>
<tr>
<td>10.0</td>
<td>...</td>
</tr>
</tbody>
</table>

Edible gelatin is made from the protein, collagen, by extraction from the connective tissues of skin and bone of animals. Collagen changes into gelatin rapidly at high temperatures in the presence of a slight amount of acid. Edible gelatin has no detrimental effect on flavor or color of gelatin dessert powders and frozen desserts.

The gel strength of gelatin is determined by test with the Bloom gelometer, named for its inventor. For instance, a 175 Bloom or a 250 Bloom gelatin means that a weight of 175 or 250 grams is required to make a certain depression in a solidified solution of the gelatin in water under certain standard conditions. The higher the Bloom test, the higher the gel strength of the gelatin.

Flavor

Liquid and spray-dried flavors of highest concentration, made from essential oils and aromatic chemicals, are used widely in gelatin desserts. Fruit flavors are often used in institutional products and for labeling purposes. For a 350 lb.-batch, 16 fl. oz. true fruit flavor are generally added. However, a mixture of full flavored concentrated fruit juices or
full aromatic fruit flavors and imitation flavors or essential oils give gelatin desserts a superior aroma and taste.

**Citrus Oils in Gelatin Desserts.**—For a three-ounce av. package of lemon gelatin dessert are required:

- 0.0044 gm. oil of lemon, 5-fold; for a three-ounce av. package of lime gelatin dessert are required;
- 0.0620 gm. oil of limes distilled, 5-fold; for a three-ounce av. package of orange gelatin dessert are required;
- 0.0440 gm. oil of orange, 5-fold.

The citrus oils are dissolved in a volatile solvent; a DeVilbis-type sprayer is useful for platting the liquids on the sugar.

**Composition of Gelatin Dessert per Three-ounce (85 gm.) Package:**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sucrose (extra-fine granulated cane or beet)</td>
<td>72.8 gm.</td>
</tr>
<tr>
<td>Gelatin (pure food, 225 Bloom)</td>
<td>9.0 gm.</td>
</tr>
</tbody>
</table>
Citric acid anhydrous ........................................ 2.4 gm.
Buffer salt (sodium citrate or 1:1 mix of mono- and di-sodium phosphate) ........................................ 0.4 gm.
Sodium chloride .................................................. 0.4 gm.

Total ...................................................................... 85.0 gm.
(3 av. oz.)

A 350-lb. batch yields 1870 3-oz. packages. Using the figures stated in the package formula, we get the batch formula presented in Table 19.

Using a stronger or a weaker gelatin, the sugar content per batch would be adjusted so that the combined sugar and gelatin ingredients would still add up to 337 lbs.

Color

Mixing of Colorings.—About 3 fl. oz. of water added to the sugar fraction (300 lbs) of the 350 lbs. mix with 2 minute agitation serves to moisten it sufficiently to cause the added powdered color to adhere to the sugar. This gives a fairly uniform color to the mass. In the case of the berry and cherry types, the true fruit extracts give enough moisture so that water need not be added.

To avoid a mottled appearance in the dish (when Blue #1 is a component of the color), the color manufacturer will upon request prepare

<table>
<thead>
<tr>
<th>Certified Primary Colors</th>
<th>Lemon Gm.</th>
<th>Lime Gm.</th>
<th>Orange Gm.</th>
<th>Cherry Gm.</th>
<th>Raspberry Gm.</th>
<th>Strawberry Gm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>FD&amp;C Red No. 1 (No. 80 Ponceau 3R)</td>
<td>...</td>
<td>...</td>
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<td>0.0120</td>
<td>0.0210</td>
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<tr>
<td>FD&amp;C Red No. 2 (No. 184 Amaranth)</td>
<td>...</td>
<td>...</td>
<td>0.0074</td>
<td>0.0400</td>
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<td>FD&amp;C Red No. 4 (Ponceau SX)</td>
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<tr>
<td>FD&amp;C Blue No. 1 (Brilliant Blue FCF)</td>
<td>...</td>
<td>0.0013</td>
<td>...</td>
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<tr>
<td>FD&amp;C Yellow No. 5 (No. 640 Tartrazine)</td>
<td>0.00280</td>
<td>0.0183</td>
<td>0.0034</td>
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<tr>
<td>FD&amp;C Yellow No. 6 (Sunset Yellow FCF)</td>
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<td>...</td>
<td>...</td>
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</tr>
<tr>
<td>Total of Coloring in grams</td>
<td>0.00291</td>
<td>0.0196</td>
<td>0.0068</td>
<td>0.0522</td>
<td>0.0311</td>
<td>0.008</td>
</tr>
</tbody>
</table>
Fig. 24. Top of Cyclone Collectors

Courtesy of Norda, Inc.
your special blend, dissolve it in water, dry, and grind. Such a color powder will remedy the difficulty.

METHOD OF MIXING GELATIN DESSERTS

The general method in preparing gelatin desserts is to plate the sugar or a mixture of sugar and corn sugar with flavoring and coloring; the gelatin and buffers are mixed separately and then slowly added to the flavored and colored sugar; mixing is continued until a uniform dry powder has been obtained.

SPRAY DRIED FLAVORS

The process of spray drying dates back as early as 1865 and was adopted in many European countries as a novelty especially to attract the household user of food flavors. Powdered flavors were originally prepared by spraying essential oils and compounds of aromatic chemicals on the surface of sugar and starch products, creating mostly mixtures which caked more or less depending on temperature and storage conditions.

The food industries which were interested in powdered flavors could not use them and did their own spraying of flavors on finished mixtures for consumers’ use, such as gelatin dessert powders and powdered drinks.

Spray drying was successfully improved by American inventors in the early part of the twentieth century. It was first in America applied in drying skim milk.
The growing interest in stable powdered flavors brought new inventions and with it new machinery to improve production of spray dried flavors. At the present time, spray drying is mostly done by heating air up to 450°F. in a drying chamber which is made of stainless steel. A flavor solution containing essential oils or a compound of aromatic chemicals mixed with colloidal matter (gum acacia with or without dextrose and water) is blown in minute droplets to meet the current of hot air and to dry instantly.

The procedures of spray dried flavor methods require a careful selection of aromatic ingredients with high boiling temperatures to resist heat; also, there must be found a way to retain the volatile aroma and taste in spray dried fruit flavors and juices.

**Spray Dried Flavoring Process**

**Procedure.**—In preparation for spray drying, the liquid flavor is emulsified with gum arabic (approximately 20 per cent by weight) to make a solution of approximately 35 per cent total solids. This solution, held in a steam-jacketed stainless steel vessel equipped with a mechanical agitator, is pumped in controlled amount to the spray drier's centrifugal atomizer.

Extending down from the 18 ft. diameter head of the drier is a centrifugal atomizer, an essential element of the process. This atomizer is driven at 12,000 r.p.m. by a 15-h.p. motor (located on top of the unit), through step-up gearing. Filtered air—heated to approximately 450°F. at a rate of 5000 c.f.m.—is released in the drier directly below the spray. And the hot blast passes through louvres which whirl it in the same direction that the centrifuge is rotating.

From holding tank to the drier's atomizer, the temperature of the liquid flavor emulsion is maintained in jacketed stainless steel tubing. So when the emulsion emerges from the atomizer, the resultant fog-like mist

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1 see Figs. 22 to 25 inc.
is split-second dried to particles of between 10- and 250-microns size. And each particle has a high ratio of sealed surface area to volume. The temperature drop of the heated air resulting from evaporation is from 450°F. to 210°F – 220°F.

The exhaust duct located nearer the bottom of the drier cone delivers air and fines to three cyclone collectors. And the product dust collected in these is reprocessed.

Finished product discharge continuously from the cone bottom of the drier onto a closed vibrating conveyor which empties into a spout feeding a gyratory sifter. Then the flavor goes into fiber drums.

Particle size of finished flavors (which depends on use for which product is intended) ranges generally between 75 and 250 microns, averaging 150 microns. Oversize particles, almost negligible in quantity, are separated in the gyratory sifter and returned with the fines for reprocessing.

**Flavoring Compound.**—Flavor emulsions are delivered to the atomizer at a temperature between 120° and 150°, depending to some extent on flavor constituents and their volatilizing temperatures. Herein lies one of the technical problems of spray-drying flavors—even when in an emulsified colloidal state.

A single flavor may be compounded of as many as 20 or 30 alcohols, ethers, aldehydes, ketones, etc. Boiling points of the various components may range from 100° to 120° to 300° to 350°F. And though total evaporation loss of flavor components during processing has proved to be less than five per cent, the loss of some of the low-boiling ingredients may be considerably higher.

Laboratory research and pilot-plant testing are therefore requisites for initial compounding of a flavor. Such study is necessary if the final dry flavor powder is to contain the flavor ingredients in exactly the proportion required, regardless of the evaporation rate of any and all of the flavoring constituents.

Although air at 450°F. blasts the sprayed flavor emulsion, the evaporation rate (800 lbs. of water per hour) is controlled to prevent product damage through over-heating. Even with the exit temperature of the exhaust air at 210° to 220°F., the product is rarely discharged from the drier at a temperature above 150° to 160°F. And then it is cooled rapidly to approximately 90°F. as soon as it is discharged.

This product cooling is accomplished as the dry powder travels along the vibrating conveyor between the drier exit and the gyratory sifter. Air at room temperature is drawn into the discharge end of the closed vibrating conveyor by slight negative pressure, and it travels countercurrent to the product. Vacuum in the drier is maintained by the differential between the volume of the hot-air input blower and that of the...
exhaust blower. Located after the cyclone, the latter discharges to atmosphere.

Production Control.—At many steps in the process, precautions are taken to control quality and prevent contamination of the product. After each run, the system is washed. Water for this washdown is pumped through a plate-and-paper type filter before entering the system via the jacketed holding tank.

Several devices are engineered into the spray drier to insure that the product never makes contact with any over-heated surface inside the unit. Entering near the bottom of the drier, the hot-air duct extends up through the unit, to within approximately one foot of the atomizer. But this duct is covered by a layer of insulation and is surrounded by an air chamber. Filtered air at plant temperature is blown through this chamber to exhaust at the duct terminal with the heated air.

To prevent any product from settling on horizontal sections of either the intake or exit duct, both are covered by sharp-gabled stainless steel "roofs."

One other precaution against product damage bears mention. Before the 5000 c.f.m. air-blast is heated, it passes through an air filter.

The drying air is electrically heated by a three-section unit with capacities of 372, 192, and 86 kw., respectively. Three transformers totaling 650 kw. are installed to handle the heating and power requirements, stepping the power from 4100 to 440 volts.

Heated air entering the drier is maintained at the required temperature (± a few degrees) by thermocouples in the duct near its entrance to the drier. These turn the current on and off, first for the 86-kw. heater, then for the others if necessary.

Located in the exhaust duct where the heated air leaves the drier is a temperature-sensing element for a controller that actuates an air-operated valve in the flavor-emulsion line. This valve reduces, or increases, flow of liquid to the atomizer. Since exit temperature of the constant flow of air leaving the drier is determined by the rate of evaporation of the flavor liquid, this control system is important to drier efficiency and product quality.

Flavor emulsion, with its 35 per cent solids content, is fed to the atomizer at the rate of 1265 lbs. per hr. The drier evaporates 800 lbs. of water per hr. to recover 375 lbs. per hr. of dried flavor powder, plus 90 lbs. of powder fines that are reprocessed.
Genuine Full Flavor Black Raspberry Gelatin Dessert  
*MF 220*

(a) Preparation of full flavor black raspberry concentrated syrup.

Mix:

- 1 lb. full flavor black raspberry concentrated juice 68° Brix, formula *MF 30*, with
- 3 lbs. syrup 75° Brix

Yield 4 lbs. full flavor black raspberry concentrated syrup.

(b) Then dissolve eight gm. of unflavored gelatin powder in a quarter cup of cold water, stir, and mix with one and a quarter cups of boiling water. Add one-eighth teaspoon salt, 3 teaspoons of lemon juice, and 4 fluid ounces or half a cup of full flavor black raspberry concentrated syrup of (a).

Powdered Butterscotch Candy  
*MF 221*

Procedure

(a) 180.0 gm. cane sugar are mixed with
- 140.0 gm. sugar syrup of 36° Baumé
- 50.0 gm. butter
- 50.0 gm. vinegar 4 per cent or 5 per cent
- 5.0 gm. oleic acid (emulsifying agent); the mixture is heated until the sugar is dissolved; to the heated mixture is added at 140°F.

(b) 3.5 gm. diacetyl; the mixture is agitated while the heating continues until the temperature of 221°F. is reached; from then on the heating is regulated to an increase of 1.8° Fahrenheit per minute up to the temperature of 293°F. It takes ten minutes until the temperature of 293°F. is reached, whereupon heating is stopped.

(c) a little bicarbonate is added to create foam and to neutralize acid;

(d) starch is sprayed on wooden trays or stainless steel pans to avoid sticking of the heated candy mass when it is poured into the containers where it is left to cool;

(e) the cooled candy is then ground to powder.

Butterscotch Powder  
*MF 222A*

Mix:

- 10 gm. pulverized butterscotch candy—formula *MF 221*
- 12 gm. dextrose

Total

22 gm., grind to a uniform powder.

*This full flavor concentrated syrup is also recommended for use in fruit juice ices on a stick, fruity ice pops, sherbets, and ice cream.*
GELATIN AND PUDDING FLAVORINGS

Butterscotch Powder and Vanilla Sugar       MF 222B

Mix:
- 50 gm. pulverized butterscotch candy—formula MF 221.
- 25 gm. dextrose
- 10 gm. vanilla sugar
- 15 gm. starch

Total
100 gm.

Vanilla Flavor Imitation Chocolate Pudding       MF 223

Mix:
- 0.75 oz. av. vanillin
- 1.00 oz. av. oleoresin of vanilla—formula MF 62.
- 0.25 oz. av. ethyl vanillin
- 15.00 oz. av. dextrose (pulverize before adding ingredients)
- 1.00 oz. av. cornstarch

The yield is one pound, due to the loss of moisture by evaporation and drying of the material.

Recommended Use.—Two ounces per 100 lbs. chocolate type puddings.
CHAPTER 19

Flavorings for Candy and Chocolate Confectionery

Candy and chocolate confectionery products are composed of sugars, syrups, starches, cocoa products, edible oils and fats, egg products, fruit products, gelatin, dairy products, nut products, acids, coloring, gums, pectins, and flavoring material.

Over 4,000,000 lbs. of flavoring material are used in the manufacture of confectionery products annually. The flavoring ingredients are aromatic flavor imitations, true fruit flavor concentrates, essential oils, vanilla, and spices. No more than one-half of one per cent of alcohol, by weight, contained in the flavoring ingredients is permitted in the manufacture of candy products.

Confectionery products are divided generally into hard candy, fondants (sugar creams), lozenges, fudge, caramels and toffee, marshmallow and whips, nougat, jellies and gums, bonbons, and chocolate and sugar coated candies.

INGREDIENTS

Sugars

Sweeteners for confectionery may be cane or beet sugar (sucrose), honey, maple syrup, molasses, refiners' syrup, corn syrup, dextrose, lactose, levulose, or maltose. These vary in sweetness, flavor, and behavior on processing.

Sugar (sucrose) is usually measured as 100. Levulose is sweeter than any other sugar. The average measurements are presented in Table 8 (p. 208).

The taste of sugar (sucrose) is neutral. By comparison, the taste of all other sugars cannot be called neutral.

Dextrose (corn sugar) is manufactured by heating corn starch in the presence of an acid. It crystallizes more slowly than cane or beet sugar and is less soluble. It is not as sweet as these sugars.

Honey, molasses, or maple syrup are used to add flavor as well as sweetness. Dairy products, fruits, and nuts are used similarly. The use of citric and tartaric acids enhances the fruit flavors. Candies with acid require less added flavor than candies without acid. Starch and flour subdue flavors, as do fats and oils. Fondants require more flavor when chocolate coatings are used. Chewy confections and sugar fondants require only half as much flavor as hard candy, due to their speedy dispersion in the mouth.
Sucrose is the most important of the sugars. It occurs in the sugar cane, sugar beet, sugar millet, certain palms, and maples. Upon hydrolysis, sucrose breaks down into glucose and fructose.

Cane sugar is produced from the juice of fully ripened sugar cane which grows in Cuba, Puerto Rico, Hawaii and the Philippines, and a small portion in Louisiana and Florida. Sugar cane juice is partially clarified and then boiled under vacuum until sugar crystals are formed. The crystals are separated by centrifugal machines. The raw sugar, which is grayish-brown in color, is then refined.

Coarser grained sugar usually cooks whiter than does finer granulated sugar. Medium granulated sugar is used for clear hard candies, fondant, bonbon coatings, crystal syrup, and sanding purposes. Fine granulated is used in making pure sugar creamy mints, fountain syrups, and is sprinkled on slabs that are to have coconut candies poured upon them. Bakers’ special is added to butter crunch or toffies after they are cooked, to start the graining process. It is also used on soft panned goods such as jelly beans. Powdered sugar is made by grinding coarser sugar. Powdered sugar is used for icings and dusting candies such as marshmallow.

Yellow and brown sugar are made from the reboiled syrups of white sugars. They contain from 3 to 4 per cent moisture and harden easily. Brown sugar should be completely dissolved in hot water before adding the dry white sugar so as to be sure that it is all dissolved. The syrup of yellow and brown sugars, like molasses, acts as an invert syrup.

Beet sugar is refined with lime. Refining is practically the same for cane and beet sugar.

Maple sugar and maple syrup are used for their flavor in the making of candies. Mild sugar is used for making pure maple sugar candies such as maple cakes and cream candies. Stronger flavored maple sugar is used as a flavor by adding to other sugars. Maple sugar is made by pouring boiled syrup into molds where it crystallizes into blocks.

Maple syrup is produced commercially in New England, New York, Pennsylvania, the Ohio Valley, the Lake states, and adjacent parts of Canada.

The maple sap season may start as early as the middle of February. Holes are bored in the tree and buckets are attached to a spout which is inserted in the holes. The hole is bored with a slight upward slant not more than two inches deep. The sap is gathered periodically and is poured into a hauling tank and transported to the boiling house for concentration.

The sap contains up to five per cent total soluble solids, principally sucrose. During boiling, proteins are coagulated and come to the surface and are removed by skimming. Mineral salts, principally calcium malate,
separate during the boiling of the sap and are removed after boiling is completed.

Maple syrup is concentrated to about 65° Balling. Below 65° Balling, it will ferment and above 70° Balling, it is very apt to crystallize. Syrup of 65° Balling weighs eleven pounds per gallon at 60°F.

Molasses is a by-product of the sugar refining process. In the process of separating molasses from sugar crystals, the juice is boiled to the correct density in vacuum pans. It is then passed on to a centrifuge where the molasses is separated from the sugar crystals.

The sugar content varies in different types and grades of molasses. Molasses should be of low ash and mineral content for they scorch easily at low temperatures and give the candy a bitter, salty taste. Scorched candies also become sticky very quickly.

Invert sugar is used to control inversion of the sugar contained in the candy, to replace corn syrup where sweetness is desired, as addition to creams after they are cooked to act as a softener and to retain moisture, to prevent fermentation in chocolate coated creams, to increase the density, and to create sweetness and tenderness of hand rolled creams. Invert sugar can replace honey and will have the same texture as nougat made with honey. It is used in fudge, caramels and starch jellies, fountain syrups, and to make fondant for cordial cherries and cream dipped fruits.

Dextrose or corn sugar is obtained by converting corn starch into a sugar by the use of acids. It is not to be confused with cane or beet sugar (sucrose). Corn sugar or dextrose cannot replace sucrose completely. However, it can be used to substitute for some of the sugar in starch jellies, ungrained marshmallow, nougat, and chewy candies.

Corn syrup (glucose) prevents the graining of sugar in candy. Confectioners corn syrups are of 42 Baumé and 43 Baumé.

In cream candies the tenderness of the creams depends on the amount of corn syrup used. A large percentage of corn syrup will result in gummy creams. Creams with a smaller percentage of corn syrup will be more tender. Corn syrup in hard candies prevents graining. In jellies, marshmallow, nougats, fudge, caramels and coconut candies, corn syrup is used to control graining.

Honey is used for its flavor of the flowers from which it is collected. Clover honey is preferred for its delicate taste in uncoated nougats. Puerto Rican honey has a darker color and stronger flavor. Honey cooked with sugar will invert some of it and prevent crystallization. Honey for nougat should be used raw or cooked in the portion that is whipped up with egg albumen.

Invertase converts sugar into invert sugar and assists the invert sugar to increase and soften the creams after they are chocolate coated. Less
invertase is needed for fruit of high moisture content and more needed for dried fruit.

Acids

Acids control inversion of sugar and starch as well as fortify or bring out the true fruit flavor of candies.

The commonly used acids in candy making are acetic acid, citric acid, cream of tartar, tartaric acid, and phosphoric acid.

Acetic acid is used in fondants to control crystallization of the sugar.

Citric acid is used in the manufacture of starch jellies to clear the batch and by inverting action to reduce the consistency of the starch. Citric acid also increases the activity of invertase. Excessive use of citric acid destroys the starch and the jellies will lack body. It also will cause jellies to sweat. Citric acid used in cream candies is added to hard candies in powder form.

Cream of tartar is used to control crystallization in fondants and in pure sugar hard candies. Cream of tartar is widely used as an inverting agent and to replace citric and tartaric acid in starch jellies. It is also mixed with bicarbonate of soda in baking powder to make coconut macaroons.

Tartaric acid is used as citric acid, but due to its strength in a smaller amount.

Phosphoric acid is used in some pectin jellies replacing citric acid.

Chocolate and Cocoa

Chocolate liquor is obtained from cocoa beans which contain up to 54 per cent natural cocoa butter. The roasted nibs are passed through mills and chocolate liquor is obtained.

Sugar and extra cocoa butter are mixed with chocolate liquor and after passing through rollers sweet chocolate is obtained. It is used as a coating for candies and for its flavor value in many candies.

Chocolate liquor contains 52 per cent or more of cocoa butter and from 30 to 35 per cent sweetened chocolate.

Cocoa powder is often used to replace chocolate liquor as a flavor. Vegetable fat is added to substitute for fat. Darkened cocoa powders which are treated with an alkaline are known as Dutch process cocoas.

Coconut

Coconut is used in freshly ground, sweetened and unsweetened, dry, toasted, and creamed form.

Freshly ground coconut imparts the best flavor and tenderness to candies. It contains from 40 to 50 per cent moisture and should be cooked before adding it to cream candies.
Often fresh coconut is replaced by a desiccated or dry coconut. The two types of desiccated or dry coconut are unsweetened and sweetened. Sweetened coconut has a little more crispness than unsweetened coconut.

Macaroon is a finely comminuted coconut which is used in toasted coconut macaroons, fudge, and other candies that require fine texture. Fine coconut is often combined with fresh ground or coarser coconut to stiffen the mass and to keep the liquid portion of the candy batch evenly distributed. Medium sized and colored coconut is most often used for decorative purposes. Chopped and colored almonds are also used as a decoration. Coarse coconut is used in coconut slugs. It can also be colored and used as a topping. Slice or chip coconut is used as a topping for fudges and in coconut brittles. Short shred coconut is used in candies that call for eye appeal. Thread coconut is used where medium or short shred coconut is not long enough to meet requirements.

Creamed coconut or plastic coconut is an emulsified coconut meat containing the solids and oils of fresh coconuts. It can be used to replace coconut oil, as a fat to icings for coating candies, in butterscotch, caramels, in hard candy filled center chips, and nougats.

Fats and Oils

Fats and oils are used extensively in the manufacture of candies. Hard butters are made from fats and oils whose melting point has been raised by a treatment with hydrogen or from which the lower melting point oils have been removed. Between the lower melting point of natural oils and the hard butters are plastic butters.

Plastic butters are hydrogenated oils that have a creamy texture. Their melting point ranges from 96° to 110°F. Plastic butters have a softer body than hard butters. They are used in icings that contain fats, for replacing all or a part of the dairy butter, in mixtures with hard butter in caramels; they are mixed with powdered sugar, cocoa, or chocolate for soft filling in hard candy straws, and are used in soft candies where the taste of dairy butter is not needed, in some popcorn confections, and in combination of chocolate and soft butters in chocolate pastes.

Hard butters are used in caramel, nougats, chewing candies, and as a replacement for a part of the dairy butter in cheaper grades of butterscotch. They are combined with egg frappé and sweet chocolate to make a pudding-type confection, and sometimes they are used in chocolate paste or combined with the soft butters.

Plastic butters are used for making butter toffies and brittles where a part of the dairy butter is replaced with a vegetable butter.

Certain nougat type candies contain malted milk, chocolate liquor, and vegetable butter.
Dairy Products

Butter is used in cream centers, butter crunches, nut brittles, and many other candies. Butter, being an animal fat, should contain an antioxidant to extend the shelf life of candies.

Milk is composed of butterfat, milk solids-not-fat, and water. The milk solids-not-fat consist of milk sugar, casein, albumin, and minerals.

Cream is a mixture of skim milk and butterfat. The higher the fat percentage in cream, the lower the percentage of milk solids-not-fat.

Dairy products normally have an acid reaction. The acidity is due to the acid reaction of the casein, albumin, citrates, phosphates, and carbon dioxide present in milk. When milk becomes contaminated with bacteria, the milk sugar is broken down by the micro-organisms, producing lactic acid and small amounts of other acids such as acetic acid.

Among the related compounds of milk fat or butter fat are also lecithin and cholesterol. Lecithin helps to emulsify the fat with the water content of the milk. When milk is churned lecithin is retained by the butter-milk. Cholesterol is a wax-like substance and is classified as solid alcohol.

The constituents present in milk in the greatest proportion are water and lactose or milk sugar.

Milk products and their cooking actions influence the texture and quality of the product in which they are used. Skim milk contains about 9 per cent solids and 91 per cent water. Whole milk contains 3.5 per cent butter fat, 8.5 per cent solids, and 88 per cent water.

Skim or whole fresh milk is used in home-made fudge. The fat deficiency of skim milk can be reduced by the addition of vegetable butters for open fire cooking.

Fresh cream contains 12 to 40 per cent butterfat. Higher butterfat creams are used in high grade fudges and truffle type candies in combination with sweet chocolate.

Powdered milk or cream is used to replace liquid milk. It is homogenized with warm water and a stabilizer to avoid curdling.

Whole sweetened condensed milk is used in fudge or caramel with a heavy body. Sweetened condensed milk can be mixed with corn syrup and added fats, or with dairy cream, unsweetened evaporated milk, or reconstituted powdered milk for desired texture of a finished product.

Commercial milk solids pastes are milk or cream in concentrated form and contain added sugar or corn syrup.

Lecithin

Lecithin is sometimes used in candies containing fats or oils. The name lecithin (lecithol, ovolceithin, phospholutein, phosphatidyl choline) is
given to a group of substances normally present in all living tissue, just
as are fats, proteins, and carbohydrates. Lecithin substances are mixtures
of the diglyceride residues of stearic, palmitic, and oleic acids, linked to
the choline ester of phosphoric acid. It occurs naturally in egg yolk,
corn, and soybeans. Lecithin is used extensively in chocolate products,
also in bakery goods and margarine to improve consistency. It is surface
active, reduces surface tension, disperses fat, and also is an antioxidant.
In the manufacture of chocolate products, it reduces the viscosity of the
chocolate and thus permits the use of less cocoa butter than would be
needed in absence of lecithin. Lecithin is usually added before the
chocolate is molded and is brought to a predetermined viscosity with
cocoa butter.

**Albumen**

Egg or soy albumen supplies whipping quality to nougat, kisses, and
frappés which are used in cream candies and toppings. Five pounds of
fresh or frozen egg whites can be replaced by dissolving 1 lb. albumen in
4 lbs. of water. Six and one-third pounds of fresh or frozen egg whites
replace one pound dried albumen.

One pound of frozen egg whites is equal to the whites of 15 medium
sized fresh eggs. Frozen egg whites should be thawed out. Warm water
is not to be used to thaw frozen egg whites.

**Gelatin**

Gelatin is used as a whipping agent in marshmallows and some types
of nougat. It is often combined with egg or soy albumen in these candies
to give them a more tender body. The quick setting gelatin gives choco­
late coated marshmallow a short breaking tender body, the slow setting
gelatin gives a more stretchy texture. Small quantities of gelatin are
often added to caramels, kisses, and pulled taffies to add chewiness and
to bonbon and wafer creams.

**Glycerin**

Glycerin is used to retain moisture in cream candies, marshmallow, pure
sugar stick candy, and cream mints.

**Gums**

Gums are used in candies to bind and hold the ingredients together.
Gum acacia (arabic) forms the body in jelly gum drops and hard gum
drops. It stiffens the sugar shell of the syrup in cordials, binds the syrup
in panned jelly and marshmallow, and closes in almonds before sugar
coating.
Gum tragacanth is applied in making short textured marshmallow for use in layer cakes. It is also used as a binding agent in sugar lozenges.

Nuts

The sweet almond is the one most widely used in confections. The shelled nuts add a pleasing taste and eye appeal to many candies, they are equally delicious either roasted or unroasted. Unroasted almonds are recommended for cream almonds, hard finished panned almonds, in nougat, and for topping purposes. Roasted almonds are preferred in hard candies, chocolate coated, and other candies. Most almonds come from Spain, Italy, the Asiatic countries, and mainly from California.

Brazil nuts are the seeds of a tropical fruit tree which grows to an enormous height in the jungles. The seed is separated from the fleshy part of the ripe fruit and then shelled. Brazil nuts can be used in any type of candy. Blanched and chopped nuts are used as an outer coating on nut rolls and similar candies. Sliced nuts are used as a topping for fudge.

Cashew nuts are the seeds which protrude from the end of a fruit. The seeds are separated from the fruit and roasted so that the shells can be cracked and the nuts removed. The inner husk is separated from the cooled nut. Cashews come in different sizes and grades; in splits, where the whole nut is split apart; in butts, where the tip is broken off, and in remaining large or small pieces. Splits, butts, and broken pieces are often used instead of chopped nuts. The whole unscorched nuts are used as an outer coating for candies and for salting purposes. Butts and splits are also used in salted nut mixtures. Unroasted cashews have a bland flavor but when roasted they develop a mild sweet taste.

Filberts are often called hazelnuts. They grow in the Orient, Italy, Spain, and United States. The imported nuts are smaller in size than the ones grown in this country. For full flavor filberts should be slightly roasted before being added to candies. Filbert paste is a combination of sugar and nuts and is mixed with fondant as a center for bonbons. It is combined with chocolate and coconut oil to add fine flavor and texture to truffle style confections. Roasted filberts mixed with cashews give a delicate filbert flavor to nut candy.

Pecans are one of the most used nuts in confections. Pecans grow in the Southern States and Mexico. The United States Government has set standards for pecans and grades them for foreign material, broken kernels, small particles and dust, how well cured, cleanliness, rancidity, decayed nuts, worm injury, shriveled nuts, and color.

The two important varieties of peanuts are the small round Spanish peanuts and the larger and longer Virginia peanuts. Spanish peanuts are
used to make peanut clusters, peanut brittle, nut rolls, and many other
confections. Virginia peanuts are used for salting and in some candies
sugar coated (or burnt). Peanuts are graded according to size. Peanuts
are rich in oil and will absorb odors from other materials.

Pistachio nuts grow on small trees in the Mediterranean countries.
Pistachio nuts have a pleasant taste and delicate green color and are some­
times used to dress up better grades of nut candies, as a topping for bon­
bons, as coating for chocolates.

English walnuts grow on trees in warm climates of France, Turkey,
Italy, and California. The nut is surrounded by a hull which must be
removed and cleaned and dried. After the kernels are removed from
the shell they are graded according to size and color. The colors vary
from light, light amber, to dark amber shades. The light nuts are used
in candies where the nut is visible to the eye. The darker shade nuts are
suitable for chocolate coating and in batch mixtures.

The black walnut grows in the temperate climes of the United States.
It is larger in size than the English walnut tree and thrives in sandy soil.
The nuts are enclosed in thick, pulpy, ball-shaped hulls. The hulls are
removed and the nuts allowed to dry. Their shells are thick and hard and
the kernels are difficult to remove in one piece. Black walnuts from the
eastern states are stronger in flavor than those grown in California. They
are used in hard candy brittles.

Pectin

Pectin is a substance that makes jellies set or congeal. It is found in
fruits, berries, and in some vegetables. Pectin is obtained from apples,
citrus fruits, and vegetables. Pectin is graded as to the amount of sugar
solution one pound will jell. Citrus pectin also comes in two types, quick
set, and slow set. Fine jelly is made by combining fruit pulp or juice
or fruit flavor and pectin powder.

Fruits, Fruit Juices, and Full Flavored Concentrated Juices

Fruits are used extensively in making fountain sundae toppings and
cream candies, and as a filling for candies.

Fruits and fruit juices are used in making jellies. Jellies may be made
from fruit or fruit juices and sugar, or consist of pectin, fruit, and sugar.
Fruit juices are also used in cordial fillings.

Other Fruits

Maraschino cherries made from sweet cherries picked just before they
are fully ripe and soaked from 4 to 6 weeks in a brine solution containing
sulfur dioxide. The brining of cherries serves to preserve the fruit and to
The sulfur dioxide is then removed and the cherries are either hand pitted or machine pitted. After being pitted and graded the cherries are processed in a low syrup. After the syrup has replaced some of the moisture in the cherries it is separated, its density is raised, and the cherries then soaked in it. The best cherries for dipping are Royal Anne or Napoleon and Bing. Michigan and New York cherries have a satisfactory flavor but the skins are tougher.

Pineapple and other fruits are cut into cubes and processed in sugar syrup solutions.

Dates grow in Western Asia, North Africa, Southern California, and Arizona. California and Arizona dates are of a light color and rather moist. Lighter dates are preferred to dark dates in candies. Darker dates are used for chocolate coated dates.

California figs are similar to Smyrna figs and Mission Black figs. The Adriatic Greek fig has a light color.

**Flavors**

Flavor is the outstanding characteristic of candy in its appeal to the sense of taste and the pleasure which is derived from its consumption.

True fruit flavors are used in various forms. True flavor is enhanced by the addition of a small amount of citric acid for citrus and tartaric acid for berry fruit, with approximately 2–4 fl. oz. to 100 lbs. centers. Often fruit flavors are fortified with volatile oils or aromatic chemicals, or both, to increase flavor strength.

Imitation flavorings are mixtures of aromatic substances which create the likeness of natural flavors.

Essential or volatile oils are extracted by pressure or distillation. They are used in this form or in flavor emulsion.

**TYPES OF CANDIES**

**Cordials**

Cordials are super-saturated solutions of sugar in water surrounded by a sugar crust. The thickness of the crust depends upon the degree to which the syrup is cooked. The higher the cook, the thicker the shell.

**Fondant Candies**

Fondants are composed of microscopic grains of sugar surrounded by a syrup. Any candy that has a creamy texture is typed as a fondant candy. Fondant candies are classified as chocolate coated, cast or hand-rolled creams, crystallized creams, bonbons, and slab creams or fudge wherein the body of the candy is composed of a creamy mass.
Hard and Chewy Candies

A high cooked mixture of sugar and water, with the addition of invert sugar, corn syrup, or cream of tartar, belongs in this hard candy group.

High cooked candies, due to their method of manufacture, will be typed as hard candy and classified as plain, grained, pulled, hard nut candies, or butterscotch. If enough inverting material is used to prevent graining, the candy is classified as plain hard candy.

The cooking temperature of the batch can be lowered to produce a chewing candy. The batch can be aerated by pulling and becomes pulled hard candy or taffy.

Another classification consists of pure sugar candy that develops a grain, such as pure sugar stick candy, creamy mints, etc.

Plain or ungrained hard candies become sticky if exposed to damp air after the heat has left them. Hard candy will also become sticky if too much corn syrup, invert sugar, or cream of tartar is used.

Hard nut candies include brittles, which contain bicarbonate of soda to add tenderness and crunchiness to the batch, plain hard candy where the nuts are added to a cooked batch, and butter crunches that contain a high percentage of dairy butter and roasted almonds. Also in this class are glacé nuts which are nuts with a hard candy coating. It is possible to make a hard candy filled with a very soft jelly center. When the 265°F. batch is cool enough to handle it is pulled on the pulling hook and twisted out. A tube is used, using the pulled batch, and filled with low cooked warm (not hot) jelly. When the high cooked batch is cool enough to handle it is pulled very lightly and wrapped around the jelly filled piece of candy. The low cooked taffy batch acts as a buffer between the liquid center and the outer hard jacket and it is possible to spin the batch without difficulty. The ends of the cut pieces must be fully closed or the jelly will leak out. If pressed together slowly so that the candy jacket will stretch with the cutter knife the ends will close tightly.

Whipped Goods

Whipped goods are candies that are aerated by whipping with albumen or gelatin. They are classified as marshmallow, coated and uncoated, cast or slab-cut, ungrained and grained, gelatin or egg-white marshmallow. Also included in the whipped goods type are the frappés used in the manufacture of nougat, cream candies, etc., and icings used for coating or decorating purposes. The manufacture of gelatin marshmallow requires the use of a good grade of gelatin. Gelatin can be soaked in cold water and added to the warm syrup batch. The heat of the syrup
will dissolve the gelatin, or it can be dissolved in water and then added to the batch. The gum arabic marshmallow requires that the gum is soaked in cold water and then dissolved by heating. The sugar is dissolved in the gum solution or cooked and added to the solution and then the corn syrup is added. It is then placed in the marshmallow beater and whipped with dissolved egg albumen.

**Jellies**

The jelly types of candies are classed as pectin, fruit, and agar jellies. Fruit or pectin jellies are made from correct proportions of pectin, water, sugar, corn syrup, acid, and buffer salts. Some fruit contains enough pectin and acid in the proper proportions and only sugar is added to cook to form a jelly. True fruit jellies are used as a center for chocolate coated candies. The flavor of pectin jellies is enhanced by adding fruit flavorings.

**Jelly Gums**

Jelly gum is formed by the use of corn starch or gum acacia; these two types are classified as starch jellies and gum arabic jellies.

**Caramels**

Caramels are a chewy type of candy. They are classified as chewy cast caramels, chewy slab caramels, caramel for coating purposes, and grained caramels.

**CANDY FLAVORINGS**

Boiled sugar mixtures are sweet. It is flavor that transforms boiled sugar mixtures into confections. Natural flavors, such as vanilla, the citrus oils, and other essential oils are frequently used in candy flavoring. So are the flavors derived from berries and other fruits.

Flavors can also be developed in candy wherein the caramelization of sugars occurs, or by including molasses, brown sugars, maple sugar, honey, chocolate, cocoa, milk, butter, cream, etc., in the formulation, to produce the highest levels of flavor from them. Some natural flavors are weak and have to be fortified with imitation flavors to produce a good level of flavor economically. Blends of the two kinds are frequently used with good results. There are many imitation flavors that are definitely superior to some natural flavors. Natural flavors are apt to vary in strength with the season, the climatic condition, the locality, and the year of growth and collection of the plants from which they are derived; whereas imitation flavors are uniform, and can be relied upon to produce identical flavor effects every time they are used under the same conditions. Salt is also a flavoring used either alone, or to bring out other flavors.
The use of food acids, citric, tartaric, malic, etc., provides tartness and pungency, and thereby enhances the flavor effects of the citrus and berry flavors. Not so generally appreciated however, is the effect of bitter substances as flavor enhancers. Among the candy bitters are: chocolate liquor, cocoa, coffee, and aromatic bitter substances of vegetable origin which produce appreciated secondary effects. The use of bitters to tone down the cloying sweetness of oversweet creams, etc., is well worth learning by the candy maker.

When adding flavors to candy, the flavors should be either measured or weighed into known weights of candy for uniform results. The practice of slopping flavor, or dashing it from a bottle into a heap of candy never produces uniform results.

**Chartreuse Type—Bitter**

Mix the following oils in amounts indicated:

- 1.0 gm. rose
- 5.0 gm. neroli
- 20.0 gm. cloves
- 25.0 gm. cardamom
- 25.0 gm. nutmeg
- 25.0 gm. cinnamon bark
- 34.0 gm. lemon, cold pressed
- 65.0 gm. orange, cold pressed
- 75.0 gm. angelica seed
- 75.0 gm. peppermint
- 200.0 gm. bitter orange
- 450.0 gm. angelica root

Total

1000.0 gm.

**Lemon Essence**

Mix:

- 200.0 gm. oil of lemon, cold pressed
- 550.0 gm. alcohol, 95 per cent
- 250.0 gm. water

Total

1000.0 gm.

Agitate well and let stand 24 hours for separation of approximately:

- 150.0 gm. terpenes;

Yield

850.0 gm. terpene-free essence to which is added:
Macaroon Flavor MF 226

Mix the following oils:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>rose</td>
<td>10 gm.</td>
</tr>
<tr>
<td>cloves</td>
<td>150 gm.</td>
</tr>
<tr>
<td>cinnamon, Ceylon</td>
<td>150 gm.</td>
</tr>
<tr>
<td>cardamom</td>
<td>125 gm.</td>
</tr>
<tr>
<td>lemon, cold pressed</td>
<td>200 gm.</td>
</tr>
<tr>
<td>bitter almond, free from prussic acid</td>
<td>365 gm.</td>
</tr>
</tbody>
</table>

Total 1000 gm.

Recommended Use.—One ounce in 100 lbs.

Maple Flavor MF 227

Mix:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. John's bread</td>
<td>56.00 gm.</td>
</tr>
<tr>
<td>oil of sage</td>
<td>2.00 gm.</td>
</tr>
<tr>
<td>fennugreek, solid extract</td>
<td>264.50 gm.</td>
</tr>
<tr>
<td>ethyl vanillin</td>
<td>8.75 gm.</td>
</tr>
<tr>
<td>Cyclotene (trade name)</td>
<td>2.00 gm.</td>
</tr>
<tr>
<td>racemic acid-formula MF 121</td>
<td>1.50 gm.</td>
</tr>
<tr>
<td>caramel</td>
<td>35.25 gm.</td>
</tr>
<tr>
<td>propylene glycol</td>
<td>315.00 gm.</td>
</tr>
<tr>
<td>maple syrup</td>
<td>315.00 gm.</td>
</tr>
</tbody>
</table>

Total 1000.00 gm.

Orange Essence MF 228 (Terpene-free)

Mixture of:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>oil of orange, cold pressed</td>
<td>200.0 gm.</td>
</tr>
<tr>
<td>alcohol, 95 per cent</td>
<td>500.0 gm.</td>
</tr>
<tr>
<td>water</td>
<td>300.0 gm.</td>
</tr>
</tbody>
</table>

Total 1000.0 gm.

Agitate well and let stay in terpene separator (Fig. 14) 24 hours for separation of approximately:

- 175.0 gm. terpenes,

Yield

825.0 gm. terpene-free essence, to which is added:
+175.0 gm. alcohol, 95 per cent;

Yield
1000.0 gm. orange essence, terpene-free.
(Filter if necessary.)

Orange-Curacao (Triple Sec) Essence MF 229

(a) Mix the following oils:

91.5000 gm. bitter orange
17.5000 gm. orange, cold pressed
4.2500 gm. lemon, cold pressed
0.1250 gm. nutmeg
0.0625 gm. neroli
0.0625 gm. coriander

Total
113.5000 gm. or 4 fl. ozs.

(b) Curacao Essence

Mixture of:

- 4.0 fl. oz. mixture of (a)
- 12.0 fl. oz. alcohol, 95 per cent
- 18.0 fl. oz. water

- 34.0 fl. oz. mix well, and let stand in terpene separator (Fig. 14) for 24 hours for separation of terpenes;
- 3.5 fl. oz. separated terpenes
- 30.5 fl. oz. take from below; then add:
- +1.5 fl. oz. alcohol, 95 per cent

Total
32.0 fl. oz. finished curacao (triple sec) essence; filter if necessary.

Pistachio MF 230

Mix:

290.0 gm. oil of bitter orange
100.0 gm. oil of cloves
40.0 gm. oil of mace
40.0 gm. oil of cinnamon
400.0 gm. oil of bitter almond, free from prussic acid
120.0 gm. black walnut flavor—formula MF 231
10.0 gm. neroli oil

Total
1000.0 gm.
Walnut Flavor

Mix:

- 10.00 gm. oil of cardamom
- 25.00 gm. oil of anise
- 50.00 gm. oil of cloves
- 50.00 gm. butyric acid
- 75.00 gm. oil of orange, cold pressed
- 115.00 gm. oil of bitter almond, free from prussic acid
- 125.00 gm. vanillin
- 250.00 gm. oil of lemon, cold pressed
- 300.00 gm. oil of mace

Total
1000.00 gm.
CHAPTER 20

LIQUEUR FLAVORINGS

ALCOHOL

The word alcohol is supposed to be of Arabian origin; "Al-Cohol" or "Al-Kohal" means a purified substance. Some investigators believe that the old Egyptians knew distillation. In legend, the distillation is ascribed to a Greek physician who noted the condensation of liquid on a plate which had been placed over some heated vegetable to keep it warm while it was served to him.

The first evidence of the separation of alcohol appears in the writings of an Italian physician named Master Salernus, who died in the year 1167. More information is given by an ecclesiastic Albertus Magnus, who lived in the German city of Regensburg, Bavaria. The new knowledge in those days was mainly applied by the monks to make preparations of distilled medicines in the monasteries. The Benedictines and the monks of the Chartreuse are still guarding their secret formulas and distillation procedures of their preparations.

Neutral spirits or alcohol are distilled at or above 190 proof. In the United States the strength of alcoholic beverages is officially stated by "proof." The United States Statutes define this standard as follows: "Proof spirit shall be held to be that alcoholic liquor which contains one-half its volume of alcohol of a specific gravity of 0.7939 at 60°F." The figure for proof is double that of the alcoholic content by volume.

WHISKEY AND OTHER DISTILLED BEVERAGES

"Whiskey" is an alcoholic distillate which is obtained from a fermented mash of grains (or mixture of grains) and that has the traditional and characteristic taste and aroma associated with whiskey.

The resulting whiskey is designated "rye whiskey," "bourbon whiskey," "wheat whiskey," "malt whiskey," "rye malt whiskey," depending on the predominating type of grain used in the preparation. Not less than 51 per cent of grain of one type must be used in order to justify identifying the product accordingly. The distillation is carried out at a proof not exceeding 160. The storage of the distillate must be in charred, new, oak containers.

"Straight Whiskey" is defined as "an alcoholic distillate from a fermented mash of grain distilled at not exceeding 160 proof and withdrawn from the cistern room of the distillery at not more than 110 and not less
than 80 proof," and it must be aged in charred, new, oak containers for not less than two years. No product may be called simply "straight" in its labeling, and the type of grain utilized must always be stated.

“Rum” is the distillate from the fermented juice of sugar cane, molasses, and other sugar cane by-products, distilled at less than 190 proof. New England rum is further defined as having been produced in the United States and distilled at less than 160 proof. Other rums are distinguished by geographic origin, such as Jamaica rum and Virgin Island rum.

“Gin” is a distillate obtained either by distillation from a fermented mash or the redistillation of neutral spirits with juniper berries and other aromatic botanicals.

“Compound gin” is obtained by mixing neutral spirits with distilled gin or gin essence or other flavoring materials deriving its main characteristic flavor from juniper berries and reduced at the time of bottling to not less than 80 proof.

“Brandy” is a distillate from the fermented grape juice or wine distilled at less than 140 proof alcohol content. Brandy is diluted with water to drinkable proof strength.

“Liqueurs” are cordials, flavored brandies, and flavored gins which are made by mixing distilled spirits with fruit juices, fruit extracts and fruit flavors, botanical distillates and extracts, essences of essential oils, syrup, and water. The sugar content is not to be less than 2.50 per cent weight of the finished liqueur.

“Vodka” is made from neutral spirits. In Russia, mainly potatoes are used to make vodka. The quality of vodka depends on the treatment of the pure alcohol with activated charcoal and on the water which is used to dilute it to drinkable proof strength. Test of Russian vodka showed an average pH of approximately 8. The low or non-existent acid content of vodka reduces the formation of esters and avoids the development of flavor.
FRUIT BRANDY DISTILLATE AND BRAN DY FLAV OR ESSENCE

Property of Fruit Brandies

Fruit brandies take their names from the fruit from which they are manufactured. They are reduced in alcoholic strength by the addition of water after distillation to make them drinkable.

Any fruit may be used for the production of fruit brandies. There are four ways in which to produce fruit brandies.

Crush the fruits, allow the pulp to ferment, and then distill the fermented mash.

Crush the fruits, allow the pulp to ferment, express the juice, continuing fermentation, and then proceed with fractional distillation of the cleared juice. The middle fraction of the distillation can be used to fortify fruit flavors.

In this method the fermented and cleared juice of the second procedure is concentrated by freezing and centrifuging to an alcohol content of 30 per cent and then distilled. The middle fraction of the distillation yields the finest fruit flavor essence. It is useful as a natural fortifier of dessert wine, champagne, fruit flavored brandies, and fruit flavors.
In full flavor brandy, the evolution of carbon dioxide during fermentation tends to volatilize some of the aromatic, volatile flavor constituents. In order to produce a full flavored brandy the aromatic fraction may be removed by distillation before fermentation and is then added to the distilled brandy. To obtain the best possible yield, fruit should be subjected to a slow fermentation.

**Fermentation**

Fermentation refers to the process whereby sugars are converted into ethyl alcohol and carbon dioxide by the action of yeast.

Fruit sugars contain fructose, sucrose, and glucose. The sucrose is inverted in the early stages of fermentation. Fermentation under controlled conditions converts sugars into alcohol and produces a minimum of undesirable side reactions.

Fermentation may be accomplished in three ways:

- Natural or spontaneous fermentation. There is a continuous struggle between the yeast capable of producing a sound type of alcohol fermentation and undesirable yeasts and bacteria which find a favorable fostering place in the mash. Most of the bacteria produce acids either directly from sugar or change the alcohol which has already been formed into acid. Lactic and butyric bacteria in the mash will produce lactic and butyric acid while the acetic bacteria produce acids out of alcohol.
- Dominant fermentation which is assured by the addition of a culture of selected yeast to freshly pressed juice.
- Pure fermentation which involves preliminary sterilization of the fresh juice, followed by the addition of a pure yeast culture. However, sterilization treatments may adversely affect the flavor of the product.

**Distillation**

Distillation is the separation of the volatile constituents of the fermented product with the aid of heat. The product of distillation is called fruit brandy distillate. The first fraction from a fractional distillation contains pure alcohol and the most volatile flavor. The second fraction, the heart, is of a smooth taste and of finest aroma. As soon as any alteration in flavor is perceivable, a third receiver is employed to catch the last fraction, or so-called tails. The tails contain little alcohol and are rich in fusel oils.

**FRUIT LIQUEURS**

Fine fruit liqueurs are made by mixing expressed fruit juice and flavoring extracts or fruit flavor concentrates with sugar and alcohol. Fruit juices, extracts, and flavors contain natural acids. They improve the taste and make the liqueurs refreshing and interesting. The acids also serve
to invert the sugar which makes the sweetness of the liqueur less evident with age. The sweetness of fruit liqueurs decreases in the first few weeks after manufacture, then increases and gives a mellow character to the liqueur.

Many fruit liqueurs contain small additions of vanilla, cloves, cinnamon, and other spice extractives. Fruit liqueurs should be bottled four weeks after manufacture. In production of fruit liqueurs only the finest alcohol is used.

The most preferred fruit liqueurs are those made from cherries, blackberry, cassis or currant, sloe, peach, and apricots. Raspberry, banana, pineapple, strawberry, and other fruit liqueurs are less prominent. However, fruit liqueurs require, individually, various procedures to manufacture suitable fruit juices, fruit flavoring extractives, and fruit flavor distillates.

**Apricot and Peach Liqueurs**

Apricots and peaches should be ripe and soft for use in juice and fruit flavors. Ripe apricots and peaches are washed rapidly in cold drinking water, then passed over an inspection belt to eliminate damaged fruit. The fruit is comminuted and mixed as rapidly as possible with alcohol in order to prevent browning and deterioration of flavor.

Apricot and peach juice and flavoring extracts are also obtained from frozen fruit.

**Banana Liqueur**

The production of this fine liqueur depends on the stage of the ripe bananas. The peel is of little value to aroma and taste of banana liqueurs.

**Bilberry Liqueur**

Bilberries are mainly used to add red color to other fruit juices. In order to obtain the coloring matter, berries are comminuted and left to ferment. Ammonium chloride is added to speed up the fermentation. Expressed juice is then mixed with alcohol.

**Blackberry Liqueur**

The blackberries should be comminuted and left to ferment slightly. Alcohol is mixed with the partly fermented fruit and then pressed. Expressed juice is allowed to stand for the separation of sediment.

**Citrus Liqueurs**

Among the citrus fruits used in fruit liqueurs are: sweet oranges, lemons, tangerines, bergamots, Curacao oranges, and bitter oranges. The
flavor of these fruits is in the skin or peel, while the pulp is free of aroma and taste. Juices of citrus fruit usually do not possess outstanding characteristics that would definitely point to one particular fruit.

**Cherry Liqueur**

Cherry liqueurs are often called cherry brandy, Morello cordial, or griotte. Bilberry, raspberry juice, or extracts of elderberry are added to increase coloring matter, while addition of kirschwasser, wine distillate, and traces of rum and other ingredients serve to distinguish the various brands.

**Currant or Cassis Liqueur**

In the manufacture of currant liqueur it is advisable to use three-fourths red currants and one-fourth black currants. Red currant juice is cold processed while black currants are left to ferment. Fermentation of black currants improves the flavor. Pectic enzymes are added to the ground fruit before pressing.

**Grenadine (Pomegranate) Liqueur**

Pomegranates grow abundantly in Spain. Fully ripe pomegranates yield a sweet deep colored juice which is similar to that of peaches and strawberries. The juice is expressed from halved or quartered fruit. It is high in sugar and acid. Grenadine syrup and grenadine liqueurs are especially favored in France. The juice is left to stand for about eight days to settle, then the clear liquid is drawn off. Pomegranate juice should not be heated since heat destroys its flavor.

**Mountain Ash Liqueur**

These liqueurs and brandies are known under the names of Jarzebinka, or jarbemiak. They are especially favored in Poland.

**Mulberry**

This fruit also produces a very tasty liqueur.

**Mirabelle**

The mirabelle is a fruit which has the quality of being very sweet and aromatic. The ripe mirabelle is picked during dry weather and is then placed in casks to ferment. The fermentation is treated scientifically to eliminate harmful elements and to develop its bouquet. When fermentation is finished the hogsheads are refilled to the bung, then hermetically sealed and allowed to stand for at least two months prior to distillation. The distillation is performed first to separate the alcohol from the fer-
mented mash. The distillate is submitted to redistillation. The final operation is given special attention as to heating, which must be moderate and just sufficient to allow the distillate to emerge in a very slow flow. The aroma and the sweetness of flavor depends upon the slowness of the distillation.

**Pineapple Liqueur**

The most aromatic part of pineapple is the peel. The pulp itself is far less aromatic. In the manufacture of pineapple liqueur the fruit is peeled, the juice expressed, and immediately mixed with alcohol. The peels are extracted with the alcohol and pressed after three days.

**Raspberry Liqueur**

This liqueur is made from expressed juice of freshly picked raspberries and alcoholic extractives of the pressed remains. Fermentation of red raspberries followed by distillation yields a brandy with the fine aroma and expressive taste of raspberry.

**Framboise**

The word framboise is often used in the nomenclature of raspberry liqueur.

**Rheine-Claude Plums**

Rheine-Claude plums are fermented and distilled. The fruit takes its name from Queen Claude of France.

**Sloe Gin**

The sloe berries ripen after the first frost and are then harvested. The juice is rich in tannin and contains about 3.50 per cent malic acid. The sloe kernel or seed is large and makes up about 25 per cent of the fruit.

**Strawberry Liqueur**

To make this fine flavored liqueur freshly picked strawberries are required and should be pressed immediately. The remains are extracted with alcohol and pressed after a few days. Distillation destroys the strawberry aroma.

**Tutti-Frutti**

Tutti-frutti flavor comprises a mixture of a variety of fruits, such as cherries, mirabelles, strawberries, raspberries, apricots, peaches, apples and pears.
Cognac Oil

Cognac oil is also called wine oil. It is derived from the yeast of the lees or remnants of fermented wine.

Before wine lees are distilled the tartrates are removed. A very slow distillation is used to separate alcohol and esters. On the bottom of the still remains wine oil. It is separated as a so-called green cognac oil or is distilled as a so-called white cognac oil. The best oil is made from the lees of high grade wines.

THE MANUFACTURE OF LIQUEURS

Commercial Liqueur Production

In the manufacture of liqueurs the flavoring extracts and the flavor distillates supply only a part of the alcohol content of the liqueur. Neutral alcohol is added to the required strength of the finished beverage. If alcohol and flavor distillates are mixed, the mixture is allowed to stand twenty-four hours to unify aroma and taste before water, syrup, and other ingredients are added to make the liqueur. The finished flavoring should be aged in the mixing tank at room temperature for more than two weeks to round out aroma and taste. Alcohol also loses its biting harshness at the same time. Liqueurs should not be taste-tested immediately after manufacture but 24 hours or more later.

Full Aromatic Liqueurs.—Full aromatic liqueurs are made entirely from flavor distillates. The procedure of the full aromatic flavor distillation yields a product with sufficient alcoholic content to make the addition of alcohol to the required proof strength for liqueur unnecessary. The alcoholic content of the finished liqueur is thus made up entirely from the alcohol contained in the flavor distillate. The full aromatic flavor distillation requires that the quantities of botanical ingredients, alcohol, and water be exactly determined to yield the quantity of alcoholic flavor distillate which is necessary both for flavor and alcohol content in the manufacture of the intended volume of liqueur.

The distillation procedure is performed at atmospheric pressure under the same conditions as described in the flavor distillation of botanical ingredients. Comprehensive knowledge of aromatic yield assists in determining the quantity of botanical ingredients from which to obtain the required flavor by distillation. Experience in distillation and fractionation make it easy to calculate the necessary quantities of alcohol and water which are needed in the menstruum to yield a flavor distillate.

A liqueur made from the flavor distillate alone, containing sufficient alcohol content for its required strength, is a full aromatic product of un-
surpassed quality. Formula MF 262 is the best example of the full aromatic cordial production.

**CONTRACTION OF ALCOHOL-WATER MIXTURES**

High proof alcohol in mixtures with water has the peculiarity of decreasing in volume and increasing in proof strength. When 50 parts by volume of 95 per cent alcohol is mixed with an equal volume of water, the yield instead of 100 parts is only 96.4 parts containing approximately 52 per cent alcohol by volume. An additional quantity of water (approximately 3.6 parts by volume) is required to yield 100 parts by volume of 50 per cent alcohol content.

The contraction table (Table 21) is of great assistance for accurate work in the manufacture of alcoholic beverages.

**FRENCH COGNAC OR BRANDY**

Wine Distillate

Wines of good quality and preferably of high fixed acidity are used in the production of grape brandy. The acidity of the wine effects esterification and the quality of the distilled product. Unsound wine yields brandies that are high in undesirable acids. The ideal material is an aged wine of good quality. Aged wine improves the flavor of the brandy immensely.

The grapes are cleaned, then crushed and pressed. Only expressed juice is used in fermentation, no sulfur dioxide is added, due to the possibility of hydrogen sulfide formation, which would impair the quality of the brandy. Often pure yeast cultures are used to facilitate efficient and clean fermentation. The fermented juice yields a wine of 7 to 9 per cent alcohol content. The lees are left in the wine and distilled with it. It is from the lees that the cognac or brandy flavor is obtained. The pomace is washed, fermented, and distilled separately.

The classical production of wine distillate for use in cognac and brandy proceeds with the use of a pot-still which is usually wood fired. The still is of small capacity, averaging about 320 gallons. A preheater is used to warm the next succeeding charge of wine with the vapors of the charge being distilled. The wine of 7 to 9 per cent alcohol is slowly heated in the boiler of the still. The quantity of the condensed distillate which contains all the separated alcohol represents about one-third of the original wine in the boiler. It contains about 25 per cent alcohol. The remainder in the pot is discarded. The distillate contains head and tail products.

1 Original procedure.
Liqueur Flavorings

Table 21

Average contraction for the quantitative determination by volume of alcohol (95 to 97 per cent and water in mixtures of alcoholic beverages)

<table>
<thead>
<tr>
<th></th>
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<th>1</th>
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<th>3</th>
<th>4</th>
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<td>93.17</td>
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<td>98.34</td>
<td>99.38</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

1. How to Use the Table.—The first vertical line of the table gives the tens, the horizontal one, the units. The squares in which two groups of figures are found show the volume of alcohol and water to be used. The upper figures show the quantity of alcohol, the lower ones that of water.

Following is an example of how to use the table: 100 gallons mixture, of 45 per cent alcohol content, is to be made. How much alcohol and how much water are required to make the mixture?

Solution:

4: 46.58 gallons of alcohol
56.61 gallons of water

In mixing sweetened alcoholic beverages the sugar content is deducted by volume before the quantity of water is calculated for the required liqueur. To convert the weight of sugar into volume quantity, it is multiplied by 0.625, which is the cubic contents of one kilogram (2.2 pounds) of sugar. The result is deducted from the intended quantity of liqueur.

It is redistilled and condensed in three fractions. The first fraction contains the head which is composed of alcohol and impurities, primarily aldehydes. The second fraction is the “body” or middle-run of the distillation and constitutes the desired product. The third fraction is the tails and contains the fusel oils of the amyl alcohol class. The second fraction is clear and colorless, contains from 60 to 70 per cent alcohol and is known as wine distillate. It is transferred to wooden tanks and left to stay there for a period of time. Each tank holds about 750 gallons wine distillate. The staves are made from a well-seasoned oak, and the bark side of the tree forms the inside of the tank. The peculiar musty odor of cognac-brandy comes from the bark fragments on the staves, after contact with the high proof wine distillate.
Brandy

At the end of the resting period the wine distillate is removed and cut back with distilled water to brandy of 50 per cent alcohol content which is very suitable for the aging process. Often brandies of various productions are blended to develop the best flavor and quality. The brandy is then filled in 60 to 300 gallon barrels and stored in warehouses for a period of 6 to 10 years. The barrels are not touched for the first year other than periodic inspection. At the end of this period samples are drawn and the barreled brandy moved from rack to rack every 3 or 4 months for a period of 2 or 3 years. The samples that are taken are checked for esters and acidity and graded for aging.

Aging of Brandy

There is a direct dependency between the time of aging and the tempo of oxidation. The slower the oxidation the better are the forthcoming changes in the esters which produce the quality of aroma and taste in brandy.

The quality of flavor also depends upon the type of cooperage used for storage. The best suited barrel is the white limousin oak barrel, from which the resins and tannoid bodies present are assimilated and give the brandy certain characteristic qualities.

Also important is the atmospheric conditions at which the barreled product is stored. Air and humidity in the warehouse allow for even aging and minimize evaporation losses.

Commercial Brandy

In the manufacture of commercial brandy, the alcohol content of wine distillate is reduced with distilled water to required strength and barreled. Caramel is usually added for color at the time of packaging. The brandy maker makes his own caramel by cooking slightly fermenting red wine juice (filtered) very slowly over direct fire to caramel. Because of the slow cooking, the grape-flavored caramel does not taste like caramel at all.

Altvater—Jaegerndorf\(^2\)  MF 232

(a) Botanical ingredients:

- 225.00 gm. mullein (\textit{Verbascum thapsus})
- 187.50 gm. angelica root
- 112.50 gm. wormwood
- 57.00 gm. orris root
- 57.00 gm. cardamum root
- 57.00 gm. cardus Benedictus

\(^2\) Original Czechoslovakian recipe for use per 100 liters of cordial.
LIQUEUR FLAVORINGS

37.50 gm. unripe orange fruit
37.50 gm. Curacao peels
37.50 gm. galanga root
37.50 gm. orange peels, sweet
18.75 gm. orange peels, bitter
18.75 gm. peppermint leaves
7.50 gm. marjoram

(b) The botanicals in (a) are comminuted and percolated with 3.0 liters of hot water at 130°F. The mixture is left to stand twenty-four hours to cool; the water is then drained off. With it are also removed the bitter resinous substances.

(c) The remaining botanical ingredients are then extracted for three days with a menstruum consisting of:

5.65 li. alcohol, 95 per cent
5.15 li. water.

Yield is:
10.80 li. extract.

(d) After percolation, water is added to the extracted herbs to obtain an additional yield of:

1.75 li. percolated extract; it is mixed with the
10.50 li. extract of (c), to yield:
12.25 li. Altvater flavoring extract of about 40 per cent alcohol content.

(e) Mixture of: 100 liters cordial consisting of:

12.25 li. Altvater flavoring extract (d)
36.55 li. alcohol, 95 per cent
30.40 li. water (includes 2.5 liters of water for contraction)
23.00 li. syrup of 36° Baumé

Yield is:
100.00 li. Cordial “Altvater—Jaegerndorf”

Remarks.—The procedure in the extraction of the botanical ingredients for use in the cordial “Altvater—Jaegerndorf” is interesting for it shows how the distillation of aroma has been avoided in the manufacture of the aromatic beverage.

Amarantina Cordial MF 233
(Aromatic Sweet Bitters)

(a) Extract the following comminuted botanical ingredients:

300 gm. sweet orange peels
300 gm. bitter orange peels
300 gm. cascarilla bark
180 gm. cardamom
150 gm. cinnamon bark
120 gm. zedoary root
120 gm. winters bark
120 gm. gentian root
100 gm. centauri herb
100 gm. cardus benedictus
100 gm. wormwood
60 gm. Curacao peel
50 gm. angelica seed
50 gm. clove buds
40 gm. musk root;

Extracting menstruum.—12 li. of 60 per cent alcohol.
Time of extraction: 8 days
Yield.—10.0 li. extract

(b) Extract three times
Extracting Menstrum. 4.5 li. water for each extraction to wash remaining herb mixture of (a).
Yield of the Three Extractions of (b).—12.0 li. exact.

(c) Mix

<table>
<thead>
<tr>
<th>Li.</th>
<th>extract of (a)</th>
<th>extract of (b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total 22.0 li. flavoring extract of about 25.5 per cent alcohol content. It is either allowed to stand to remove sediment or it is filtered and used in (d).

(d) *Amarantina cordial* (*Aromatic sweet bitters*)
40 per cent alcohol—25 per cent sugar
Mixture of

<table>
<thead>
<tr>
<th>Li.</th>
<th>Flavoring extract of (c)</th>
<th>25.5 per cent alcohol content</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.0</td>
<td></td>
<td>25.5 per cent alcohol content</td>
</tr>
<tr>
<td>5.0</td>
<td>wine distillate of 64/65 per cent alcohol content</td>
<td></td>
</tr>
<tr>
<td>33.5</td>
<td>alcohol, 95 per cent</td>
<td></td>
</tr>
<tr>
<td>18.5</td>
<td>water (includes 2 li. of water for contraction)</td>
<td></td>
</tr>
<tr>
<td>25.0</td>
<td>syrup of 36° Baumé</td>
<td></td>
</tr>
</tbody>
</table>

Yield:
100.0 li. *Amarantina cordial* to which caramel color may be added to desired shade of brown.

Full Aromatic Creme de Anisette

(a) The extraction is performed in the still, for twenty-four hours, and the botanical ingredients are comminuted before use:

<table>
<thead>
<tr>
<th>Kg.</th>
<th>Ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.0</td>
<td>aniseed</td>
</tr>
<tr>
<td>16.0</td>
<td>badian or staranis</td>
</tr>
<tr>
<td>2.0</td>
<td>orange peels, sweet</td>
</tr>
<tr>
<td>2.0</td>
<td>lemon peels</td>
</tr>
<tr>
<td>800.0</td>
<td>coriander</td>
</tr>
<tr>
<td>450.0</td>
<td>orris root</td>
</tr>
<tr>
<td>400.0</td>
<td>juniper berries</td>
</tr>
<tr>
<td>400.0</td>
<td>melissa herb</td>
</tr>
<tr>
<td>250.0</td>
<td>cinnamon bark</td>
</tr>
<tr>
<td>200.0</td>
<td>angelica root</td>
</tr>
</tbody>
</table>

Original French recipe.
80.0 gm. cloves
60.0 gm. nutmeg

The botanical ingredients are extracted with a menstruum consisting of:

- 240.0 li. alcohol, 95 per cent
- 80.0 li. wine distillate 65 per cent
- 2.0 li. rose water, formula MF 235
- 2.0 li. orange flower water, formula MF 236
- 150.0 li. water

(b) After twenty-four hours maceration, the extract mixture of (a) is distilled slowly at atmospheric pressure to obtain a yield of 300.0 liters flavor distillate—first fraction.

(c) The second fraction is distilled to recover the rest of the alcohol. It is redistilled and is used in the next production batch.

(d) The 300 li. flavor distillate of (b) are mixed with 120 liters water to lower proof strength. The mixture is filtered and then redistilled slowly at atmospheric pressure with dephlegmation (or reflux) on, to obtain a yield of:

- 250.0 li. flavor distillate of about 84 per cent alcohol content. The second fraction contains the balance of the alcohol; it is redistilled and is used in the next production batch.

(e) Mixture for 700 li. liqueur:

- 250.0 li. flavor distillate of 84 per cent alcohol content of (d)
- 4.0 li. glycerin
- 33.0 li. distilled water (including 7 liters for contraction)
- 420.0 li. syrup made from 280-350 kg. sugar.
- 700.0 li. Cream de anisette, 30 per cent alcohol content.

**Rose Water**  
**MF 235**

Distill at atmospheric pressure

- 500.0 gm. fresh rose petals mixed with:
- 2.00 li. water to obtain yield of:
- 1.00 li. rose water.

The separated drops of volatile oil on the surface are rose oil which is to be separated from the rose water.

**Orange Flower Water**  
**MF 236**

Distill at atmospheric pressure

- 400.0 gm. fresh or dried orange flowers mixed with:
- 1.80 li. water to obtain a yield of:
- 1.00 li. flavor distillate

There is a separation of volatile oil on the surface of the distilled yield in form of drops. The volatile oil is neroli and is to be separated from the orange flower water.
Anisette Cordial Flavor  \( \text{MF 237} \)

**Compound**

- 13.75 gm. oil of orange, cold pressed
- 13.72 gm. oil of lemon, cold pressed
- 2.35 gm. oil of nutmeg
- 0.03 gm. oil of neroli
- 2.35 gm. oil of cassia
- 3.50 gm. oil of cloves
- 1.20 gm. oil of cardamom
- 0.50 gm. oil of rose
- 1200.00 gm. oil of staranis
- 8762.60 gm. alcohol, 9.3 per cent
- 1237.40 gm. water

Agitate well. Let stand 24 hours for separation of terpenes which are then removed. Filter remaining mixture.

**Apricot Liqueur Flavor** \( \text{MF 238} \)

Mix

- 3.75 gal. apricot fruit flavor, 19 per cent alcohol content, formula \( \text{MF 4} \)
- 0.47 gal. wine distillate, 65 per cent alcohol content, in which are dissolved:
  - 8.0 gm. oil of bitter almond F.F.P.A. (free from Prussic acid)
  - 3.0 gm. oil of cinnamon
- 0.75 gal. apricot fruit color—15 per cent alcohol content—formula \( \text{MF 44} \)
- 100.0 gm. vanilla extract two-fold—formula \( \text{MF 64} \)

5.00 gal. Apricot liqueur flavor

Use 5 gal. flavor in the manufacture of 100 gal. apricot liqueur.

**Apricot Cordial Flavor** \( \text{MF 239} \)

Mix

- 2.00 gal. apricot fruit flavor, formula \( \text{MF 4} \)
- 2.25 gal. apricot true fruit flavor concentrated extract, formula \( \text{MF 5} \)
- 0.75 gal. apricot fruit color, formula \( \text{MF 44} \)

Yield is:

- 5.00 gal. apricot cordial flavor

Use 5 gal. flavor in the manufacture of 100 gal. apricot cordial.

**Aquavit Flavor**  \( \text{MF 240} \)

(a) **Ingredients**

- 125 gm. oil of caraway
- 8 gm. oil of coriander

\( ^{1} \) Continental recipe.
\( ^{2} \) American recipe.
LIQUEUR FLAVORINGS

3 gm. oil of orange, terpeneless
744 gm. alcohol, 95 per cent
120 gm. water
1000 gm.

(b) Procedure—filter and add sufficient alcohol, 95 per cent, to obtain 1000 gm. of flavor.

Benedictine Type Cordial Flavor  

(a) Extraction of comminuted botanical ingredients:

- 0.150 lbs. nutmeg
- 0.250 lbs. cloves
- 0.500 lbs. cassia
- 0.500 lbs. cardamom seeds
- 0.875 lbs. musk seed
- 1.000 lbs. arnica blossom
- 1.250 lbs. thyme
- 1.250 lbs. hyssop leaves
- 1.250 lbs. hyssop herbs
- 1.500 lbs. calamus root
- 2.000 lbs. coriander
- 2.250 lbs. Valencia orange peels
- 2.500 lbs. peppermint leaves
- 2.500 lbs. mugwort
- 2.500 lbs. lemon balm herbs
- 7.500 lbs. imported angelica root

First with:

- 163.930 lbs. or 19.75 gal. warm water 140°F. and after cooling, mixed with:
- 93.500 lbs. or 13.75 gal. alcohol, 95 per cent
- 257.430 lbs. or 33 gal. menstruum of 40 per cent alcohol content.

Agitate twice daily. On the fourth day, take off 20 gal. extract which is to be used in (c).

(b) To the remaining herbs and menstruum of (a) are added the comminuted botanical ingredients:

- 1.250 lbs. thyme
- 1.875 lbs. cardamom seeds
- 1.875 lbs. Roman chamomile
- 1.875 lbs. cloves
- 2.250 lbs. Spanish orange peels
- 4.500 lbs. gentian root
- 4.500 lbs. mace
- 4.500 lbs. imported angelica root
- 4.500 lbs. calamus root and menstruum consisting of:
- 153.000 lbs. or 22.5 gal. alcohol, 95 per cent
- 294.050 lbs. or 35.5 gal. water

447.650 lbs. or 58.0 gal. of 37 per cent alcoholic content.

(c) The mixture of (b) is then distilled at atmospheric pressure on the following day; the distillation yields:
first fraction: 10 gallons flavor distillate which is to be used in (d),
(alcoholic contents—approx. 80 per cent)
second fraction: to be rectified and used in next production batch.

(d) Finished mixture:
20.0 gal.—extract of (a)
10.0 gal.—flavor distillate of (c)
30.0 gal. flavor of approximately 50 per cent alcohol content.

Benedictine Type Flavoring Essence    MF 242

(a) Benedictine type flavor consisting of:
20 gm. oil of angelica root
16 gm. oil of bitter orange
16 gm. oil of lemon, cold pressed
12 gm. oil of peppermint, rectified
 4 gm. oil of cognac, rectified
 4 gm. oil of lavender
 8 gm. oil of wormwood
 4 gm. oil of calamus
 2 gm. oil of neroli, Bigarade
 2 gm. oil of pimento berries
 2 gm. oil of wintergreen
 2 gm. oil of ginger
 2 gm. oil of bergamot
 2 gm. oil of cinnamon bark
 2 gm. oil of cloves
 2 gm. oil of nutmeg
20 gm. ethyl acetate

Total  120 gm. or approximately 4 fl. oz.

(b) Mixture of:
 4.0 fl. oz. Benedictine type flavor of (a)
20.0 fl. oz. alcohol, 95 per cent
10.0 fl. oz. water, ice cold,

Total 34.0 fl. oz. agitate the mixture for 5 minutes, then let stand for 24 hours to separate terpenes; there will be:
−1.5 fl. oz. of separated terpenes, which are used in (c); to the
32.5 fl. oz. terpene-free mixture are then added:
+1.5 fl. oz. alcohol 95 per cent

Yield: 34.0 fl. oz. essence

(c) 1.5 fl. oz. separated terpenes of (b) are mixed with:
 5.0 fl. oz. alcohol, 95 per cent, and
 2.5 fl. oz. water, ice cold,

Total 9.0 fl. oz.: agitate the mixture for 5 minutes, then let stand for 24 hours to separate terpenes; there will be:
LIQUEUR FLAVORINGS

—1.0 fl. oz. of separated terpenes, which are to be discarded; to the remaining
8.0 fl. oz. terpene-free mixture are added:
+0.5 fl. oz. alcohol, 95 per cent

Yield:
8.5 fl. oz. essence

(d) Benedictine type flavoring essence consists of:
34.0 fl. oz. essence of (b)
8.5 fl. oz. essence of (c)

Yield:
42.5 fl. oz. finished flavoring essence.

Blackberry Cordial Flavor W.O.N.F. MF 243
(for French type blackberry liqueur)

Mixture of:
4.125 gal. blackberry fruit flavor—formula MF 7
0.125 gal. raspberry flavor distillate (50 per cent alcohol content)
formula MF 29
in which are dissolved:
0.15 gram oil of cinnamon
0.75 gram oil of bitter almond F.F.P.A.
0.750 gal. fruit color, without flavor (15 per cent alcohol content)
formula MF 46

Yield:
5.000 gal. blackberry fruit flavor W.O.N.F.

Use 5 gal. flavor in the manufacture of 1000 gal. French-type blackberry liqueur.

Blackberry Fortifier W.O.N.F. MF 244

Mixture of:
124.50 gm. oil of cinnamon leaf
93.50 gm. oil of pimento
93.50 gm. oil of cloves
31.00 gm. oil of cassia
15.50 gm. oil of ylang
7.75 gm. oil of lemon—five-fold
375.75 gm. rhubarb root tincture (a), see below
258.50 gm. orris tincture (b), see below
1000.00 gm.
and
300.00 gm. water.

Agitate and let stand for 24 hours for separation of terpenes which are then decanted. The remaining mixture is filtered.
(a) **Rhubarb Tincture**

Extraction of:

- 312.00 gm. rhubarb root Indian, pulverized
- 1000.00 gm. alcohol, 95 per cent

(b) **Orris Tincture**

Solution of:

- 7.75 gm. orris concrete
- 1000.00 gm. alcohol, 95 per cent

**Bonificateur**

MF 245

(for use per 1000 liters of cognac and brandy)

(a) **Extraction of:**

- 1.0 kg. tea of finest quality is extracted in
- 8.0 li. boiling water for about two minutes and the tea extract then drained off. It is used in imitation rum preparations in proportion of 0.5:100. The remaining tea leaves, stripped of their flavor, are left to cool and then are extracted for five days with a mixture of:
  - 4.0 li. alcohol, 95 per cent, and
  - 2.0 li. water; after extraction the remains are expressed.

Yield is:

- 6.0 li. tea extract

(b) **Extraction of:**

- 3.75 kg. prune extract syrup, formula MF 26
- 9.00 li. water
- 3.00 li. alcohol, 95 per cent

- 15.00 li. prune extract

(c) **Extraction of:**

- 18.0 gm. Bourbon vanilla beans, comminuted and menstruum consisting of:
  - 672.0 ml. alcohol, 95 per cent
  - 358.0 ml. water; after eight days extraction the vanilla beans are taken off and pressed. The yield is:
  - 1.0 li. vanilla extract

(d) **Extraction of:**

- 2.5 kg. limousin wood chips covered with water for three days. The water extract is taken off daily and replaced with fresh water. The extraction has the purpose of removing resinous matter and woody flavor. The limousin chips are then extracted for ten days with a mixture of:
  - 5.5 li. alcohol, 95 per cent, and
  - 10.0 li. water; after extraction the remains are pressed. The yield is:
  - 15.0 li. limousin extract

(e) **Extraction of:** (eight days)

- 1.00 kg. comminuted St. John's bread, with a mixture of:
  - 0.75 li. alcohol, 95 per cent
  - 2.25 li. water; after extraction the remains are pressed.

Yield is:
2.75 li. St. John’s bread extract

(f) Extraction of:

0.5 kg. pulverized shells of sweet almonds are roasted in a frying pan to become brown in color. The cooled powder of almond shells is extracted, for five days, with a mixture of:

0.9 li. alcohol, 95 per cent, and
1.7 li. water; after extraction the remains are pressed. The yield is:
2.5 li. almond shell extract

(g) Finished mixture consists of:

| 6.00 li. | tea extract of (a) |
| 15.00 li. | prune extract of (b) |
| 1.00 li. | vanilla extract of (c) |
| 15.00 li. | limousin extract of (d) |
| 2.75 li. | St. John’s bread extract of (e) |
| 2.50 li. | almond shell extract of (f) |

Total
42.25 li. Bonificateur

Cassis Flavor MF 246

(a) 5 kg. or 11 lbs. cassis flower buds (imported), are to be extracted with a menstruum consisting of:

| 3.25 gal. | alcohol, 95 per cent, and |
| 2.75 gal. | water |

Total
6.00 gal.

Extraction should last five days, then take off:

4.00 gal. flavoring extract; (it is to be used in (c)).

(b) Distill at atmospheric pressure, slowly, of remains mixed with:

| 3.00 gal. | water—to obtain: |

First fraction: 1 gallon flavor distillate. Further distillation is to be discontinued;

(c) Mixture of:

| 4.00 gal. | flavoring extract of (a) |
| 1.00 gal. | flavoring distillate of (b) |

Total
5.00 gal. cassis flavor

Chartreuse Type Flavor MF 247

(a) Maceration of the following comminuted botanical ingredients:

| 11,847 gm. | angelica seed |
| 6,661 gm. | angelica root |
| 2,862 gm. | arnica blossom |
| 1,893 gm. | calamus root |
| 2,385 gm. | cardamom |
| 11,847 gm. | lemon peels |
1,893 gm. mace
11,355 gm. melissa herbs
1,893 gm. cloves
11,355 gm. wormwood
10,220 gm. hyssop herbs
1,325 gm. saffron
75,536 gm. total to be extracted with a menstruum consisting of:
450 lbs. or 75 gal. alcohol, 95 per cent, and
415 lbs. or 50 gal. water
865 lbs. or 125 gal. (alcohol content 57 per cent)
After five days take off 5 gal. extract for use in finished flavor mixture of (d) and 115 gal. extract for use in distillation (e).

(b) To the remaining botanicals and menstruum add:
664 lbs. or 80 gal. water; agitate and press to obtain about 85 gal. expressed extract for use in distillation (e).

(c) 115 gal. of 2.-extract of (a) macerations—is mixed with:
85 gal. expressed extract of (b) to make a total of:
200 gal. extract; the mixture is filtered and then distilled at atmospheric pressure to obtain a yield of:
95 gal. of flavor distillate of about 60 to 65 per cent alcoholic content. The flavor distillate is used in (d) finished flavor mixture;

(d) Finished flavor mixture consisting of:
5 gal. extract of (a)
95 gal. flavor distillate (d) to yield a total of:
100 gal. Chartreuse type essence.

Recommended Use.—3 gal. in 100 gal. cordial.

Chartreuse White-Type Flavor Distillate

The comminuted botanical ingredients:

(a) 399.0 gm. melissa herb
116.0 gm. peppermint herb
152.0 gm. genepi herb
58.0 gm. genepi des Alpes
117.0 gm. hyssop herb
23.0 gm. nutmeg
23.0 gm. tonka beans
116.0 gm. angelica seed
20.0 gm. angelica root
51.0 gm. cardamom seed
31.0 gm. cloves
8.0 gm. cinnamon bark
81.0 gm. calamus root
39.0 gm. sweet orange peel
are mixed with:
21.5 gal. menstruum of 56.5 per cent alcohol content and after an extraction of 48 hours distilled, at atmospheric pressure, to yield in:

(b) First fraction: 0.5 gal. distillate which contains alcohol of high proof and very little flavor and is returned to still after the second or middle fraction progresses.

(c) The yield of the second fraction is 13.25 gal. flavor distillate.

(d) The third fraction is redistilled after having been first mixed with sodium sulfate for purification and filtered. The redistilled fraction is used in the next production.

Loss of alcohol is 3.2 proof.

Cherry Cordial Fruit Flavor MF 249

Mix

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.0 gm. oil of bitter almond</td>
<td></td>
</tr>
<tr>
<td>1.0 fl. oz. wild cherry bark flavor distillate—formula MF 14</td>
<td></td>
</tr>
<tr>
<td>1.0 fl. oz. bourbon vanilla extract—two fold—formula MF 64</td>
<td></td>
</tr>
<tr>
<td>32.0 fl. oz. wild cherry fruit flavoring extract—formula MF 12</td>
<td></td>
</tr>
<tr>
<td>84.0 fl. oz. full aromatic cherry fruit flavor—formula MF 20</td>
<td></td>
</tr>
<tr>
<td>10.0 fl. oz. full flavor raspberry concentrated juice—formula MF 30, or Dalmatian cherry extract—formula MF 13, can be substituted for the raspberry juice when the raspberry flavor is not wanted.</td>
<td></td>
</tr>
</tbody>
</table>

128.0 fl. oz. or one gallon flavor of 15 per cent alcohol content.

Use:—3 to 5 gal. per 100 gal. cherry liqueurs.

Label.—Cherry concentrated juice, cherry extractives, other fruit extractives, essential oil, and alcohol.

Danish Type Cherry Cordial Flavor MF 250

(a) Extract

440.0 lbs. Dalmatian cherries, coarsely ground, with a menstruum of:

120.0 gal. Morello cherry juice and flavoring extract, formula MF 11.

Rotate menstruum by pumping over Dalmatian cherries twice daily for five days; then take off extract.

Yield:

90.0 gal. Dalmatian and Morello cherry flavoring extract. Use: 40 gal. in (f) and 50 gal. in (g).

(b) Add to the remaining fruit of (a), another:

50.0 gal. Morello cherry juice and flavoring extract and let stay for 24 hours. DO NOT ROTATE MENSTRUUM; take off extract. Yield:

50.0 gal. flavoring extract of second extraction. Use: 50.0 gal. in (d).

(c) Pit flavor: Mix remaining fruit in:

40.0 gal. water. Agitate and heat to 131°F. Keep at this temperature for six hours to facilitate hydrolysis of the crushed pits, then let cool and add:
6.0 gal. alcohol, 95 per cent, to the mixture. Agitate and distill slowly at atmospheric pressure to obtain yield of:
15.0 gal. first fraction: pit flavor distillate of 55 to 60 per cent alcohol content. Use: 15 gal. in (g); second fraction is to be redistilled and used in the next production batch.

(d) Fruit coloring extraction:
80.0 lbs. imported dried elderberries are mixed with menstruum of:
40.0 gal. Morello cherry flavoring extract of formula MF 11. Rotate menstruum over fruit twice daily for five days; yield:
40.0 gal. elderberry and cherry coloring and flavoring extract; use in (f).

(e) Add to the remaining fruit:
40.0 gal. water and let stand 24 hours. DO NOT ROTATE MENSTRUUM. Then take off extract; yield:
40.0 gal. coloring extract; use in (f).

(f) Concentrate by vacuum distillation:
40.0 gal. Dalmatian and Morello cherry flavoring extract of (a)
40.0 gal. elderberry and cherry coloring and flavoring extract of (d)
40.0 gal. coloring extract of (e); the yield is:
35.0 gal. concentrated soluble solids and coloring extract, which is used in (g), and
10.0 gal. distillate of recovered alcohol which is to be redistilled to about 65 per cent alcohol content; the distillate is used in the distillation of pit flavor (d), in the next production batch, instead of alcohol.

(g) Mixture of:
50.0 gal. Dalmatian and Morello cherry flavoring extract of (a)
35.0 gal. concentrated soluble solids and coloring extract of (f)
15.0 gal. pit flavor distillate of (e)
Yield: 100.0 gal. fruit flavor of about 15 to 17 per cent alcohol content.

Cocoa Flavor MF 251

Mixture of:
31.600 lbs. or 4.0 gal. cocoa flavor distillate
45 per cent alcohol content, formula MF 57.
18.000 lbs. or 2.0 gal. cocoa true flavor concentrate, formula MF 55.
18.525 lbs. or 2.0 gal. vanilla extract, 2-fold, formula MF 64.
2.375 lbs. or 0.25 gal. coffee extract, formula MF 61.
6.000 lbs. or 0.5 gal. caramel, suitable for use in alcoholic beverages
76.500 lbs. or 8.75 gal. flavor.
Use:—8.75 gal. flavor per 100 gal. cordial; 16 fl. oz. flavor per 100 lbs. cream centers for confectionery.

Distilled Gin MF 252

(a) Distillation, at atmospheric pressure, in an especially built gin still, of the comminuted botanical ingredients:
LIQUEUR FLAVORINGS

12 lbs. juniper berries of Italian or Jugoslavian origin
6 lbs. juniper berries of Russian origin
1 lb. and 14.5 oz. av. coriander
1 lb. and 13.5 oz. av. angelica root
1 lb. and 11.0 oz. av. bitter orange peels of West Indian or Spanish origin
12.75 oz. av. bitter orange peels—Californian
12.0 oz. av. Valencia sweet orange peels
3.5 oz. av. orris root
1.25 oz. av. cassia
1.25 oz. av. cardamom
1.25 oz. av. calamus root
2147 lbs. alcohol, 95 per cent
2621 lbs. water
Yield: first fraction—214.5 lbs. gin distillate.
(b) The second fraction contains the recovered alcohol. It is redistilled and used in the next production batch.

Dry Gin Flavor MF 253

Mix the following oils in amounts indicated:

80.0 gm. juniper, Italian
40.0 gm. juniper, Russian
16.0 gm. lemon
10.0 gm. bitter orange, cold pressed
10.0 gm. angelica root
6.0 gm. coriander
4.0 gm. wormwood
2.0 gm. cardamom
2.0 gm. cinnamon bark
2.0 gm. clove buds
2.0 gm. mace
2.0 gm. pimento berries
2.0 gm. petitgrain
1.0 gm. cognac

mix with:
4.08 lbs. or 0.6 gal. alcohol, 95 per cent
4.15 lbs. of 0.5 gal. water

The mixture is agitated and then left to stand for separation of terpenes. The terpene-free yield is approximately one gallon flavor and is to be filtered.

Full Aromatic Kuemmel Liqueur Flavor* MF 254

(1) Flavor Distillate

(a) Extraction, in still, for 24 hours of:

10.0 kg. caraway seeds, comminuted with menstruum consisting of:
82.0 li. alcohol, 95 per cent, and

*Original continental recipe.
FOOD FLAVORINGS

30.0 li. water; after 24 hours, add the following comminuted ingredients:
0.5 kg. sweet orange peels
0.5 kg. coriander
0.3 kg. staranis (badian)
100.0 gm. orange flowers;

(b) distill slowly, at atmospheric pressure, without dephlegmation, to yield the first fraction of:
90.00 li. flavor distillate of about 77 per cent alcohol content. The distillate is to be reduced with water to 45 per cent alcohol content, filtered, and is to be redistilled at atmospheric pressure to obtain:

(c) 60.00 li. Kuemmel flavor distillate of approximately 84 per cent alcohol content;
(d) the last fractions of the distillations of (b) and (c) are to be redistilled to higher proof strength and are used in the next production batch.

(2) Production of Liqueurs

(e) Eckau Kuemmel Liqueur Crystal—mixture of:
57.15 li. kuemmel flavor distillate of (c) 84 per cent alcohol content
9.35 li. distilled water (includes 2.5 li. water for contraction)
36.00 li. syrup 68° Brix
100.00 li. Eckau Kuemmel Crystal—48 per cent alcohol content.

(f) Kuemmel Doux or Allasch Liqueur—mixture of:
47.62 li. kuemmel flavor distillate of (c) 84 per cent alcohol content
29.38 li. distilled water (includes 2.0 li. water for contraction)
25.00 li. syrup 68° Brix
100.00 li. Kuemmel Doux or Allasch—40 per cent alcohol content.

Preparation of Cordial Kuemmel Crystals

(5) Ingredients
480 lbs. sugar
11 lbs. milk sugar
25 gal. distilled water
43 gal. alcohol, 95 per cent

(b) Heat the water to 200°F. Add the sugar, agitate to dissolve, then add the milk sugar.

(c) Cool the mixture of (b) to 160°F.; then mix with the 43 gal. alcohol, 95 per cent. The mixture is immediately bottled and is stored, loosely stoppered, in a dark room at a temperature of 55° to 65°F. for crystallization of sugar on the walls of the bottles.

(d) After two weeks storage, the tasteless alcoholic contents are removed from the bottles. This is used in the manufacture of other cordials.

(e) The bottles with crystals are then filled with Eckau Kuemmel Liqueur of formula MF 254.

Per 100 gal. of 40 per cent alcohol.
MALT

Property

Malt is produced by controlled partial germination of barley. During the process, amylolytic enzymes are released. They are essential to starch conversion. For varieties of flavor and color malt depends on the conditions of germination and on the type of "kilning" or drying of the germinated barley. The more severe the kilning (drying), the lower the enzyme content and the higher the extract color also the greater the development of its aroma and taste.

The Malton Whiskey or Brandy Flavors require brewers' malts which are dried at 120°F. and finished at 180°F. A higher drying temperature lowers the power of the diastase which converts starch into fermentable sugars. Diastase is an enzyme which hydrolyzes starch to maltose. High heat lowers diastatic power to 90 to 150 Lintner (the measure of amylase activity) and alpha amylase 20 to 38. Brewers' malt contains about four per cent moisture content.

Munich brewers' malt is dried at 220°F., its diastatic power and alpha amylase activity are lowered, the moisture is about three per cent; however color, aroma, and taste are increased. Distillers' malt is dried at about 150°F.

Dextrin malt is first heated to 200°F. to gelatinize its starch, then the heat is reduced to 175°F. Diastatic power is largely destroyed.

Caramel malt is prepared by roasting green malt immediately after germination at 240°F. to saccharify the starch and to make the kernel brittle and glossy. Moisture is reduced to two per cent and almost no diastatic activity is left. The color grades vary from pale to dark. Black malt is made by roasting barley until it is black. No diastatic power is left.

Malton-Whiskey® Flavor or Malton Brandy® Flavor  MF256

Malt (Barley)

Average Content.— Protein, 8.5; amide, 1.5; fat, 1.7; fiber, 1.5; minerals, 1.9; water, 10.0; starch, 75.0.

One hundred kilograms of barley malt yield 52.5 kg. malt sugar which equal 55.0 kg. fermentable sugar, from which may be obtained 27.5 li. absolute alcohol.

Procedure

(a) Starter:  mixture of:

3.0 lbs. barley malt, coarsely ground, with:
8.3 lbs. or one gallon water and heated to 140°F. The mixture is agitated and kept at this temperature for two hours.

* Registered Tradenames.
The diastase (enzyme) of the malt converts the starch into invert sugar (maltose).

(b) The heated mash is then speedily pressed or centrifuged. The expressed Malton juice is heated to 158°F. for about ten minutes for pasteurization. It is then rapidly cooled to 77°F. and inoculated with a pure and powerful wine yeast culture for controlled fermentation.

(c) Production of Malton-Wine:

300.0 lbs. malt, coarsely ground, are mixed with:
830.0 lbs. or 100 gal. water.

The mixture is heated to 140°F. and is kept at this temperature under agitation for two hours. The mash is then centrifuged (Fig. 26) or speedily pressed. The Malton juice is heated to 158°F. under agitation for ten minutes for pasteurization. It is then cooled to 77°F. To it is added the halfway fermented starter of (a). It is mixed well and left for controlled fermentation. The fermentation yields a malt wine of about ten per cent alcohol content.

(d) The lees of the fermented Malton wine are mixed with an equal quantity of water and are distilled at atmospheric pressure. It yields Malton wine oil which resembles cognac oil.

(e) The fermented malt wine of (c) is put into refrigeration to freeze for concentration. The frozen malt wine is mechanically reduced to chopped ice pieces and centrifuged.

(f) The yield is a concentrated wine flavor of approximately 30 per cent alcohol content.

The wine flavor of (d) is left to clear. It is then slowly distilled at atmospheric pressure to yield in the first fraction malt whiskey flavor or malt brandy flavor of 60 to 70 per cent alcohol content.

The flavor blends well with neutral spirits to produce drinkable alcoholic beverages. It can be used in compounds of various flavoring material for application in food products. Malt brandy flavor is also useful in perfumery goods.

Grand "M" Type Flavor*  MF 257

(a) Extract the following comminuted botanical ingredients:

- 4750 gm. orange peels, bitter
- 2500 gm. peppermint herb
- 2250 gm. orange peels, sweet
- 1750 gm. lemon peels
- 1500 gm. coriander seed
- 1500 gm. curacao orange peels
- 1500 gm. ginger
- 1500 gm. orange blossoms
- 875 gm. cinnamon
- 1075 gm. cloves

* Continental Formula.
Liqueur Flavorings

875 gm. angelica seed
250 gm. cardamom
100 gm. tonka beans
100 gm. saffron

20,525 gm.

with menstruum consisting of:
72 li. alcohol 95 per cent
50 li. water
Extract for four days.
Then take off:
5 kg. extract

(b) Add to remaining botanical ingredients and menstruum:
50 li. water,
and distill slowly at atmospheric pressure to obtain:
90 li. flavor distillate

(c) Finished flavor mixture:
90 li. distillate (b)
5 kg. extract (a)
5 li. wine distillate

Yield
100 li. Grand "M" type flavor

Peach Cordial Flavor MF 258

Mix:
4.25 gal. peach fruit flavoring extract—15 per cent alcohol content, formula MF 23.
0.75 gal. peach fruit color, 15 per cent alcohol content, formula MF 47. This color is manufactured similarly to apricot fruit color, formula MF 44. This yield is
5.00 gal. peach cordial flavor.
Use 5 gal. flavor in the manufacture of 100 gal. peach cordial.

Crystallized Rock and Rye MF 259

Procedure

(a) Bottles.—Special bottles are used for crystallized rock and rye. It is of the greatest importance that the bottles are absolutely clean. If the bottles are new, a thorough cleansing with water should be sufficient but if the bottles are dusty or otherwise dirty, they must be cleaned with a solution of 10 per cent sodium hydroxide (warm) followed by a thorough rinsing with water. If the tap water is too hard, a final rinsing with distilled water may be necessary.

(b) Crystalline Coating.—Preparatory to coating, prepare a sugar syrup by dissolving ordinary crystal sugar in water, using 75 per cent sugar by weight. This solution should be made at about 176°F., under constant stirring. The heating must be done by steam or hot water and not over a flame so that disintegration of the sugar cannot occur.

The sugar solution is then cooled to 86°F. and arrangements should be made to hold a supply of the sugar syrup at this temperature. It is important that this syrup should be used for the subsequent operations at 86°F.
About 5 fl. oz. of this syrup are poured into a quart bottle (3 fl. oz. to the pint bottle). This quantity is sufficient to coat the entire inside of the bottle well with syrup. The bottle should be rotated in order to assure good distribution and complete and uniform coating over the entire inner surfaces. The bottle is then placed on a rotating table and the excess syrup is allowed to drain.

After the surplus syrup has been removed by drainage, coarse, granulated sugar crystals are filled into the bottle through a funnel. For the quart sized bottles, 80 gm. of crystals are needed and 60 gm. for the pint size. The bottles are vigorously shaken so that the sugar crystals cover the inside of the bottle uniformly and completely. Any excess crystals are shaken out of the bottle. The bottle now must be thoroughly dried by blowing clean air into it in an inverted position on the draining table. This draining table has to be rotated very slowly because it is important that the first coating be absolutely dry. If cold air is used, the drying will take about one hour.

After completely drying the inside, a second charge of sugar syrup is administered. The quart bottle requires three ounces of sugar syrup and the pint size two ounces. It is of the greatest importance that the syrup be well spread on the inside by rotating the bottle. Then the sugar syrup is again removed by drainage.

Another charge of granulated sugar crystals is added, using 60 gm. for the quart bottle and 50 gm. for the pint.

The second layer is dried in the same manner as the first one and equally as thoroughly. For the quart bottles, a third layer is then applied by the same method; for the pints two layers should be sufficient. For the third layer two ounces of sugar syrup are used and 40 gm. of crystals.

**Rock and Rye Solution**  

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-proof rye whiskey</td>
<td>36.8 gal.</td>
</tr>
<tr>
<td>190-proof spirits</td>
<td>17.0 gal.</td>
</tr>
<tr>
<td>Milk-sugar solution</td>
<td>1.0 gal.</td>
</tr>
<tr>
<td>Water</td>
<td></td>
</tr>
<tr>
<td>Sugar syrup</td>
<td>45.2 gal.</td>
</tr>
</tbody>
</table>

Each batch of solution has to be tested by the ebulliometer method before being used and the proof adjusted, if necessary. The mixture is cooled and filled carefully into the bottles through a long neck funnel so that it will not splash. The finished rock and rye bottles should be stored in a cold place.

**Sloe Gin Flavor W.O.N.F.**  

Mix:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sloe flavoring extract</td>
<td>64.0 fl. oz.</td>
</tr>
<tr>
<td>Red fruit color</td>
<td>32.0 fl. oz.</td>
</tr>
<tr>
<td>Vanilla extract, two fold</td>
<td>2.0 fl. oz.</td>
</tr>
<tr>
<td>Wild cherry bark flavor distillate</td>
<td>24.0 fl. oz.</td>
</tr>
</tbody>
</table>

In which are to be dissolved:
Liqueur Flavorings

2.0 oz. av. vanillin
6.0 fl. oz. tartaric acid solution 50 per cent

Yield
128.0 fl. oz. sloe gin flavor

Full Aromatic Triple Sec Cordial Flavor\textsuperscript{10} \hspace{1cm} MF 262
(Made from the peels of Curacao Oranges and sweet oranges)

First production:

(a) Put the following ingredients into a 200 gal. still with a perforated stainless steel plate above the edge of the steam jacket:
- 125.0 lbs. coarsely ground peels of ripe sweet oranges
- 425.0 gm. orris root, pulverized
- 170.0 gm. orange blossoms; add the menstruum of about 60 per cent alcohol content, consisting of:
  - 249.0 lbs. or 30 gal. water
  - 353.6 lbs. or 52 gal. alcohol, 95 per cent.

(b) Procedure: After 24 hours extraction, distill at atmospheric pressure, slowly, without dephlegmation up to 78 per cent alcohol content of the condensate, then turn on dephlegmation to retain a high proof alcohol content in the distillate. The yield of the first fraction is:
- 40.0 gal. flavor distillate, of about 82 per cent alcohol content. It is used in (d).

(c) Procedure: The distillation of procedure (b) continues until all the alcohol is recovered. It yields a second fraction of approximately:
- 30.0 gal. distillate of about 45 per cent alcohol content. It is used in (f).

(d) Procedure: The 40 gal. flavor distillate first fraction of (b) is mixed with 40 gal. water. It is allowed to stand a few hours for separation of terpenes which are removed by decantation and the aqueous solution is then filtered. The terpene-free flavor is redistilled at atmospheric pressure, slowly, and in the same manner as in procedure (b), to obtain as first fraction:
- 20.0 gal. flavor distillate of about 80-84 per cent alcohol content. It is then used in (m).

(e) The distillation of the terpene-free flavor of (d) continues unchanged, slowly, with dephlegmation, to recover all the alcohol and to yield as second fraction of approximately:
- 30.0 gal. distillate of about 50 per cent alcohol content. It is used in (f).

(f) Procedure: mixture and distillation of:
- 30.0 gal. second fraction distillate, 45 per cent alcohol content, of (e) and:
- 30.0 gal. second fraction distillate, 50 per cent alcohol content, of (e) and:
- 40.0 gal. water, to yield total of:
- 100.0 gal. mixture of about 28.5 per cent alcohol content. The mixture

\textsuperscript{10} Original French recipe.
is left to stand a few hours for separation of terpenes. After the separation of terpenes it is filtered and then redistilled at atmospheric pressure slowly with dephlegmation applied to retain a high proof alcohol content in the distillate and yields approximately:

40.0 gal. distillate of about 64 per cent alcohol content. It is used in the second production batch and distillation of curacao peels of procedure (g) of second production.

Second Production:

(g) Put into 200 gal. still with perforated stainless steel plate above heat line, the following ingredients:

125.0 lbs. curacao peels, expulpatated or coarsely ground
425.0 gm. mace, pulverized. Add to it a menstruum of 64 per cent alcohol content, consisting of:

141.1 lbs. or 17.0 gal. water, and
238.0 lbs. or 35.0 gal. alcohol, 95 per cent, and
40.0 gal. distillate, 64 per cent alcohol content, of (f).

(h) Procedure: After 24 hours extraction, distill at atmospheric pressure, slowly, without dephlegmation, up to 78 per cent alcohol content of the condensate, then turn on dephlegmation to retain a high proof alcohol content in the distillate. The yield of the first fraction is approximately:

60.0 gal. flavor distillate, of about 80 per cent alcohol content. It is used in (j).

(i) Procedure: The distillation of (h) continues until all the alcohol is recovered and yields a second fraction of approximately:

30.0 gal. distillate, of about 30 per cent alcohol content; it is used in (l).

(j) 60.0 gal. Flavor distillate of the first fraction of (h), of 80 per cent alcohol content, is mixed with:

60.0 gal. water, and left to stand a few hours for separation of terpenes. The terpene-free flavor is then filtered and redistilled at atmospheric pressure, slowly, and with dephlegmation turned on, to obtain a yield of approximately:

30.0 gal. flavor distillate (first fraction) of about 80-84 per cent alcohol content; it is then used in (m).

(k) The distillation of the flavor distillate of (j) procedure continues to recover all the alcohol and to yield as second fraction:

40.0 gal. distillate of about 50 per cent alcohol content. It is used in (l).

(l) Mix and distill

40.0 gal. distillate (second fraction), of 50 per cent alcohol content, of (k) procedure, and
30.0 gal. distillate (second fraction), of 30 per cent alcohol content, of (i) procedure, and
30.0 gal. water, to yield a total of:

100.0 gal. mixture of about 29 per cent alcohol content; the mixture is allowed to stand a few hours to separate terpenes. It is then filtered and redistilled at atmospheric pressure, slowly, and dephlegmation is applied to yield approximately:
LIQUEUR FLAVORINGS

40.0 gal. distillate of 64 per cent alcohol content. It is used in the next production batch of orange peels.

(m) Finished flavor mixture consisting of:
- 20.0 gal. flavor distillate of 80-84 per cent of (d) procedure, first fraction, and
- 30.0 gal. flavor distillate of 80-84 per cent of (j) procedure, first fraction. Total:

50.0 gal. full aromatic flavor distillate, of about 80-84 per cent alcohol content.

Remarks:—If the entire quantity of the flavor mixture of (m) is used in the manufacture of 100 gal. Triple Sec cordial it yields a beverage of finest quality.

Wine Bitter Aperitif Flavor  MF 263

Extract the following comminuted botanical ingredients:

(a) 1000 gm. coriander
   300 gm. angelica root
   300 gm. melissa herb
   200 gm. angelica seed
   150 gm. wormwood, alpine
   100 gm. hyssop herb
   100 gm. calamus root
   100 gm. gentian root
   50 gm. arnica root
   50 gm. muscat flowers
   50 gm. muscat nut

mixture of:
10.88 lbs. or 1.60 gal. alcohol, 95 per cent
11.62 lbs. or 1.40 gal. distilled water

3.00 gal. menstruum of approximately 50 per cent alcohol content; duration of extraction: 5 days.

Take off one gallon extract for use in (c).

(b) Add to the remaining mixture of botanical ingredients and menstruum:
   1.00 gal. water, and slowly distill, at atmospheric pressure, to obtain:
   first fraction yield:
   0.50 gal. distillate of about 70 per cent alcohol content, which is used in (c); second fraction yield:
   1.25 gal. distillate of about 45 per cent alcohol content, which is to be mixed with equal quantity of water, filtered, and redistilled to obtain a higher alcohol proof. It is then used in the next production batch.

(c) Mixture of:
   1.0 gal. extract of (a) of about 50 per cent alcohol content
   0.5 gal. distillate, first fraction of (b) of about 70 per cent alcohol content.
   2.5 gal. distilled water.

4.0 gal. flavor of about 21 per cent alcohol content. Filter if necessary.
(d) Mixture of wine bitter aperitif consisting of:

- 5.0 gal. syrup 68° Brix
- 80.0 gal. white wine of low acid content and of about 9 to 10 per cent alcohol content
- 4.0 gal. flavor of (d) of about 21 per cent alcohol content
- 11.0 gal. alcohol, 95 per cent

**Yield**

100.0 gal. wine bitter aperitif of approximately 18 per cent alcohol content.
CHAPTER 21

Tobacco Flavorings

Tobacco flavor additives are included as a chapter of “Food Flavorings” for they are used for human consumption. Tobacco and its flavoring material are inhaled in form of heated vapor, and are said to penetrate tissues and organs of the human body.

TOBACCO BLENDERS

Tobacco blenders are modifiers, mellowers, or aromatic fortifiers which combine with the natural flavor of the processed tobacco leaf. They are often called “finishing flavors or dressing.” “Casing” is the part of the curing process during which the tobacco leaf is made flexible and pliable through introduction of moisture. The leaf absorbs flavor to a high degree at the same time. The flavoring or casing ingredients are mostly sweetening syrups, honey, maple syrup and molasses, sugar, apple-, prune-, or fig-juice, either in liquid or in paste form, St. John’s bread, concentrated raisin juice, licorice root, and cocoa powder.

A stew is made up from these materials and the tobacco is dipped after it has been steamed. The leaves are then run through a wringer and the excess casing is squeezed out and poured back into the dipping tank. This squeezed tobacco is spread on a moving belt and passed through a drier. It generally requires from 30 to 40 minutes for the tobacco to transverse the full length of the drying chambers. The first and second chambers have a temperature of approximately 240° to 280°F. to remove most of the moisture. In the last stage of the drier some moisture is reintroduced into the heated leaf, so that it can be handled without breakage.

Elasticity of the tobacco leaf is important in the processing of tobacco. Gums and waxes are added to increase the elasticity. They also mask the bitterness and acrid taste of the resins in the leaf as well as the tars which are formed during smoking of the tobacco.

Extracts of vanilla and tonka beans are extensively used as ingredients in tobacco processing. Balsam Peru, balsam tolu, and resinoids of styx and opoponax are also utilized. These natural aromatic extractives are mixed with the sweetening agents before application.

Wine and rum are used in large quantities in cigarette and pipe tobacco to insure uniformity. Essential oils of rose, geranium, anise, cinnamon, allspice, and others, are used to obtain top notes. Similar taste effects are obtained with tinctures of aromatic roots, herbs and beans, orris, valerian,
coffee, and deer tongue. Solid extracts of orris, valerian, St. John's bread, coffee, and deer tongue are preferably diluted with glycols to make their flavor more resistant to heat. Glycerin, propylene glycol, diethylene glycol, triethylene glycol in flavoring compounds give lasting elasticity to tobacco and contribute to increased stability of the flavor.

Aromatic chemicals are usually used to replace the more costly aromatic ingredients of natural flavoring material. Vanillin and ethyl vanillin are used to replace extract of vanilla beans, coumarin is substituted for tonka bean and deer tongue leaf. Anisic aldehyde is used instead of anise oil, rhodinol instead of otto of rose and geranium oil, cinnamic aldehyde replaces cinnamon, and eugenol substitutes for cloves.

Aldehydes, esters, and ketones are used to create top notes and to distinguish competitive tobacco brands. Aromatic chemicals with floral notes are to be used sparingly since they form odors offensive to smokers. Tobacco flavors must be free of terpene substances and remain uniformly stable during burning of the tobacco. The flavors should contain heat resistant solvents and be hygroscopic.

**FLAVORINGS FOR USE IN CIGARETTES, CIGARS, PIPE AND CHEWING TOBACCO**

The average cigarette contains Virginia and Carolina leaf, Burley and Latakia tobacco, as well as some Turkish tobacco. This combination has an abundance of natural flavor. The use of rum, fermented or unfermented fruit juice, vanilla and tonka (either natural or synthetic), licorice, cocoa and sugar, terpene-free essential oils, will take off the rough edges. Cigars are seldom flavored.

Pipe mixtures contain a mixture of Burley, Virginia leaf, Latakia, and Perique tobacco. Spice and fruit flavors are used in pipe mixtures together with flavors such as maple, vanilla, and rum. Botanical extractions should be free of resinous substances to avoid formation of tars during burning and smoking of tobacco products.

Chewing tobacco is flavored with cocoa, anise, peach, licorice, and other sweet flavorings. For Latakia tobacco flavor, a pyroligneous acid solution and tar derivates are recommended.

**TOBACCO ALCOHOL**

S.D.A. No. 4

S.D.A. No. 4 is a special denatured alcohol which is prepared by adding one gallon denaturant solution to every one hundred gallons of 95 per cent ethyl alcohol.

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1 Title 26—Internal Revenue, 1954, Part 182—App. B.
The denaturant is an aqueous solution containing per 100 gallons mixture the following preparation:

Five gallons water in which 40 per cent nicotine is dissolved, and to it added 3.6 oz. methylene blue color and water to make 100 gal. denaturant.

**Apple Flavor Imitation MF 264**

Mix

- 0.125 fl. oz. benzaldehyde
- 4.000 fl. oz. ethyl butyrate
- 4.000 fl. oz. amyl acetate
- 8.000 fl. oz. amyl valerate
- 4.000 fl. oz. ethyl valerate
- 4.000 fl. oz. ethyl acetate
- 32.000 fl. oz. alcohol 95 per cent S.D.A. No. 4, or rum ether—formula MF 125
- 71.875 fl. oz. propylene glycol

Total 128.000 fl. oz.

**Apple True Fruit and Imitation Flavor MF 265**

Mix

- 48.0 fl. oz. full flavor concentrated apple juice of 68° Brix
- 16.0 fl. oz. apple essence 100 fold—recovered from concentration of full flavor apple juice
- 70.0 fl. oz. apple flavor imitation, formula MF 264
- 134.0 fl. oz. less:
- 6.0 fl. oz. separated terpenes

Total 128.0 fl. oz.

**Cigarette Flavoring Extract MF 266**

**C-Type**

Extract the finely comminuted botanicals:

- 125.0 gm. deer tongue,
- 125.0 gm. tonka beans,
- 125.0 gm. coriander seed,
- 64.0 gm. angelica root,
- 8.0 gm. cardamom,
- 16.0 gm. mace, with a menstruum consisting of:
- 390.0 gm. alcohol, 95 per cent
- 840.0 gm. water

extraction should last 8 days; then the extract is taken off;

Yield:

1000.0 gm. flavoring extract has approximately 30 per cent alcohol content; filter.

*The casing material of the C-type contains supposedly the same ingredients as the L-type except for balsam of Peru, tolu, and styrax; which are left out.*
Cascarrilla Tincture  MF 267
Mix
100.0 gm. cascarrilla bark, ground
178.0 gm. S.D.A. No. 4 (150 proof) alcohol
540.0 gm. water

Castor Tincture  MF 268
Mix
100.0 gm. brown castors, cut fine
1114.0 gm. S.D.A. No. 4 (150 proof) alcohol

St. John’s Bread Tincture  MF 269
Mix
751.0 gm. roasted St. John’s bread
712.0 gm. S.D.A. No. 4 (150 proof) alcohol
373.0 gm. water

Havana Cigar Flavor  MF 270
Mix
0.50 gm. vanillin
1.50 gm. oil of valerian
0.25 gm. oil of cascarrilla
0.50 gm. amyl valerate
0.25 gm. ethyl valerate
0.50 gm. oil of geranium
3.25 gm. oil of lavender
6.50 gm. oil of sandalwood
6.50 gm. cascarrilla tincture—formula MF 267
72.00 gm. butyric acid
72.00 gm. balsam Peru
32.00 gm. castor tincture—formula No. MF 268
269.00 gm. ethyl butyrate
445.25 gm. special denatured alcohol (S.D.A.) No. 4–150-proof alcohol content
280.00 gm. tobacco rum flavor, formula MF 277
192.00 gm. St. John’s bread tincture, formula MF 269
1326.00 gm.

Honey Flavor Imitation  MF 271
Mix
12.00 gm. ethyl vanillin
24.00 gm. phenylacetic acid
24.00 gm. methylphenylacetate

*S.D.A. is the abbreviation for special denatured alcohol.
0.75 gm. methylacetophenone  
0.75 gm. methyl-aceto-phenone  
0.75 gm. oil of celery  
0.75 gm. oil of geranium  
937.75 gm. propylene glycol  
1000.00 gm.

Latakia Tobacco Flavor  MF 272

Mix

<table>
<thead>
<tr>
<th>Component</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caproic ether, absolute</td>
<td>0.125 gm.</td>
</tr>
<tr>
<td>Birch tar oil</td>
<td>2.000 gm.</td>
</tr>
<tr>
<td>Acetic acid essence, (a) below</td>
<td>0.250 gm.</td>
</tr>
<tr>
<td>Camphor essence, (b) below</td>
<td>2.000 gm.</td>
</tr>
<tr>
<td>Diacetyl essence, (c) below</td>
<td>2.000 gm.</td>
</tr>
<tr>
<td>Castor tincture, (d) below</td>
<td>16.000 gm.</td>
</tr>
<tr>
<td>Durez, powdered resin</td>
<td>48.000 gm.</td>
</tr>
<tr>
<td>Fire wood (Cyrilla racemi flora) concentrated distillate</td>
<td>48.000 gm.</td>
</tr>
<tr>
<td>Alcohol, 95 per cent S.D.A. No. 4</td>
<td>881.625 gm.</td>
</tr>
<tr>
<td>Total</td>
<td>1000.00 gm.</td>
</tr>
</tbody>
</table>

(a) Acetic acid essence—mixture of

<table>
<thead>
<tr>
<th>Component</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glacial acetic acid</td>
<td>1 gm.</td>
</tr>
<tr>
<td>Alcohol, 95 per cent S.D.A. No. 4</td>
<td>109 gm.</td>
</tr>
<tr>
<td>Total</td>
<td>110 gm.</td>
</tr>
</tbody>
</table>

(b) Camphor essence—mixture of

<table>
<thead>
<tr>
<th>Component</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camphor</td>
<td>1 gm.</td>
</tr>
<tr>
<td>Alcohol, 95 per cent S.D.A. No. 4</td>
<td>109 gm.</td>
</tr>
<tr>
<td>Total</td>
<td>110 gm.</td>
</tr>
</tbody>
</table>

(c) Diacetyl essence—mixture of

<table>
<thead>
<tr>
<th>Component</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diacetyl</td>
<td>1 gm.</td>
</tr>
<tr>
<td>Alcohol, 95 per cent S.D.A. No. 4</td>
<td>109 gm.</td>
</tr>
<tr>
<td>Total</td>
<td>110 gm.</td>
</tr>
</tbody>
</table>

(d) Castor tincture—mixture of

<table>
<thead>
<tr>
<th>Component</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown castor, finely cut</td>
<td>80 gm.</td>
</tr>
<tr>
<td>Alcohol, 95 per cent S.D.A. No. 4</td>
<td>920 gm.</td>
</tr>
<tr>
<td>Total</td>
<td>1000 gm.</td>
</tr>
</tbody>
</table>

Cigarette Flavoring Extract  MF 273

L-Type

Extract the following finely comminuted botanicals:

<table>
<thead>
<tr>
<th>Component</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tonka beans</td>
<td>125.0 gm.</td>
</tr>
<tr>
<td>Coriander seed</td>
<td>125.0 gm.</td>
</tr>
<tr>
<td>Cardamom seed</td>
<td>8.0 gm.</td>
</tr>
<tr>
<td>Mace</td>
<td>1.2 gm.</td>
</tr>
<tr>
<td>Alcohol, 95 per cent S.D.A. No. 4</td>
<td>357.0 gm.</td>
</tr>
<tr>
<td>Total</td>
<td>333.625 gm.</td>
</tr>
</tbody>
</table>
773.0 gm. water; extraction should last 8 days; then the extract is taken off.

Yield:
1000.0 gm. flavoring extract containing approximately 30 per cent alcohol content; filter.

The casing in the L-type of cigarette tobacco, which consists mainly of Burley and Virginia blended with small quantities of Turkish tobacco leaves, is usually composed of maple syrup, sugar, licorice, cocoa powder, balsam of Peru, tolu, and styrrax.

**Maple Flavor**

**Mix**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>vanillin</td>
<td>9.00 gm.</td>
</tr>
<tr>
<td>balsam Peru</td>
<td>5.50 gm.</td>
</tr>
<tr>
<td>ethyl oenanthate</td>
<td>0.75 gm.</td>
</tr>
<tr>
<td>alcohol, 95 per cent S.D.A. No. 4</td>
<td>67.25 gm.</td>
</tr>
<tr>
<td>angelica tincture, (a) below</td>
<td>29.25 gm.</td>
</tr>
<tr>
<td>coffee tincture, (b) below</td>
<td>145.25 gm.</td>
</tr>
<tr>
<td>foenugreek tincture, (c) below</td>
<td>743.00 gm.</td>
</tr>
</tbody>
</table>

Total 1000.00 gm.

(a) Angelica tincture
100.00 lbs. pulverized angelica root
127.50 gal. alcohol, 95 per cent S.D.A. No. 4
51.75 gal. water

(b) Coffee Tincture
100.00 lbs. coffee, freshly roasted and pulverized
136.00 gal. alcohol, 95 per cent S.D.A. No. 4
83.00 gal. water

(c) Foenugreek Tincture
100.00 gm. solid extract of foenugreek
350.00 gm. water
550.00 gm. propylene glycol

**Peach Flavor Imitation**

(a) Prepare a solution of
145.00 gm. aldehyde C-14
24.00 gm. meroli oil imitation—formula MF 112
3.00 gm. oil of valerian
44.00 gm. ethyl valerate
18.50 gm. capronic ether, absolute
0.25 gm. oil of cinnamon
0.25 gm. oil of geranium
2.00 gm. oil of bitter almond, free from prussic acid
18.00 gm. amyl formate
8.00 gm. amyl butyrate
8.00 gm. amyl acetate
Tobacco Flavorings

(b) Mix
84.00 gm. vanillin
145.00 gm. alcohol, 95 per cent S.D.A. No. 4

Total
500.00 gm.

Procedure.—Agitate the mixture and let stand for one hour; separate terpenes;
the terpene-free mixture is then filtered and mixed with propylene glycol, to yield a total of:
1000.00 gm. finished flavor.

Raisin True Fruit Concentrated Juice  MF 276

(a) 2000.0 lbs. seedless raisins, unbleached, should be mixed with
320.0 gal. water and left to stand for twenty-four hours; the soaked
raisins are comminuted in a Fitzpatrick machine, using sieve No. 3;
(b) the mash is then to be mixed with
80.0 gal. isopropyl-alcohol, 99 per cent, and expressed to separate the
juice;
(c) the remaining pomace is to be mixed with:
80.0 gal. isopropyl-alcohol 99 per cent and
252.0 gal. water; after twenty-four hours, the mash is expressed to yield
juice.
(d) The expressed juices of (b) and (c) are then mixed together and filtered;
(e) the filtered juice of (d) is then concentrated by vacuum distillation, first to
remove the isopropyl-alcohol in the first fraction, then water in the second fraction;
(f) the vacuum distillation is continued until a yield of approximately:
100 to 112 gal.
Raisin true fruit concentrated juice, of approximately 72° Brix, is obtained.

Tobacco Rum Flavor  MF 277

Mix
3379.625 gm. rum ether, formula MF 125
8.000 gm. ethyl butyrate
8.000 gm. ethyl valerate
2.000 gm. oil of lemon, cold pressed
0.750 gm. oil of cinnamon
0.750 gm. oil of pimento
0.375 gm. oil of neroli
0.250 gm. oil of chamomile
0.250 gm. oil of cascarilla

Total
3400.000 gm.
### Turkish Tobacco Flavor

**Mix**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.85 gm. balsam Peru</td>
<td></td>
</tr>
<tr>
<td>0.85 gm. balsam tolu</td>
<td></td>
</tr>
<tr>
<td>0.85 gm. styrax</td>
<td></td>
</tr>
<tr>
<td>23.88 gm. rum ether, formula MF 125</td>
<td></td>
</tr>
<tr>
<td>956.94 gm. propylene glycol</td>
<td></td>
</tr>
<tr>
<td>13.73 gm. vanillin</td>
<td></td>
</tr>
<tr>
<td>1.25 gm. oil of rose Otto</td>
<td></td>
</tr>
<tr>
<td>0.44 gm. phenyl-ethyl valerate</td>
<td></td>
</tr>
<tr>
<td>0.44 gm. honey flavor imitation MF 271</td>
<td></td>
</tr>
<tr>
<td>0.22 gm. rhodinol-acetate</td>
<td></td>
</tr>
<tr>
<td>0.22 gm. methyl phenyl acetate</td>
<td></td>
</tr>
<tr>
<td>0.11 gm. oil of valerian</td>
<td></td>
</tr>
<tr>
<td>0.11 gm. oil of snake root</td>
<td></td>
</tr>
<tr>
<td>0.11 gm. oil of lovage</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1000.00 gm.</td>
</tr>
</tbody>
</table>

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### Walnut Flavor

**Mix**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.75 gm. ethyl valerate</td>
<td></td>
</tr>
<tr>
<td>3.85 gm. methyl-para-cresol</td>
<td></td>
</tr>
<tr>
<td>247.40 gm. maple flavor-formula MF 274</td>
<td></td>
</tr>
<tr>
<td>741.00 gm. valerian root flavoring extract, formula MF 280</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1000.00 gm.</td>
</tr>
</tbody>
</table>

---

### Valerian Root Extract

**Extract**

<table>
<thead>
<tr>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.500 lbs. valerian root with</td>
</tr>
<tr>
<td>11.750 gal. alcohol, 95 per cent</td>
</tr>
<tr>
<td>5.625 gal. water</td>
</tr>
<tr>
<td><strong>16.375 gal.</strong> 68.16 per cent alcohol content; duration of extraction—8 days; then the extract is decanted;</td>
</tr>
</tbody>
</table>

**Yield:** 12 gal. flavoring extract of 54 per cent alcohol content.

**Distillation**

<table>
<thead>
<tr>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 gal. distillate of 48 per cent alcohol content; which can be used in next production.</td>
</tr>
</tbody>
</table>

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3 Valerian is the rhizome and roots of *Valeriana officinalis*, well known in this country and throughout Europe and Northern Asia. Valerian possesses a powerful and disagreeable odor while the taste is officially described as being sweetish, camphoraceous, and slightly bitter. Valerian contains about one per cent of a brownish-yellow volatile oil. The principal constituent of the oil is about ten per cent of the ester, bornyl isovalerate, the remainder consisting chiefly of the terpenes, camphene, pinene, about one per cent each of the bornyl esters of formic, acetic, and butyric acids. The characteristic odor of valerian is due to the gradual formation of free isovaleric acid from the bornyl isovalerate. Valerian root derived from Mexico contains free isovaleric acid but does not yield any volatile oil. Valerian also contains two alkaloids, chatinine and valerine.


Ferguson, L. R. 1959. Typical gelatin dessert formulas. Personal communication. Stamford, Conn.


Gnadinger, C. B. 1927. Vanilla. McLaughlin, Gormley, King Co., Minneapolis, Minn.
BIBLIOGRAPHY


Appendix
§121.101 Substances that are generally recognized as safe.

(a) It is impracticable to list all substances that are generally recognized as safe for their intended use. However, by way of illustration, the Commissioner regards such common food ingredients as salt, pepper, sugar, vinegar, baking powder, and monosodium glutamate as safe for their intended use. The lists in paragraph (d) of this section include additional substances that, when used for the purposes indicated, in accordance with good manufacturing practice, are regarded by the Commissioner as generally recognized as safe for such uses.

(b) For the purposes of this section, good manufacturing practice shall be defined to include the following restrictions:

1. The quantity of a substance added to food does not exceed the amount reasonably required to accomplish its intended physical, nutritional, or other technical effect in food; and

2. The quantity of a substance that becomes a component of food as a result of its use in the manufacturing, processing, or packaging of food, and which is not intended to accomplish any physical or other technical effect in the food itself, shall be reduced to the extent reasonably possible.

3. The substance is of appropriate food grade and is prepared and handled as a food ingredient. Upon request the Commissioner will offer an opinion, based on specifications and intended use, as to whether or not a particular grade or lot of the substance is of suitable purity for use in food and would generally be regarded as safe for the purpose intended, by experts qualified to evaluate its safety.

(c) The inclusion of substances in the list of nutrients does not constitute a finding on the part of the Department that the substance is useful as a supplement to the diet for humans.

(d) Substances that are generally recognized as safe for their intended use within the meaning of section 409 of the act are as follows:

<table>
<thead>
<tr>
<th>CHEMICAL PRESERVATIVES</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascorbic acid.</td>
<td>Calcium propionate.</td>
</tr>
<tr>
<td>Ascorbyl palmitate.</td>
<td>Erythorbic acid.</td>
</tr>
<tr>
<td>Calcium ascorbate.</td>
<td>Potassium sorbate.</td>
</tr>
</tbody>
</table>


2 Published in the Federal Register: November 20, 1959; 24 F.R. 9368.

3 This order becomes effective 30 days after date of publication.
### CHEMICAL PRESERVATIVES (Continued)

- Propionic acid
- Sodium ascorbate
- Sodium propionate
- Sodium sorbate
- Sorbic acid
- Tocopherols

### BUFFERS AND NEUTRALIZING AGENTS

- Acetic acid
- Magnesium carbonate
- Aluminum ammonium sulfate
- Magnesium oxide
- Aluminum potassium sulfate
- Potassium acid tartrate
- Ammonium bicarbonate
- Potassium bicarbonate
- Ammonium carbonate
- Potassium carbonate
- Ammonium hydroxide
- Potassium citrate
- Ammonium phosphate (mono- and dibasic-)
- Potassium hydroxide
- Calcium carbonate
- Sodium acetate
- Calcium chloride
- Sodium acid pyrophosphate
- Calcium citrate
- Sodium bicarbonate
- Calcium gluconate
- Sodium carbonate
- Calcium hydroxide
- Sodium citrate
- Calcium lactate
- Sodium hydroxide
- Calcium oxide
- Sodium hydrogen carbonate
- Calcium phosphate
- Sodium sesquicarbonate
- Citric acid
- Sulfuric acid
- Lactic acid
- Tartaric acid

### EMULSIFYING AGENTS

- Diacetyl tartaric acid esters of mono- and diglycerides from the glycerolysis of edible fats or oils
- Mono- and diglycerides from the glycerolysis of edible fats or oils
- Monosodium phosphate derivatives of mono- and diglycerides from the glycerolysis of edible fats or oils
- Propylene glycol

### MISCELLANEOUS

- Acetic acid
- Magnesium hydroxide
- Aluminum ammonium sulfate
- Monosodium glutamate
- Aluminum sulfate
- Nitrogen
- Butane
- Papain
- Calcium phosphate, tribasic
- Phosphoric acid
- Caramel
- Propylene glycol
- Carbon dioxide
- Triacetin (glyceryl triacetate)
- Carnauba wax
- Tricalcium phosphate
- Citric acid
- Sodium carbonate
- Glycerin
- Sodium phosphate
- Glycerol monostearate
- Sodium tripolyphosphate
- Helium
- Nontrophic sweeteners
- Magnesium carbonate
- Calcium cyclohexyl sulfamate
- Saccharin
- Sodium cyclohexyl sulfamate
- Saccharin

### NONNUTRITIVE SWEETENERS

- Ascorbic acid
- Carotene
- Calcium carbonate
- Ferric phosphate
- Calcium oxide
- Ferric pyrophosphate
- Calcium pantothenate
- Ferric sodium pyrophosphate
- Calcium phosphate (mono-, di-, tribasic) Ferric sulfate
- Calcium sulfate
- Iron, reduced.
APPENDIX

I-Lysine monohydrochloride.
Niacin.
Nicotinamide.
d-Pantothenyl alcohol.
Potassium chloride.
Pyridoxine hydrochloride.
Riboflavin.
Riboflavin-5-phosphate.
Sodium pantothenate.

APPELDIX

Thiamin hydrochloride.
Thiamin mononitrate.
Tocopherols.
α-Tocopherol acetate.
Vitamin A.
Vitamin A acetate.
Vitamin A palmitate.
Vitamin D₃.
Vitamin B₆.
Sodium pantothenate (mono-, di-, tribasic).

SEQUESTHRANTS

For the purposes of this list, no attempt has been made to designate those sequestrants which may also function as chemical preservatives.

Calcium acetate.
Calcium chloride.
Calcium citrate.
Calcium diacetate.
Calcium gluconate.
Calcium hexametaphosphate.
Calcium phytate.
Citrates.
Dipotassium phosphate.
Disodium phosphate.
Dicalcium acid phosphate.
Imonoisopropyl citrate.
Potassium citrate.
Sodium acid phosphate.
Sodium citrate.
Sodium diacetate.
Sodium gluconate.
Sodium hexametaphosphate.
Sodium metaphosphate.
Sodium phosphate (mono-, di-, tribasic-).
Sodium potassium tartrate.
Sodium pyrophosphate.
Sodium tetrasyrophosphate.
Sodium tripolyphosphate.
Tartaric acid.

STABILIZERS

Agar-agar.
Carob bean gum (locust bean gum).

Product | Tolerance | Specific uses or restrictions
---|---|---
Anticaking agents
Aluminium calcium silicate | 2 per cent | In table salt.
Calcium silicate | 2 per cent | In baking powder.
Magnesium silicate | do | In table salt.
Tricalcium silicate | do | do.
Chemical preservatives
Benzic acid | 0.1 per cent | In edible fats or oils.
Butylated hydroxyanisole | Total content of antioxidants not over 0.05 per cent of fat or oil content, including essential (volatile) oil content of food, | In cheese wraps.
Butylated hydroxytoluene | do | do.
Caprylic acid | Total content of antioxidants not over 0.05 per cent of fat or oil content, including essential (volatile) oil content of the food, | do.
Diallyl thiodipropionate | Total content of antioxidants not over 0.02 per cent of fat or oil content, including essential (volatile) oil content of the food, | do.
Gum guaiac | 0.1 per cent (equivalent antioxidant activity 0.01 per cent) | Not in meats or in food recognizable as a source of vitamin B₁₂.
Potassium bisulfite | do | do.
Potassium metabisulfite | do | do.

Total content of antioxidants not over 0.02 per cent of fat or oil content, including essential (volatile) oil content of the food.
FOOD FLAVORINGS

<table>
<thead>
<tr>
<th>Product</th>
<th>Tolerance</th>
<th>Specific uses or restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEMICAL PRESERVATIVES—Contd.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Propyl gallate</td>
<td>Total content of antioxidants not over 0.02 per cent of fat or oil content, including essential (volatile) oil content of the food.</td>
<td></td>
</tr>
<tr>
<td>Sodium benzoate</td>
<td>0.1 per cent</td>
<td></td>
</tr>
<tr>
<td>Sodium bisulfite</td>
<td></td>
<td>Not in meats or in foods recognizable as a source of vitamin B1.</td>
</tr>
<tr>
<td>Sodium metabisulfite</td>
<td></td>
<td>Do.</td>
</tr>
<tr>
<td>Sodium sulfite</td>
<td></td>
<td>Do.</td>
</tr>
<tr>
<td>Thioglycolic acid</td>
<td>Total content of antioxidants not over 0.02 per cent of fat or oil content, including essential (volatile) oil content of the food.</td>
<td></td>
</tr>
</tbody>
</table>

EMULSIFYING AGENTS

| Cholic acid                                  | 0.1 per cent                                                              | Dried egg whites.            |
| Deyoxycholic acid                           | do                                                                        | Do.                           |
| Glycocholic acid                            | do                                                                        | Do.                           |
| Ox bile extract                             | do                                                                        | Do.                           |
| Taurocholic acid (or its sodium salt)       | do                                                                        | Do.                           |

MISCELLANEOUS

| Caffeine                                     | 0.02 per cent                                                             | In cola type beverages.     |
| Ethyl formate                                | 0.0015 per cent                                                           | As flavoring for cashew nuts. |
| Magnesium stearate                          |                                                                           | As migratory substance from packaging materials when used as a stabilizer. |
| Sorbitol                                     | 7.6 per cent                                                              | In foods for special dietary use. |
| Triethyl citrate                            | 0.25 per cent                                                             | Egg whites.                  |

NUTRIENTS

| Copper gluconate                            | 0.005 per cent                                                            | In table salt as a source of dietary iodine. |
| Cuprous iodide                               | 0.01 per cent                                                             | Do.                                         |
| Potassium iodide                             | do                                                                        | Do.                                         |

SEQUESTRANTS

| Isopropyl citrate                           | 0.02 per cent                                                             | In salt.                                    |
| Sodium thiosulfate                          | 0.1 per cent                                                              | Do.                                         |
| Stearyl citrate                             | 0.15 per cent                                                             | Do.                                         |

For the purpose of this list no attempt has been made to designate those sequestrants which may also function as chemical preservatives.

(c) Spices, seasonings, essential oils, oleoresins, and natural extractives that are generally recognized as safe for their intended use, within the meaning of section 409 of the act, are as follows:

(1) SPICES AND OTHER NATURAL SEASONINGS AND FLAVORINGS (LEAVES, ROOTS, BANKS, BERRIES, ETC.)

<table>
<thead>
<tr>
<th>Common name</th>
<th>Botanical name of plant source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allspice</td>
<td>Pimenta officinalis Lindl.</td>
</tr>
<tr>
<td>Anise</td>
<td>Pimpinella anisum L.</td>
</tr>
<tr>
<td>Anise, star</td>
<td>Illicium verum Hook. f.</td>
</tr>
<tr>
<td>Basil, sweet</td>
<td>Ocimum basilicum L.</td>
</tr>
<tr>
<td>Basil, bush</td>
<td>Ocimum minimum L.</td>
</tr>
<tr>
<td>Bay</td>
<td>Laurus nobilis L.</td>
</tr>
<tr>
<td>Calendula</td>
<td>Calendula officinalis L.</td>
</tr>
<tr>
<td>Carapers</td>
<td>Capsicum frutescens L. or Capsicum annum l.</td>
</tr>
<tr>
<td>Caraway</td>
<td>Carum carvi L.</td>
</tr>
<tr>
<td>Caraway, black (black cumin)</td>
<td>Nigella sativa L.</td>
</tr>
</tbody>
</table>
Cardamon (cardamon)  Elettaria cardamomum Maton.
Cassia, Chinese  Cinnamomum cassia Blume.
Cassia, Padang or Batavia  Cinnamomum burmanni Blume.
Cassia, Saigon  Cinnamomum loureiri Nees.
Cayenne pepper  Capsicum frutescens L. or Capsicum annuum L.
Celery seed  Apium graveolens L.
Chives  Allium schoenoprasum L.
Cinnamon, Ceylon  Cinnamomum zeylanicum Nees.
Cinnamon, Chinese  Cinnamomum cassia Blume.
Cinnamon, Saigon  Cinnamomum loureiri Nees.
Clary (clary sage)  Salvia sclarea L.
Cumin  Cuminum cyllinum L.
Cumin, black (black caraway)  Nigella sativa L.
Dill  Anethum graveolens L.
Fennel, common  Foeniculum vulgare Mill.
Fennel, sweet (finocchio, Florence fennel)  Foeniculum vulgare Mill. var. dulce (DC.) Alef.
Fenugreek  Trigonella foenum-graecum L.
Garlic  Allium sativum L.
Ginger  Zingiber officinale Rosc.
Grains of paradise  Anomum negequeta Rosc.
Horseradish  Armoracia lapathifolia Gilib.
Lavender  Lavandula officinalis C. Chat.
Licorice  Glycyrrhiza glabra L. and other spp. of Glycyrrhiza.
Mace  Myristica fragrans Houtt.
Marigold, pot  Calendula officinalis L.
Marjoram, pot  Majorana officinalis (L.) Benth.
Marjoram, sweet  Majorana hortensis Moench.
Mustard, black or brown  Brassica nigra (L.) Koch.
Mustard, brown  Brassica juncea (L.) Coss.
Mustard, white or yellow  Brassica alba (L.) Boiss.
Nutmeg  Myristica fragrans Houtt.
Oregano (oregano, Mexican oregano, Mexican sage, origan)  Lippia spp.
Paprika  Capsicum annuum L.
Parsley  Petroselinum crispum (Mill.) Mansf.
Pepper, black  Piper nigrum L.
Pepper, cayenne  Capsicum frutescens L. or Capsicum annuum L.
Pepper, red  Do.
Pepper, white  Piper nigrum L.
Peppermint  Mentha piperita L.
Poppies  Papaver somniferum L.
Pot marigold  Calendula officinalis L.
Pot marjoram  Majorana officinalis (L.) Benth.
Rosemary  Rosmarinus officinalis L.
Rue  Ruta graveolens L.
Saffron  Crocus sativus L.
Sage (sage)  Salvia officinalis L.
Savory, summer  Satureja hortensis L. (Satureja).  Satureja hortensis L. (Satureja).
Savory, winter  Satureja montana L. (Satureja).  Satureja montana L. (Satureja).
Sesame  Sesamum indicum L.
Spearmint  Mentha spicata L.
Star anise  Illicium verum Hook. f.
Tarragon  Artemisia dracunculus L.
Thyme  Thymus vulgaris L.
Turmeric  Curcuma longa L.
Vanilla  Vanilla planifolia Andr. or Vanilla tahitensis J. W. Moore
Zedoary  Curcuma zedoaria Roxb.
<table>
<thead>
<tr>
<th>Common name</th>
<th>Botanical name of plant source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allspice</td>
<td>Pimenta officinalis Lodd.</td>
</tr>
<tr>
<td>Almond, bitter (free from prussic acid)</td>
<td>Prunus amygdalus Batsch, Prunus armeniaca L. or Prunus persica (L.) Batsch.</td>
</tr>
<tr>
<td>Angelica root</td>
<td>Angelica archangelica L.</td>
</tr>
<tr>
<td>Angelica stem</td>
<td>Do.</td>
</tr>
<tr>
<td>Angostura (cusparia bark)</td>
<td>Galipea officinalis Hancock.</td>
</tr>
<tr>
<td>Anise</td>
<td>Pimpinella anisum L.</td>
</tr>
<tr>
<td>Asafetida</td>
<td>Ferula assa-foetida L. and related spp. of Ferula.</td>
</tr>
<tr>
<td>Balsam of Peru</td>
<td>Myroxylon pereirae Klotzsch.</td>
</tr>
<tr>
<td>Basil</td>
<td>Ocimum basilicum L.</td>
</tr>
<tr>
<td>Bay leaves</td>
<td>Laurus nobilis L.</td>
</tr>
<tr>
<td>Bay (myrcia oil)</td>
<td>Pimenta racemosa (Mill.) J. W. Moore.</td>
</tr>
<tr>
<td>Bitter almond (free from prussic acid)</td>
<td>Prunus amygdalus Batsch, Prunus armeniaca L., or Prunus persica (L.) Batsch.</td>
</tr>
<tr>
<td>Bois de rose</td>
<td>Aniba rosaeodora Dudee.</td>
</tr>
<tr>
<td>Camanga</td>
<td>Camanga odorata Hook. f. and Thoms.</td>
</tr>
<tr>
<td>Capsicum</td>
<td>Capsicum frutescens L. and Capsicum annuum L.</td>
</tr>
<tr>
<td>Caraway</td>
<td>Carum carvi L.</td>
</tr>
<tr>
<td>Cardamon seed (cardamon)</td>
<td>Elettaria cardamomum Maton.</td>
</tr>
<tr>
<td>Carob bean</td>
<td>Ceratonia siliquea L.</td>
</tr>
<tr>
<td>Cascarilla bark</td>
<td>Croton eluteria Benn.</td>
</tr>
<tr>
<td>Cassia bark, Chinese</td>
<td>Cinnamomum cassia Blume.</td>
</tr>
<tr>
<td>Cassia bark, Padang or Batavia</td>
<td>Cinnamomum burmanni Blume.</td>
</tr>
<tr>
<td>Cassia bark, Saigon</td>
<td>Cinnamomum loureirii Nees.</td>
</tr>
<tr>
<td>Celery seed</td>
<td>Apium graveolens L.</td>
</tr>
<tr>
<td>Chamomile flowers, Hungarian</td>
<td>Matricaria chamomilla L.</td>
</tr>
<tr>
<td>Chamomile flowers, Roman or English (camomile)</td>
<td>Anthemis nobilis L.</td>
</tr>
<tr>
<td>Cherry, wild, bark</td>
<td>Prunus serotina Ehrl.</td>
</tr>
<tr>
<td>Chicory</td>
<td>Chichorium intybus L.</td>
</tr>
<tr>
<td>Cinnamon bark, Ceylon</td>
<td>Cinamomum zeylanicum Nees.</td>
</tr>
<tr>
<td>Cinnamon bark, Chinese</td>
<td>Cinamomum cassia Blume.</td>
</tr>
<tr>
<td>Cinnamon bark, Saigon</td>
<td>Cinamomum loureirii Nees.</td>
</tr>
<tr>
<td>Cinnamon leaf, Ceylon</td>
<td>Cinamomum zeylanicum Nees.</td>
</tr>
<tr>
<td>Cinnamon leaf, Chinese</td>
<td>Cinamomum cassia Blume.</td>
</tr>
<tr>
<td>Cinnamon leaf, Saigon</td>
<td>Cinamomum loureirii Nees.</td>
</tr>
<tr>
<td>Citronella</td>
<td>Cymbopogon nardus Rendle.</td>
</tr>
<tr>
<td>Citrus peels</td>
<td>Citrus spp.</td>
</tr>
<tr>
<td>Clary (clary sage)</td>
<td>Salvia sclarea L.</td>
</tr>
<tr>
<td>Clove bud</td>
<td>Eugenia caryophyllata Thumb.</td>
</tr>
<tr>
<td>Clove leaf</td>
<td>Do.</td>
</tr>
<tr>
<td>Clove stem</td>
<td>Eugenia caryophyllata Thumb.</td>
</tr>
<tr>
<td>Coca (decoainized)</td>
<td>Erythroxylum coca Lam. and other spp. of Erythroxylum.</td>
</tr>
<tr>
<td>Coffee</td>
<td>Coffea spp.</td>
</tr>
<tr>
<td>Cola nut</td>
<td>Cola acuminata Schott and Endl., and other spp. of Cola.</td>
</tr>
<tr>
<td>Coriander</td>
<td>Coriandrum sativum L.</td>
</tr>
<tr>
<td>Cumin (cummin)</td>
<td>Cuminum cyminum L.</td>
</tr>
<tr>
<td>Cusparia bark</td>
<td>Galipea officinalis Hancock.</td>
</tr>
<tr>
<td>Dill</td>
<td>Anethum graveolens L.</td>
</tr>
<tr>
<td>Estragole (esdragol, esdragon, tarragon)</td>
<td>Artenisia dracunculus L.</td>
</tr>
<tr>
<td>Fennel, sweet</td>
<td>Foeniculum vulgare Mill.</td>
</tr>
<tr>
<td>Fennugreek</td>
<td>Trigonella foenum-graecum L.</td>
</tr>
<tr>
<td>Garlic</td>
<td>Allium sativum L.</td>
</tr>
</tbody>
</table>
### APPENDIX

<table>
<thead>
<tr>
<th>Plant</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geranium, East Indian</td>
<td>Cymbopogon martini Stapf.</td>
</tr>
<tr>
<td>Geranium, rose</td>
<td>Pelargonium graveolens L'Her.</td>
</tr>
<tr>
<td>Ginger</td>
<td>Zingiber officinale Rose.</td>
</tr>
<tr>
<td>Glycyrrhiza</td>
<td>Glycyrrhiza glabra L. and other spp. of Glycyrrhiza.</td>
</tr>
<tr>
<td>Grapefruit</td>
<td>Citrus paradisi.</td>
</tr>
<tr>
<td>Guava</td>
<td>Psidium spp.</td>
</tr>
<tr>
<td>Hoarhound</td>
<td>Marrubium vulgare L.</td>
</tr>
<tr>
<td>Hops</td>
<td>Humulus lupulus L.</td>
</tr>
<tr>
<td>Jasmine</td>
<td>Jasminum officinale L. and other spp. of Jasminum</td>
</tr>
<tr>
<td>Juniper (berries)</td>
<td>Juniperus communis L.</td>
</tr>
<tr>
<td>Kola nut</td>
<td>Cola acuminata Schott and Endl., and other spp. of</td>
</tr>
<tr>
<td>Laurel leaves</td>
<td>Laurus nobilis L.</td>
</tr>
<tr>
<td>Lavender</td>
<td>Lavandula officinalis Chaix.</td>
</tr>
<tr>
<td>Lavender, spike</td>
<td>Lavandula latifolia Vill.</td>
</tr>
<tr>
<td>Lavandin</td>
<td>Hybrids between Lavandula officinalis Chaix and</td>
</tr>
<tr>
<td></td>
<td>Lavandula latifolia Vill.</td>
</tr>
<tr>
<td>Lemon</td>
<td>Citrus Linon (L.) Burm. f.</td>
</tr>
<tr>
<td>Lemon grass</td>
<td>Cymbopogon citratus DC. and Cymbopogon flexuosus Stapf.</td>
</tr>
<tr>
<td>Lichene</td>
<td>Glycyrrhiza glabra L. and other spp. of Glycyrrhiza.</td>
</tr>
<tr>
<td>Lime</td>
<td>Citrus aurantifolia Swingle.</td>
</tr>
<tr>
<td>Locust bean</td>
<td>Ceratonia siliqua L.</td>
</tr>
<tr>
<td>Mace</td>
<td>Myristica fragrans Houtt.</td>
</tr>
<tr>
<td>Mandarin</td>
<td>Citrus reticulata Blanco.</td>
</tr>
<tr>
<td>Marjoram, sweet</td>
<td>Majorana hortensis Moench.</td>
</tr>
<tr>
<td>Maté</td>
<td>Ilex paraguariensis St. Hil.</td>
</tr>
<tr>
<td>Mustard</td>
<td>Brassica spp.</td>
</tr>
<tr>
<td>Nerito</td>
<td>Citrus paradisi Macf.</td>
</tr>
<tr>
<td>Neroli, bigarade</td>
<td>Citrus aurantium L.</td>
</tr>
<tr>
<td>Nutmeg</td>
<td>Myristica fragrans Houtt.</td>
</tr>
<tr>
<td>Onion</td>
<td>Allium cepa L.</td>
</tr>
<tr>
<td>Orange, bitter, flowers</td>
<td>Citrus aurantium L.</td>
</tr>
<tr>
<td>Orange leaf</td>
<td>Citrus sinensis (L.) Osbeck.</td>
</tr>
<tr>
<td>Orange, bitter, peel</td>
<td>Citrus aurantium L.</td>
</tr>
<tr>
<td>Orange, sweet</td>
<td>Citrus sinensis (L.) Osbeck.</td>
</tr>
<tr>
<td>Origanum</td>
<td>Origanum spp.</td>
</tr>
<tr>
<td>Palmarosa</td>
<td>Cymbopogon martini Stapf.</td>
</tr>
<tr>
<td>Paprika</td>
<td>Capsicum annuum L.</td>
</tr>
<tr>
<td>Parsley</td>
<td>Petroselnum crispum (Mill.) Mansf.</td>
</tr>
<tr>
<td>Pepper, black</td>
<td>Piper nigrum L.</td>
</tr>
<tr>
<td>Pepper, white</td>
<td>Piper nigrum L.</td>
</tr>
<tr>
<td>Peppermint</td>
<td>Mentha piperita L.</td>
</tr>
<tr>
<td>Peruvian balsam</td>
<td>Myroxylon pereirae Klotzsch.</td>
</tr>
<tr>
<td>Petitgrain</td>
<td>Citrus aurantium L.</td>
</tr>
<tr>
<td>Petitgrain lemon</td>
<td>Citrus limon (L.) Burm. f.</td>
</tr>
<tr>
<td>Petitgrain mandarin or tangerine</td>
<td>Citrus reticulata Blanco.</td>
</tr>
<tr>
<td>Pimenta</td>
<td>Pimenta officinalis Lindl.</td>
</tr>
<tr>
<td>Pimenta leaf</td>
<td>Do.</td>
</tr>
<tr>
<td>Pistissequa leaves</td>
<td>Chinarhaphia umbellata Nutt.</td>
</tr>
<tr>
<td>Pomegranate</td>
<td>Punica granatum L.</td>
</tr>
<tr>
<td>Prickly ash bark</td>
<td>Xanthoxylum (or Zanthoxylum) Americanum Mill.</td>
</tr>
<tr>
<td></td>
<td>or Xanthoxylum clava-herculis L.</td>
</tr>
<tr>
<td>Rose absolute</td>
<td>Rosa alba L., centifolia L., Rosa damascena Mill.,</td>
</tr>
<tr>
<td></td>
<td>Rose gallica L., and vars. of these spp.</td>
</tr>
<tr>
<td>Rose (otto of roses, attar of roses)</td>
<td>Do.</td>
</tr>
<tr>
<td>Rose geranium</td>
<td>Pelargonium graveolens L'Her.</td>
</tr>
<tr>
<td>Rosemary</td>
<td>Rosmarinus officinalis L.</td>
</tr>
<tr>
<td>Rue</td>
<td>Ruta graveolens L.</td>
</tr>
<tr>
<td>Saffron</td>
<td>Crocus sativus L.</td>
</tr>
<tr>
<td>Sage</td>
<td>Salvia officinalis L.</td>
</tr>
<tr>
<td>Sage, Spanish</td>
<td>Salvia lavandulafolia Vahl.</td>
</tr>
</tbody>
</table>
This order became effective on the date of publication. The following paragraph excerpted from the order is reprinted for your information:

Pursuant to the authority vested in the Secretary of Health, Education, and Welfare by the Federal Food, Drug, and Cosmetic Act (secs. 409, 701, 52 Stat. 1055, 72 Stat. 1785; 21 U.S.C. 348, 371) and delegated to the Commissioner of Food and Drugs by the Secretary (23 F.R. 9500), and after having considered all comments on the proposed order published in the Federal Register of April 21, 1959 (24 F.R. 3055), containing a list of spices, seasonings, essential oils, oleoresins, and natural extractives generally recognized as safe within the meaning of section 409 of the act, the Commissioner has concluded that the substances in that list, with the exception of cinchona bark (red), cinchona bark (yellow), orris root, orris (concrete, liquid), quinine, wintergreen, and methyl salicylate are generally recognized as safe. The failure to include these substances in the list published in this order does not indicate that these substances as they are used for flavoring are not safe. However, it is concluded that in the case of the first five there is not a general recognition of their safety without adequate restrictions being placed upon their use as flavoring agents, through the promulgation of appropriate regulations. In the case of methyl salicylate and wintergreen, it was decided to delay any determination on the question of general recognition of safety pending the completion of pharmacological studies of methyl salicylate. These studies have been underway for some time and are nearly completed.
Composition of Vanilla and Other Extracts

One U.S. gallon of vanilla extract should contain the soluble matter from not less than 13.35 ounces (avoirdupois) of vanilla beans. Some manufacturers use only 12.8 ounces of vanilla beans per gallon, in the mistaken belief that this quantity is proper. The finished flavor should contain at least 35 per cent of alcohol by volume to keep this soluble matter in solution.

Pending the establishment of standards for specific flavoring oils and extracts, the following articles should have the composition indicated in each case.

**Almond Extract.**—The flavoring extract prepared from oil of bitter almonds, free from hydrocyanic acid. It contains not less than one per cent by volume of oil of bitter almonds.

**Oil of Bitter Almonds, Commercial.**—The volatile oil obtained from the seed of the bitter almond (*Amygdalus communis* L.), the apricot (*Prunus armeniaca* L.), or the peach (*Amygdalus persica* L.).

**Anise Extract.**—The flavoring extract prepared from oil of anise. It contains not less than three per cent by volume of oil of anise.

**Oil of Anise.**—The volatile oil obtained from aniseed.

**Celery Seed Extract.**—The flavoring extract prepared from celery seed or the oil of celery seed, or both. It contains not less than 0.3 per cent by volume of oil of celery seed.

**Oil of Celery Seed.**—The volatile oil obtained from celery seed.

**Cinnamon Extract, Cassia Extract, Cassia Cinnamon Extract.**—The flavoring product prepared from oil of cinnamon. It contains not less than two per cent by volume of oil of cinnamon.

**Oil of Cinnamon, Oil of Cassia, Oil of Cinnamon.**—The lead-free volatile oil obtained from the leaves or bark of *Cinnamomum cassia* (L.) Blume. It contains not less than 80 per cent by volume of cinnamic aldehyde.

**Ceylon Cinnamon Extract.**—The flavoring extract prepared from oil of Ceylon cinnamon. It contains not less than two per cent by volume of oil of Ceylon cinnamon.

**Oil of Ceylon Cinnamon.**—The lead-free volatile oil obtained from the bark of the Ceylon cinnamon (*Cinnamomum zeylanicum* Nees). It contains not less than 65 per cent by weight of cinnamic aldehyde and not more than 10 per cent by weight of eugenol.

**Clove Extract.**—The flavoring extract prepared from oil of cloves. It contains not less than two per cent by volume of oil of cloves.

**Oil of Cloves.**—The lead-free volatile oil obtained from cloves.

**Ginger Extract.**—The flavoring extract prepared from ginger. It contains in each 100 cubic centimeters the alcohol-soluble matters from not less than 20 grains of ginger.

**Lemon Extract.**—The flavoring extract prepared from oil of lemon, or from lemon peel, or both. It contains not less than five per cent by volume of oil of lemon.

**Oil of Lemon.**—The volatile oil expressed, without the aid of heat, from the fresh peel of the lemon (*Citrus limonia* Osbeck), with or without previous separation of the pulp and peel.
Terpeneless Extract of Lemon.—The flavoring extract prepared by shaking oil of lemon with dilute alcohol, or by dissolving terpeneless oil of lemon in dilute alcohol. It contains not less than 0.2 per cent by weight of citral derived from oil of lemon.

Terpeneless Oil of Lemon.—Oil of lemon from which all or nearly all of the terpenes have been removed.

Nutmeg Extract.—The flavoring extract prepared from oil of nutmeg. It contains not less than two per cent by volume of oil of nutmeg.

Oil of Nutmeg.—The volatile oil obtained from nutmogs.

Orange Extract.—The flavoring extract prepared from oil of orange, or from orange peel, or both. It contains not less than five per cent by volume of oil of orange.

Oil of Orange.—The volatile oil obtained, by expression or alcoholic solution, from the fresh peel of the orange (Citrus aurantium L.). It has an optical rotation (at 77°F.) of not less than +95° in a 100-millimeter tube.

Terpeneless Extract of Orange.—The flavoring extract prepared by shaking oil of orange with dilute alcohol, or by dissolving terpeneless oil of orange in dilute alcohol. It corresponds in flavoring strength to orange extract.

Terpeneless Oil of Orange.—Oil of orange from which all or nearly all of the terpenes have been removed.

Peppermint Extract.—The flavoring extract prepared from oil of peppermint, or from peppermint, or both. It contains not less than three per cent by volume of oil of peppermint.

Peppermint.—The leaves and flowering tops of Mentha piperita L.

Oil of Peppermint.—The volatile oil obtained from peppermint. It contains not less than 50 per cent by weight of menthol.

Rose Extract.—The flavoring extract prepared from attar of roses, with or without red rose petals. It contains not less than 0.4 per cent by volume of attar of roses.

Attar of Roses.—The volatile oil obtained from the petals of Rosa Damascena Mill., R. centifolia L., or R. moschata Herm.

Savory Extract.—The flavoring extract prepared from oil of savory, or from savory, or both. It contains not less than 0.35 per cent by volume of oil of savory.

Oil of Savory.—The volatile oil obtained from savory.

Spearmint Extract.—The flavoring extract prepared from oil of spearmint, or from spearmint, or both. It contains not less than three per cent by volume of oil of spearmint.

Spearmint.—The leaves and flowering tops of Mentha spicata L.

Oil of Spearmint.—The volatile oil obtained from spearmint.

Star Anise Extract.—The flavoring extract prepared from oil of star anise. It contains not less than three per cent by volume of oil of star anise.

Oil of Star Anise.—The volatile oil distilled from the fruit of the star anise (Illicium verum Hook.).

Sweet Basil Extract.—The flavoring extract prepared from oil of sweet basil, or from sweet basil, or both. It contains not less than 0.1 per cent by volume of oil of sweet basil.

Sweet Basil, Basil.—The leaves and tops of Ocimum basilicum L.

Oil of Sweet Basil.—The volatile oil obtained from basil.

Sweet Marjoram Extract, Marjoram Extract.—The flavoring extract prepared
from the oil of marjoram, or from marjoram, or both. It contains not less than one per cent by volume of oil of marjoram.

Oil of Marjoram.—The volatile oil obtained from marjoram.

Thyme Extract.—The flavoring extract prepared from oil of thyme, or from thyme, or both. It contains not less than 0.2 per cent by volume of oil of thyme.

Oil of Thyme.—The volatile oil obtained from thyme.

Tonka Extract.—The flavoring extract prepared from tonka bean, with or without one or more of the following: Sugar, dextrose, glycerin. It contains not less than 0.1 per cent by weight of coumarin extracted from the tonka bean, together with a corresponding proportion of the other soluble matters thereof.

Tonka Bean.—The seed of *Coumaronia odorata* Aublet (*Dipteryx odorata* (Aubl.) Wild.).

Vanilla Extract.—The flavoring extract prepared from vanilla bean, with or without one or more of the following: Sugar, dextrose, glycerin. It contains in 100 cubic centimeters the soluble matters from not less than 10 grains of the vanilla bean.

Vanilla Bean.—The dried, cured fruit of *Vanilla fragrans* (Salisb. Ames (*V. planifolia* Andr.).

Wintergreen Extract.—The flavoring extract prepared from oil of wintergreen. It contains not less than three per cent by volume of oil of wintergreen.

Oil of Wintergreen.—The volatile oil distilled from the leaves of *Galium procumbens* L.

### Vanilla and Vanillin Flavor

The name “Vanilla and Vanillin Flavor” implies that approximately as much of the total flavor of the product is due to true vanilla as to vanillin. Such a name should not be applied to an article that owes its flavor chiefly to vanillin. We have found that a standard vanilla extract is equivalent in flavoring strength, though not necessarily in flavoring quality, to a seven-tenths of one per cent vanillin solution. Expressed in another way, 1 pound of vanilla beans has a flavoring strength equivalent to about 1 1/8 ounces of vanillin. We also established that 1 part of coumarin is equivalent in flavoring strength to 3 parts of vanillin, that 1 part of heliotropine or piperonal is equivalent in flavoring strength to 2 parts of vanillin, and that a standard tonka extract is equivalent in flavoring strength to a three-tenths of one per cent (0.37%) vanillin solution.

In the light of the foregoing results, it is a simple matter to construct formulas for flavoring products of different strengths that can be legitimately designated “Vanilla and Vanillin Flavor.” For example, if a manufacturer desires to make a product of this type equal in flavoring strength to vanilla extract, he should use one-half gallon of vanilla extract (13.35 ounces of beans per gallon) and one-half gallon of seven-tenths of one per cent vanillin solution (0.93 ounce of vanillin per gallon). For a double-strength extract of this type he should dissolve 0.93 ounce of vanillin in 1 gallon of standard vanilla extract. For higher concentration it is necessary to use a concentrated vanilla extract or a vanilla oleoresin in order to obtain a proper proportion of true vanilla.

### Summary of Relative Flavoring Strengths

The relative flavoring strengths of the ordinary constituents of imitation vanilla flavors have been determined organoleptically in the laboratories of the Food and Drug Administration and found to be as follows:
Any harmless vegetable dye may be used in flavors or other food. There is no system of certification in the case of vegetable dyes.

The presence of a certified coal-tar color may be shown on the label by the words, “Artificially colored,” “Certified color,” or merely “Color added.”

Information regarding certification and labeling of coal-tar colors is contained in Service and Regulatory Announcement, SRA, F.C.C. 3, which will be sent on request.

The presence of caramel may be declared on the labels of flavors as “Colored with caramel,” “Caramel color,” or “Artificially colored.”

Chemical Preservative

The presence of benzoate of soda may be declared as “Preserved with 0.1 per cent benzoate of soda,” if that proportion is present, or as “Preserved with benzoate of soda.”

Artificial Flavoring

The use of synthetic flavoring ingredients in a flavor will usually result in causing the flavor to be classed as an imitation. This is especially the case when the flavor is artificially colored.

Where Label Statements Must Appear

In general, all required information should appear on the main display panel of bottle and carton. If more than one panel is used for display, the required information should appear on each. This statement applies to the name and address of manufacturer, distributor or packer, the quantity of contents, name of the product, list of ingredients when required, declaration of artificial color, added preservative, and imitation character. For qualifications of this general statement see Regulations, section 403 (e) and (f).

Use of Menstruums Other Than Ethyl Alcohol and Vegetable Oils

There is no objection to the use of edible vegetable oils such as corn oil and peanut oil, as vehicles for non-alcoholic flavors, provided the oils contain no impurities that might render the products injurious to health and provided suitable labeling is employed.

Glycerin

There is no objection to the use of the usual small quantities of glycerin in food products provided it is of a purity suitable for food use and provided its presence is plainly declared in the labeling when required by the act.

Other “Alcohol Substitutes”

A number of chemicals have been proposed for use in place of alcohol in the manufacture of flavors. These so-called “alcohol substitutes” have either been shown to be toxic to such a degree that food flavors containing them would be classed as adulterated under the act, or their freedom from toxic properties has not been demonstrated with that degree of finality which would warrant sanction of their use under all conditions.
Responsibility for Use of Questionable Vehicles or Menstruums

The responsibility for the use as vehicles in extracts, in place of alcohol, of chemicals that have not been thoroughly investigated as to their physiological action, must be assumed by the manufacturer. Only those substances found wholesome through adequate investigations by competent pharmacologists should be used.

State Laws

State laws may contain additional requirements for the labeling of flavors and extracts or different ones than those set forth here. For instance, the Federal Food, Drug, and Cosmetic Act does not require a statement of the proportion of alcohol on the labels of flavoring extracts used exclusively for food purposes, although certain State laws make this requirement. A list of State food officials will be forwarded upon request. Information regarding State laws and regulations should be obtained direct from the State officials.

Approval of Labeling

Neither the Administration nor the Agency is authorized to approve labels of flavors. If manufacturers will submit specimens of labels of which they are in doubt as to proper legal form, the Administration will be glad to comment upon them from the standpoint of the act, provided a complete quantitative statement of the composition of the article is also submitted. However, absence of comment should not be construed as approval of the label for the reasons just mentioned.
Summary

Vanilla and other plant extracts were applied to Whatman No. 1 filter paper and chromatographed in one dimension with a solvent containing potassium hydroxide (20 gm.), sodium bromide (100 gm.), and ethanol (200 ml.) made up to 1 liter with water, a solvent containing isopropanol (240 ml.), concentrated ammonium hydroxide (150 ml.), sodium bromide (84 gm.), and water (150 ml.), and a solvent containing acetic acid, hydrochloric acid, and water in a 30:30:10 ratio. When viewed under ultra-violet light, fluorescent patterns were seen that were characteristic of the plant extracts. This provided a method for identifying materials of botanical origin that was found to be useful for characterizing vanilla extracts and establishing the presence of many adulterants. In addition, the intensity of fluorescence was proportional to concentration so that dilution of the product could be detected. Four out of seven samples of household vanilla extracts that were examined were obviously diluted, and the patterns of the other three were somewhat weaker than usually obtained on authentic vanilla extract. Seven out of 13 industrial ten-fold extracts were adulterated, four were suspected of adulteration, one was grossly diluted, and one gave an authentic but slightly weak fluorescent pattern.

Introduction

Authentic single-fold vanilla extract is the extract of 10 grams of the cured unripe fruit of *Vanilla planifolia* Andrews or *V. tahitensis* Moore in 100 ml. of solution. The solvent is usually 35 per cent alcohol, but it may also contain added sucrose, glycerin, or propylene glycol. The ten-fold vanilla extracts used in the baking and dairy industries are supposed to be single-fold extracts concentrated to one-tenth the original volume. However, because of the high and fluctuating price of vanilla beans, some manufacturers market products which are adulterated with foreign botanicals to increase color, lead number, and resin content. Many of these malpractices can be detected by quantitative methods of analysis, but the need still exists for a simple screening procedure by which large numbers of samples can be sorted according to quality in advance of more detailed evaluation. This can be accomplished by paper chromatography.

Materials and Methods

Extracts and Reagents.—Commercial ten-fold and household vanilla extracts and fluid extracts of hickory bark, angostura, St. John’s-wort, cherry bark, black walnut, cascara, etc. containing the soluble components of 100 gm. of the products in 100 ml. of solution were supplied by the Scientific Research Co.

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From Burchfield and Prill (1960), Copyrighted Boyce Thompson Institute for Plant Research, Inc., and reprinted by permission of the copyright owner.
mittee of the Flavoring Extract Manufacturers' Association. Plant extracts other than vanilla were tested at a concentration of ten per cent of the fluid extract in aqueous alcohol. The preparation of authentic vanilla extracts and manufacturing-type vanilla extracts has been described elsewhere (Burchfield and Prill 1959).

The principal solvent used for chromatography contained 20 gm. of KOH, 100 gm. of NaBr, and 200 ml. of absolute ethanol diluted to 1 liter with water. With the exception of the NaBr, which was added to decrease the rate of travel of the solvent front, this combination was identical to a mixture suggested by Mitchell. The isopropanol-NaBr-ammonia solvent contained 240 ml. of isopropanol, 150 ml. of concentrated NH$_4$OH, 84 gm. of NaBr, and 450 ml. of water. The third solvent contained acetic acid, hydrochloric acid (37 per cent), and water in a 30:3:10 ratio (2).

The reagent used for extracting the fluorescent pigments from vanilla was a two per cent conclusion of N,N-dimethyldodecylamine (Eastman P5829) in chloroform.

Chromatograms were viewed in a dark room using long wavelength ultraviolet Model XX15 Black ray lamps. These are obtainable from Ultra-Violet Products Inc., San Gabriel, Calif.

fig. 27. CHROMATOGRAPHIC PATTERNS OF VANILLA EXTRACT

Developed with KOH-NaBr-ethanol obtained on eight authentic vanilla extracts prepared from (F-1) Madagascar thirds, (F-2) Guadeloupe beans, one-half whole and one-half splits, (F-3) Mexican medianas, (F-4) Reunion seconds, (F-5) Comores thirds, (F-6) Tahiti one-half white label and one-half yellow label, (F-7) split Bourbon fourths, new crop, and (F-8) whole Bourbon thirds, new crop.
Procedure

Samples of vanilla extract at five-fold strength were applied to 18 1/8 X 221/4 inch Whatman No. 1 paper as described previously (2). To examine single-strength extracts containing sucrose and other additives such as glycerin and propylene glycol, the extracts were concentrated on the paper by applying five aliquots of 10μ each to the same location, the paper being dried carefully between applications with a hair drier to prevent spreading of the spots. The samples were spaced 2.5 inches apart in a row parallel to the long edge (221/4 inches) of the paper, and development with solvent was carried out perpendicular to the machine direction of the paper.

<table>
<thead>
<tr>
<th>Region Number</th>
<th>Chromatogram Approximate Rf</th>
<th>Color Under Ultra Violet Radiation</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>XII</td>
<td>0.96</td>
<td>Brown (visible)</td>
<td>Sometimes unresolved in the presence of sugar</td>
</tr>
<tr>
<td>XI</td>
<td>0.97-0.96</td>
<td>White</td>
<td>Diffuse and very faint</td>
</tr>
<tr>
<td>X</td>
<td>0.76</td>
<td>Blue-black</td>
<td>Absorpt spot arising from vanillin</td>
</tr>
<tr>
<td>IX</td>
<td>0.71</td>
<td>Blue</td>
<td>Sometimes unresolved from XI, intense in Tahiti</td>
</tr>
<tr>
<td>VIII</td>
<td>0.61-0.69</td>
<td>Yellow-white to yellow-green</td>
<td>Present in all authentics</td>
</tr>
<tr>
<td>VII</td>
<td>0.57</td>
<td>White</td>
<td>Sometimes indistinguishable from background</td>
</tr>
<tr>
<td>VI-VII</td>
<td>0.37-0.53</td>
<td>Yellow-white to yellow-green</td>
<td>Present in all authentics</td>
</tr>
<tr>
<td>V</td>
<td>0.66</td>
<td>Yellow/orange</td>
<td>X, Y, VI sometimes unresolved especially on small papers</td>
</tr>
<tr>
<td>IV</td>
<td>0.30-0.35</td>
<td>White</td>
<td>Present in all authentics</td>
</tr>
<tr>
<td>III</td>
<td>0.27</td>
<td>White</td>
<td>Present but always present except for Tahiti</td>
</tr>
<tr>
<td>II</td>
<td>0.07-0.24</td>
<td>White</td>
<td>Diffuse</td>
</tr>
<tr>
<td>I</td>
<td>0.02</td>
<td>White</td>
<td>More brilliant than II</td>
</tr>
</tbody>
</table>

Courtesy of Boyce Thompson Institute for Plant Research, Inc.

FIG. 28. SCHEMATIC DIAGRAM OF COMPOSITE CHROMATOGRAM

Obtained on authentic vanilla extracts using KOH-NaBr-ethanol for development.
Fig. 29. Chromatographic Patterns of Guadalupan Vanilla Extract

Applied to paper in different ways and developed with KOH-NaBr-ethanol. FC-2 applied as a five-fold concentrate without added sucrose. FCS-2 applied as a five-fold concentrate with added sucrose. FES-2 applied as a chloroform-amine extract. FLS-2 pigments isolated by precipitation with basic lead acetate. F-2 applied as single-fold without sucrose by multiple spotting. FS-2 applied as single-fold with sucrose by multiple spotting. FP-2 contained 20 per cent propylene glycol and was applied by multiple spotting. FG-2 contained 20 per cent glycerol and was applied by multiple spotting.

It is necessary to examine the papers under fluorescent light before they were dried to avoid missing some details which faded on longer standing. In cases where the papers were rechromatographed in the same solvent, 16 hours were sufficient for the second development.

Samples which contained added sucrose were sometimes extracted with chloroform-amine reagents to avoid the retarding effects of this material on Rf values. A 10-ml. sample of vanilla at single-fold strength was extracted with 2 ml. of the reagent, and 10\(\lambda\) of the lower (chloroform) layer spotted on paper. For more detailed examinations three extractions were made and the combined lower layers evaporated and redissolved in two ml. of chloroform. The supernatant alcohol-water mixture was next evaporated and redissolved in 2 ml. of 50 per cent ethanol. A 10\(\lambda\) aliquot of each fraction was then spotted on paper and chromatographed.

Results on Vanilla and Other Plant Extracts

When vanilla and other plant extracts are chromatographed on paper and examined under ultraviolet light, patterns are obtained that can be used as criteria of identity. Whatman No. 1 filter paper is used, while the most useful solvents so far discovered are KOH-NaBr-ethanol, isopropanol-NaBr-ammonia, and acetic acid-hydrochloric acid-water, in that order. The usual procedure is
FIG. 30. CHROMATOGRAPHIC PATTERNS OF AUTHENTIC VANILLA EXTRACT

Containing added sugar when developed with acetic acid-hydrochloric acid.
A. Mexican buena cuts; B. Guadeloupe (half splits, half cuts); C. Bourbon thirds, D. Reunion, E. Mexican medianas, F. Comores, G. Tahiti, and H. Dominican beans

to spot 10A of a five-fold concentrate of vanilla extract on paper and chromatograph with one or the other of these solvents by the ascending or descending method.

When viewed under ultraviolet radiation, authentic vanilla extracts prepared from Mexican and Bourbon beans give chromatographic patterns that differ only in minor detail (Fig. 27). Tahiti extract contains a material which gives rise to a bright blue fluorescent spot at Rf 0.7 when the paper is developed with KOH-NaBr-ethanol. The color of this spot is not so intense in other extracts. Vanilla prepared from Tahiti beans can also be distinguished from other extracts by chromatographing in isobutanol-acetic acid (Burchfield et al. 1958) or by gas chromatography (Burchfield and Prill 1959).

A schematic diagram of the fluorescent pattern obtained on chromatographing vanilla extract with KOH-NaBr-ethanol is shown in Fig. 28. This pattern with minor variations was produced by 20 extracts from vanilla beans representing the principal growing areas of the world, as well as by a large number of extracts believed to be authentic but which were prepared in other laboratories (Prill et al. 1960).

Region I is an oblong spot with an Rf value of 0.02. It is white in color, fluoresces with moderate intensity and is present in all authentic vanilla extracts that were tested. Region II is a diffuse white streak that fluoresces with low intensity. The spot III at Rf 0.27 is white. Although weak, it is well defined and is present in all authentic Mexican and Bourbon extracts. However, it is barely distinguishable from background fluorescence in extracts of Tahiti beans. The zone IV is diffuse and exhibits fluorescence similar to II. Regions V and VI are brilliant orange to orange yellow bands with Rf values in the
FIG. 31. PATTERNS OF BOURBON (THIRDS) VANILLA EXTRACT

Prepared in different ways and chromatographed with KOH-NaBr-ethanol. 
MC-2: Extracted 2 hours at 120°F. MC-12: Autoclaved for 2.5 hours at 15 p.s.i. 
MC-7: Extracted for 2 hours at 173°F. in presence of KHCO₃. 
MC-6: Extracted for 2 hours at 173°F. in presence of K₂CO₃. 
MC-4: Extracted for 2 hours at 173°F. in presence of KOH at a pH of 6.1 to 6.6. 
MC-8: Extracted with isopropanol in presence of KOH. 
MC-5: Same as MC-4 except the pH range was 7.1 to 8.4. 
MC-20: Extract prepared from exhausted beans.

neighborhood of 0.36. Many plants contain components which fluoresce in this region, and in some cases the emitted light is brilliant blue in color. Sometimes these materials are easily seen in the presence of vanilla, but more often it is necessary to develop the chromatogram a second time in the same solvent to obtain satisfactory resolution in this region. These components are always present in authentic vanilla extracts, and they fluoresce with high intensity. When they are absent or fluoresce weakly, it is almost certain that a full weight of vanilla beans has not been used. Region VII is a zone of diffuse fluorescence which is more intense than II and IV. Region VIII appears as a moderately intense white spot with an Rf of 0.57. It is present in most authentic extracts, but in some cases it is barely distinguishable from the diffuse fluorescent zones above and below it. The resolution of VIII can be improved by extracting the fluorescent pigments from the vanilla with chloroform-amine reagent before spotting them on paper. Apparently this solvent removes the compound responsible for the fluorescence at VIII more readily than it does the materials responsible for the background. This results in better contrast (Fig. 29). IX is a region of strong general fluorescence while X is a blue spot. Sometimes X is not resolved from XI, and it is necessary to develop the paper a second time. As mentioned before, X is very brilliant on chromatograms of Tahiti extracts, but it is uncertain whether it arises from the...
same compound that appears at this Rf value with Mexican and Bourbon extracts. Although X is not resolved in all authentic extracts, its presence is a good indication that vanilla beans have been used in substantial amounts. XI is a blue-black spot which is caused by the absorption of light by vanillin. This has been demonstrated by co-chromatography with a known sample of this chemical. XI serves as a useful landmark, but its presence has no special significance in assessing quality since it can be added at will to extracts. Region XII is a diffuse spot with very weak white fluorescence, while XIII is a compact brown spot visible under ordinary illumination. Sometimes XIII is not observed in samples having high sugar content. In such instances it can often be resolved by developing the paper a second time in the same solvent.

Good separation of some of the components of vanilla extracts can be obtained in other solvents. Thus isopropanol-NaBr-ammonia gives five distinct fluorescent spots as well as the absorbing spot derived from vanillin. Acetic acid-hydrochloric acid gives two very well resolved spots with low Rf values and one large streak with a high Rf value with all authentic vanilla extracts (Fig. 30). The position of the upper streak in this pattern is markedly influenced by the presence of added sugar. In the absence of sugar it is more nearly circular and runs closer to the solvent front.

It should be stressed that these tests provide a means of establishing whether vanilla beans have been used in reasonable amounts in preparing extracts. It has been demonstrated repeatedly on authentic samples that the resolution obtainable with these solvent combinations is sufficient to do this. If a com-

![Figure 32: Chromatograms on Plant Extracts](https://example.com/chromatograms.png)

Courtesy of Boyce Thompson Institute for Plant Research, Inc.

FIG. 32. CHROMATOGRAMS ON PLANT EXTRACTS

mmercial extract is chromatographed in two or three solvents and found to contain most of the components present in authentic extracts, it is fair to assume the product was prepared from vanilla beans.

Several permissible additives which are frequently used in preparing household vanilla extracts may interfere with the results of the test unless preventive steps are taken. These are propylene glycol, glycerin, and sugar. They may interfere in two ways. Sugar tends to decrease Rf values. Thus the blue-black vanillin spot in FC-2 (Fig. 29), a concentrate with no added sugar, is moved farther up the paper during chromatography than the vanillin spot in FCS-2, an extract prepared with added sugar. Furthermore, none of these additives is volatile, so it would be impossible to test all commercial samples at equal strength by evaporating the water and alcohol and dissolving the residues in a standard volume of solvent.

This potential concentration error can be eliminated by spotting single-strength vanilla extract on paper in five portions of 10μ each, the paper being dried between applications with a hair drier. In this way it is possible to secure a five-fold concentration of the extract directly on the paper and so avoid misjudging the quality of a product because of the presence of a non-volatile additive. As can be seen (Fig. 29), propylene glycol (FP-2) and glycerin (FG-2) when used in authentic extracts at concentrations of 20 per cent did not cause any reduction in intensity of fluorescence or loss in detail when the extracts containing them were applied to paper in this way and chromatographed. Some broadening of the pattern occurred, but this can be reduced to a minimum if the paper is dried very carefully between applications.
The multiple spotting method also reduces the retarding effect of sucrose on Rf values (Fig. 29). For example, the vanillin spot obtained on chromatographing a five-fold vanilla concentrate containing added sugar (FCS-2) had a somewhat lower Rf value than the vanillin spot found on a single-strength vanilla containing sugar which was concentrated on the paper by multiple spotting (FS-2). The retarding effect of sugar can be reduced further by developing the paper a second time in the same solvent. If the Rf value of vanillin still is not the same as that of the standard sample, the fluorescent pigments can be extracted from the vanilla with chloroform-amine reagent. This process leaves the sugar and other aqueophilic compounds in the water-alcohol phase. The resolution obtained on chromatographing an aliquot of the chloroform layer is excellent (FE-2). However, some pigments which are contained in botanicals used to adulterate vanilla are not readily removed by this reagent. Therefore, it is best to extract three times and chromatograph the combined chloroform layers and the concentrated supernatant to verify the presence of an authentic vanilla pattern and at the same time avoid missing any adulterants that might be present.

**Qualification of Vanilla Extract**

In summary, the quality of vanilla extract can be judged with ease and accuracy if the following systematic procedure is used.

1. Dilute ten-fold vanilla extracts to five-fold with 50 per cent ethanol and chromatograph on Whatman No. 1 paper with KOH-NaBr-ethanol. Compare with the results obtained on an authentic ten-fold.
(2) Apply single-fold vanilla extracts to the paper by the multiple spotting method and chromatograph in the same way, using an authentic vanilla extract which does not contain sugar for comparison. If the Rf of the vanillin spot is lower than the standard, rechromatograph in the same solvent.

(3) If the Rf of the vanillin spot is still too low, extract the vanilla with chloroform-amine reagent and apply both the extract and the supernatant to the paper.

(4) If suspicion is aroused concerning the strength of the vanilla or the presence of foreign botanicals, rechromatograph the suspected materials in isopropanol-NaBr-ammonia and/or acetic acid-hydrochloric acid-water.

Originally it was believed possible that this test might be so sensitive to differences in processing methods that reputable manufacturers might not have reasonable leeway in selecting industrial extraction procedures. To determine whether this was true, vanilla beans were extracted under 1.5 lbs. per sq. in. steam pressure or in the presence of KHCO₃, K₂CO₃, and KOH at pH values above and below seven, or with a menstruum containing both KOH and isopropanol. All of the extracts contained the fluorescent components characteristic of authentic vanilla except those prepared from spent beans (Fig. 31). In some of the more severe treatments, black materials were produced which streaked on the papers, but, after these settled out during aging of the products, the chromatographic patterns were found to be almost identical with those of extracts prepared by the standard F.E.M.A. method (Heinz 1949). Thus, it is likely that ten-fold extracts produced under industrial conditions will have acceptable patterns.

Extracts of other plants also produce chromatographic patterns, but these in no way resemble those obtained on vanilla. Therefore, this method can be used in many cases to detect adulteration with foreign botanicals (Fig. 32). Extracts of hickory bark, cherry bark, angostura, St. John's-wort, rhubarb root, licorice, black walnut, and cascara all contain fluorescent compounds, dark materials, and in some cases pigments that are visible under ordinary illumination (Fig. 32). Other plant extracts which are not illustrated but which can be detected in this way include coffee, tea, fenugreek, prune juice, buckthorn, prickly ash, pipissawa, burdock root, cacao, kola nut, and horehound. Some of these extracts contain components that fluoresce so brilliantly that they can be perceived immediately when present in vanilla, while others are masked by the vanilla pattern. Since the ease with which these materials can be detected depends on the concentration used, no general statement can be made concerning the specific extracts that can be detected when used to adulterate vanilla.

Results on Commercial Vanilla Extracts

Seven samples of household vanilla extract purchased in various sections of the United States by members of the Flavoring Extract Manufacturer's Association and submitted under code were examined by paper chromatography. Four of these (H-2, H-3, H-4, and H-7) were obviously diluted (Fig. 33). In addition, H-4 was probably adulterated since it contained a bright fluorescent component at Rf 0.9 in contrast to the general weakness of the fluorescence elsewhere. Samples H-5 and H-6 gave acceptable vanilla patterns, although the fluorescence is somewhat weaker than that of the standard. The sample coded H-1 evidently contained a large amount of sugar since development of the chromatogram was retarded. Redevelopment in the same solvent did not
eliminate this entirely, so it was necessary to extract this sample with chloroform-amine reagent to demonstrate the presence of an authentic, although somewhat weak vanilla pattern. Thus, of the seven samples examined, one was diluted and probably adulterated, three were definitely diluted, and the remaining three gave patterns that were somewhat weak but acceptable. It would be necessary to resort to quantitative analysis to show whether the full weight of beans was used in preparing these latter extracts. However, there is no doubt that the other four samples were not representative of full-strength authentic vanilla extract. In addition to the samples illustrated in Fig. 33, a large number of extracts were purchased at chain and independent grocery stores in the New York City area and analyzed. The distribution between acceptable and substandard extracts was about the same as found on the samples submitted by the F.E.M.A. membership.

The quality of commercial ten-fold vanilla extracts sold to the dairy and bakery industries was found to be much lower than was the case for the household extracts. Of thirteen samples examined, seven were definitely adulterated. The ten-folds coded T-D, T-E, T-K, and T-L (Fig. 34) are particularly obvious samples of adulteration. They would immediately be classified as spurious even by the most inexperienced observer. The difference between these samples and authentic vanilla extract (FC-2) is obvious even on a black and white reproduction (Fig. 34), and this effect is much enhanced when it is possible to see areas of blue, blue green, green, yellow, and orange fluorescence. T-R is also adulterated although this cannot be detected on a black and white photograph. T-Q is possibly adulterated, has a very weak fluorescent pattern and, in addition, did not contain the volatile components present in authentic vanilla when examined by gas chromatography. In summary, seven of these samples were definitely adulterated, four were possibly adulterated, one gave an extremely weak pattern and one (ten-fold W) gave an acceptable although weak fluorescent pattern when examined by paper chromatography. It is interesting that this sample also gave an acceptable fractogram when examined by gas chromatography (Burchfield and Prill 1959).

It is evident that standards of quality in the ten-fold industry, and to a lesser extent in the household field, are so low that paper and gas chromatography alone will suffice at present for detecting adulterated and diluted products. However, as the more flagrant violations disappear, it will be necessary to use quantitative procedures to obtain evidence on manufacturers who consistently market products which are 10 to 25 per cent understrength. It is possible that this can be accomplished by methods described elsewhere (Prill et al. 1960).

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