

FORMULATION OF READY- TO- RECONSTITUTE
THANDAI MIX POWDER

THESIS SUBMITTED TO THE
NATIONAL DAIRY RESEARCH INSTITUTE, KARNAL
(DEEMED UNIVERSITY)
IN PARTIAL FULFILMENT OF THE REQUIREMENT
FOR THE DEGREE OF
MASTER OF TECHNOLOGY
IN
DAIRYING
(DAIRY TECHNOLOGY)

By
SWATI PATEKAR

DIVISION OF DAIRY TECHNOLOGY
NATIONAL DAIRY RESEARCH INSTITUTE
(I.C.A.R.)
KARNAL - 132001 (HARYANA), INDIA
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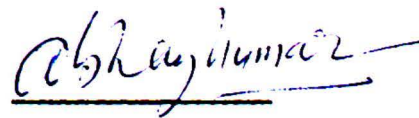
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This is to certify that the thesis entitled, "FORMULATION OF READY-TO-RECONSTITUTE THANDAI MIX POWDER" submitted by Ms. SWATI PATEKAR in partial fulfilment of the requirement for the award of the degree of MASTER OF TECHNOLOGY in DAIRYING (DAIRY TECHNOLOGY) of the NATIONAL DAIRY RESEARCH INSTITUTE (DEEMED UNIVERSITY), Karnal (Haryana), India, is a bonafide research work carried out by her under my supervision and guidance, and no part of the thesis has been submitted for any other degree or diploma.



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**MAJOR ADVISOR & CHAIRMAN
(GUIDE)**


Dated: June 19, 1996

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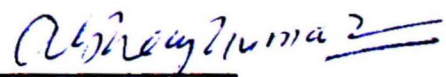
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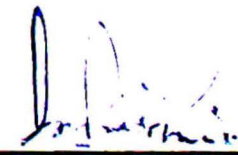
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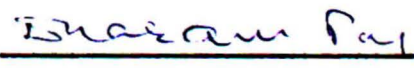
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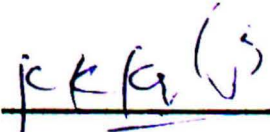
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(SWATI PATEKAR)

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CHAPTER - 1

INTRODUCTION

1. INTRODUCTION

Thandai is a very popular milk based traditional Indian beverage, known for its cooling and refreshing effect. It is usually consumed in summer, especially in the Northern India. In addition, the beverage excels other soft beverages by providing a significant amount of nutritional content.

Traditionally, thandai is prepared on small scale from a mixture of different ingredients mixed in predetermined proportions. Thandai mixture is ground to a fine paste and mixed with milk, sugar and served after chilling. However, this method is quite inconvenient, laborious and not suitable for large scale operation. In order to overcome, the problems associated with traditional method, various cottage industries have recently started marketing thandai mix in powder and syrup form on limited scale. However, these mixes require addition of milk and sugar before serving the thandai drink. Milk of good quality, during the summer season, may not be easily available throughout the country. A good "ready-to-use formulation" will be a welcome development.

The survey of the market samples of thandai mixes indicated that there exists a wide variation in the amount and type of ingredients used in making the mixes. No work of technological or scientific significance has been reported in the literature on ready to use thandai mixes of standard composition.

In the present scenario, there is a tremendous scope for enhancing the profitability of dairy industry through product diversification and value addition for efficient utilization of available milk. This would enhance the profitability of dairy plants involved in the manufacture of dried products

with minor additional facilities. A standardized ready to use product such as thandai mix is also amenable to large scale production for national marketing.

Thandai can gain significant commercial importance once an appropriate technology for ready-to-reconstitute thandai mix powder is developed and made available to the industry. A good ~~excellent~~ export potential can be foreseen for this product.

This investigation was, therefore, undertaken to develop a complete and ready to use thandai mix powder, by incorporating optimum quantities of milk solids, sugar and other ingredients of thandai mix in order to produce a standardized product, which upon reconstitution would yield a product similar to traditional thandai.

CHAPTER - 2

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

Since early times, *thandai* is popular as a thirst quencher and valued for its nourishing and refreshing effect on heart and mind (Pathak, 1996). However, no systematic study has been conducted so far to find the exact composition, physico-chemical properties of *thandai* mixes available in the market. The information on *thandai* is very scanty. Only sporadic references to the product are available in the literature.

2.1 METHOD OF MANUFACTURE

Changing lifestyles are at the root of changing food habits of consumers. This is also reflected in changing trends in *thandai* manufacture.

In the age old method, *thandai* was prepared freshly at home. Depending on the requirements of family, few kernels of almond were soaked in water, for a few hours, to make the peeling exercise easier. Peeled almonds were then mixed with poppy seeds and kernels of four other dry fruits called 'Charmagaz'. Cardamoms were added as flavouring. The mixture was then ground on 'sil - vatta' to make a thin paste of it and was added to milk (Pathak, 1996).

A more recent method is the preparation of *thandai* concentrate or paste. The method of preparation included soaking of cashewnuts, almonds, poppy seeds, rose petals and then a very fine paste of all the mentioned ingredients and black pepper corn was made in a grinder. Sugar was added. The paste was stirred into milk and saffron was added. The mixture was then

filtered and rose water added. The product was then chilled and garnished with pistachio before serving (Kalra, 1995).

Now-a-days, there is an increasing trend to utilize thandai mixes in powder or syrup form for making thandai. Various thandai mixes which are available in the market were studied in respect of their ingredients and direction of use. The information is summarized in Table 2.1.

Table 2.1 Thandai mixes available in the market.

BRAND NAME AND MANUFACTURER	INGREDIENTS	DIRECTION
1. GOPAL JEE Badam, Pista, Kesar thandai. Khushi Ram Luxmi Narain, 474, Khari Baoli, Delhi-6	Sugar, magaz, poppy seeds, pistachio, saffron, aniseed, almond, cardamom, white pepper, black pepper, rose petals, permitted preservative	1 tsp. powder in 200 ml milk, sugar to taste and ice to chill it
2. NAU BHAR Badam thandai powder. Nonand Rai Bhola Nath, 6691, Khari Baoli, Delhi-6	Sugar, magaz, poppy seeds, aniseed, almond, cardamom, white pepper, black pepper, rose petals, permitted preservative	1 tbsp. or 2 tsp. of powder in milk, sugar to taste and ice to chill it
3. DIL BAHAR Thandai powder (instant thandai masala) Mundhra Trading Co., 6699, Khari Baoli, Delhi-6	Glucose, black pepper, cardamom, rose petals, poppy seeds, aniseed, saffron, melon seeds, water melon seeds, almond, white pepper, pista	1 tbsp. powder in a glass of warm milk, add sugar, add ice to make it chill
4. MISHRAMBU Kesar, Badam thandai Mishrambu Products, Tarna, Shivpur, Varanasi	Sugar, seeds (kharbuj, kaddu, kakri, tarbuj), cardamom, aniseed, rose petals, white pepper	1 part syrup in 4 parts milk
5. GURUJI Kesaria thandai syrup Guruji Products Pvt. Ltd., 1, Jawahar Market Siya Ganj, Indore	Sugar, water, badam, thandai, cardamom, saffron, rose water, citric acid	1 part syrup in 4 parts milk

2.2 INGREDIENTS OF THANDAI

In the absence of any scientifically published literature on thandai, the nutritional, medicinal and therapeutic value of various ingredients have been reviewed here.

2.2.1 MILK

Usually, the milk available at home or market, is used for making thandai. There are no legal standards for thandai as yet in our country. However, it may be desirable that the milk used in preparing thandai should meet the legal standards of milk prescribed by the Government of India under the Prevention of Food Adulteration Act (1954).

Milk and its products are universally acknowledged as highly nutritious. The primary importance lies in their ability to improve the quality of vegetarian diet as it happens to be the cheapest protective food compared to meat, fish, eggs, fruits and vegetables.

Milk is a biofluid crowded with high quality nutrients. Proteins of milk have high nutritive value because of favourable balance of essential amino acids. Lactose of milk helps in calcium absorption and building-up of nervous tissue. Milk is an excellent source of calcium, phosphorus, citrate, magnesium, sodium, potassium and also a minibank for minor metallic elements like boron, silicon, arsenic, copper, zinc, halogens. It is also rich source of fat - soluble vitamins (A, D, E & K), thiamine, riboflavin and ascorbic acid (Rajorhia, 1995).

2.2.2 ALMONDS

Almonds (*Prunus amygdalus*) is a very important ingredient of thandai, next to milk. It imparts a typical, delicate flavour, as well as contributes to the nutritive value of drink. Almonds are rich in mineral constituents but poor in some essential amino acids and need to be associated with casein to give complete diet (Souty et al., 1971).

Almond is said to be originally a native of central and western Asia. At present, it is cultivated throughout the southern Europe, US (California), Australia and South Africa.

There are two species of almonds, the bitter and sweet. The former has a bitter kernel which is used in the manufacture of flavouring extracts and prussic (hydrocyanic) acid. Among the sweet and edible almonds, there are two types namely, hard shell and soft shell. The soft shell type is sold at premium. Both these types are grown in India (Teotia et al., 1987).

Almond is used not only in sweetmeats, thandai and other food recipes but also as an ingredient of medicinal formulations. It helps in maintaining and increasing intelligence and vigour (Anon, 1991).

2.2.3 RAISIN

Raisin (*Vitis vinifera*) provide the refreshing, cooling and thirst quenching properties.

The United States is the world's leading producer of raisins, all of which comes from California. Other leading producers of raisins are Turkey, Greece, Australia, Iran, Spain, South Africa and Cyprus (Anon, 1974).

The word 'raisin' is a contraction of the French *raisin sec*, meaning dried grapes. However, only a few varieties of grapes are said to yield raisins upon drying. The three most important varieties of raisin grapes are the Thompson seedless; the muscat or Alexandria, a large seeded variety; the black Corinth, a very small, black seedless type (Anon, 1963).

Natural raisins are dried in the sun in their natural condition, they are grayish black or grayish brown with the natural bloom intact and with a rather tough skin. Natural fruit acids contribute to the pleasant tartness of raisins (Anon, 1963).

Raisins are effective in removing body heat in fever as they have cooling and thirst quenching properties. Also, raisins are useful in treating constipation (Anon, 1991).

2.2.4 WHITE PEPPER

Pepper (*Piper nigrum*) is one of the oldest and most important of all spices. It is known as the "King of Spices". Pepper is native to northwest India, but has now been introduced into most tropical countries. India produces the bulk of world's supply (Bakhru, 1992).

Black pepper is whole dried fruit, while white is the fruit subjected to treatment in water with mesocarp removed. White pepper is, therefore, less bitter and less pungent.

White pepper yields about 1.5 percent volatile oil and 7 percent oleoresin. The volatile oil of pepper contains α -pinene, β -pinene, α -phellandrene, β -caryophyllen, didyrocaved, piperonal. The pungent principles of pepper are contained in its oleoresin, and consists of piperine, chavicine, piperidine (Merory, 1968).

- Piperine is an alkaloid, at first tasteless but with a pungent after taste.
- Chavicine is a yellowish, oily substance with a sharp biting taste.
- Piperidine, alkaloid, colourless with the odour of pepper and a biting taste.

Heath (1981) observed that the isomers of piperine have almost no pungency.

		<u>Relative Pungency</u>
Piperine	trans - trans	5
Isopiperine	cis - trans	1
Isochavicine	trans - cis	1
Chavicine	cis - cis	2

It is suggested that old samples of pepper may contain relatively large amounts of the almost non-pungent isomer, chavicine, which is determined as "Piperine" by the normal method of analysis.

The minor alkaloid present in pepper include pipertine, piperanine, piperlylin, piperolein A and piperolein B (Salzer, 1975).

Pepper is stimulant, pungent, aromatic, digestive and nervine tonic. Pepper is useful in relieving flatulence. It has a stimulating effect on the digestive organs and produces an increased flow of saliva and gastric juices. Pepper is beneficial in the treatment of cold, fever and coughs caused due to throat irritation (Bakhru, 1992).

2.2.5 ANISEED

Aniseed is the dried fruit of *Pimpinell anisum* L. (Umbelliferae family). It is a native of the Middle East. It was cultivated by the ancient Egyptians who valued its medicinal properties and culinary uses. It is now cultivated in southern Europe, north Africa, India, Pakistan, China, Chile, Mexico and the US (Bakhru, 1992).

Aroma is characteristic, agreeable, the taste is pleasant, sweetish and aromatic. Aniseed yields upto 3 percent of essential oil having upto 90 percent anethole [p-propenyl phenyl methyl ether, $(C_6H_5C_6H_4)OCH_3$] (Anon, 1982). Other organic constituents in the oil include methyl chavicol, anisketone, anisaldehyde, etc. The content of fixed oil in anise is about 10 percent (Merory, 1968).

Aniseed is esteemed in medicine for its properties to relieve flatulence and to remove catarrhal matter and phelgm from the bronchial tube. It is also useful in diarrhoea, acute pain of stomach, malfunctioning of liver and gall bladder, gastric ailment such as burning sensation. It also relieves indigestion especially gurgling of abdomen. Aniseed is an ideal medicine for expelling wind

from the stomach. It can be taken, in combination with other digestives like pepper, etc. in the form of an infusion. It is also useful in preventing gas and fermentation in the stomach and the bowels.

Aniseed is considered beneficial in the treatment of asthma due to its expectorant properties. The seeds are used to flavour curries, sweets, cake, cookies and biscuits. Aniseed or the essential oil therefrom is employed in medicine as an aromatic, carminative to relieve flatulence. Being a mild expectorant, it is used as an ingredient of beverages. It is a popular flavouring agent for dental preparations and mouthwashes (Bakhru, 1992).

2.2.6 SAFFRON

Saffron (*Crocus sativus* L.) consists of dried stigmas and part of the style of the flowers. It is one of the world's costliest herbs. It is used in thandai for imparting delicate flavour and a pleasing yellow colour to the product.

It is loosely matted, filamentous mass of dark - red to reddish brown stigmas, 2 - 2.5 cm long. At times yellow styles may be present (Heath, 1981).

Saffron is cultivated in several European countries, principally in Spain and France, northern India and China.

Saffron has an intense, characteristic odour which is not to everyone's liking; the flavour is delicate with a sharply bitter back - note. Saffron is valued primarily for its water - soluble yellow colouring matter (Heath, 1981).

Commercial saffron contains crocin and crocetin of the carotenoid group (ISI, 1969). Saffron contains (a) a highly aromatic essential oil (0.5-10%), the monoterpene aldehydes and isophrone - related compounds which were investigated by Zarghami et al. (1971), (b) picrocrocin - a colourless bitter glucoside of an aldehyde, safranal, and (c) crocin - a bright yellow

digentiobiose ester. Crocin and picrocrocin are believed to originate from a β -carotene type precursor (Fieser and Fieser, 1956).

It is reported that addition of saffron to *burfi*, *peda* and *rabri* inhibits the growth of microorganisms (Sachdeva and Rajorhia, 1982). The effects of adding saffron at three levels (0.01, 0.015 and 0.02% by weight of channa) on chemical, microbiological and sensory characteristics of Sandesh (a traditional Indian sweet) were investigated by Sen and Rajorhia (1994). The increased doses of saffron slowed down the chemical and microbiological changes during storage. An optimum quantity of 0.015 percent saffron by weight of channa is recommended for improving the flavour and shelf-life of Sandesh.

Saffron is largely used in indigenous medicine across India. It enjoys a great reputation as a drug which strengthens the functioning of stomach and promotes its action. The drug also counteracts spasmodic disorders, that is, sustained involuntary muscle contraction. It is beneficial in the treatment of several digestive disorders, especially flatulent colic. The herb is useful in promoting and regulating menstrual periods and soothes lumber pains (Bakhru, 1992).

2.2.7 SUGAR

Refined cane sugar is used as a sweetener, energy provider, preservative and adds to the total solids of the product. According to Coulter (1948) sugar helps in improving the reconstituability of the thandai mix powder. Addition of a portion of sugar to concentrated product before spray drying is reported to improve the flavour of dried product.

2.5 PHYSICAL PROPERTIES OF WHOLE MILK POWDER

Since, ready-to-reconstitute thandai mix powder is an entirely new product, there is no published literature on the physical properties of the

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2.5 PHYSICAL PROPERTIES OF WHOLE MILK POWDER

Since, ready-to-reconstitute thandai mix powder is an entirely new product, there is no published literature on the physical properties of the

powder. However, a parallel comparison can be made between thandai mix powder and whole milk powder because of the similarity in the nature of these two products.

2.3.1 BULK DENSITY

It is defined as weight per unit volume of powder and is expressed as g per ml. High bulk density is of value in products intended for shipment in bulk for saving the packaging material and transport cost. In spray dried milk powders, bulk density varies between 0.35 to 0.65 g/ml (Lewis, 1987). Bulk density is influenced by products composition, particle size and amount of interstitial air. Normally, milk powder contains between 10 and 30 ml of entrapped air in 100 g powder.

Kerekreti (1980) showed that an increase in dry matter of milk concentrate results in a powder with high bulk density. A slight increase in particle density is observed when a more viscous concentrate was employed (Baldwin et al., 1980; Snoeren et al., 1981).

Nozzle atomization typically results in 10 to 15 ml of entrapped air per 100 g, while centrifugal atomization under the same conditions will give 20 to 25 ml (Nielsen and Hansen, 1982). Bulk density decreases with increase in atomizer speed (Vielder et al., 1976). An increase in inlet air temperature causes quicker shell drying of droplets and, therefore, formation of greater number of vacuoles during diffusion evaporation (Bloore and Boeg, 1982; Neilsen and Hansen, 1982; Knipschildt, 1986).

2.3.2 WETTABILITY

Wettability of milk powder is primarily a measure of its hydrophilic properties and is expressed as the rate at which a mass of dried powder is

penetrated by quiescent water. Wettability depends mainly on the nature of surface of the particles.

The presence of fat at the surface of whole milk powder particles inhibits wetting of the particle (Baldwin and Sanderson, 1973; Pijanowski et al., 1974). Forewarming of milk at 80°C was observed to result in a powder with improved wetting time (Sheraev et al., 1981; Salooja, 1983).

Baldwin et al. (1980) observed an increased wettability with higher percent total solids in preconcentrate. This change could be due to increase in particle size of powder by higher milk solids concentration.

Dosaka et al. (1980) found that wettability of milk powders improved considerably by homogenizing the milk concentrate. The effect was attributed to the influence of homogenization on the formation of hydrophilic whey protein coat on fat globules.

Wettability can also be improved by increasing the atomizer speed (Salooja, 1983).

2.3.3 DISPERSIBILITY

The total heat treatment on the casein during processing affect dispersibility. Higher heat treatment with a higher percentage of total solids causes a greater degree of irreversible denaturation and the denatured casein under normal reconstitution does not form a stable dispersion.

Rapid, controlled cooling of dried milk and subsequent conditioning treatment, to melt the butterfat gave an improvement in the dispersibility which lasted during six months of storage at 6°C (Bullock, 1959).

Ashworth (1956) reported good dispersibility of milk powder at low temperatures. Aldrich and Downs (1959) reported that the dispersibility decreased as the temperature of water increased during reconstitution. Baker et al. (1959) observed an increased dispersibility when whole milk powder was tampered at 37°C.

2.3.4 SOLUBILITY

Solubility is referred as the rate of dissolution (solubility percent) and the total solubility (solubility index). Solubility of WMP depends on the particle size, the state of fat in dried milk and the drying conditions (Mol and Jensen, 1974). Solubility decreases as the temperature of forewarming is increased (Salooja, 1983).

Kabanov and Kharitonov (1978) observed that precondensing improved the solubility of spray dried milk. Salooja (1983) found an inverse relationship between degree of concentration and solubility. Kharitonov (1974) showed that homogenization of concentrated whole milk before drying improved the solubility of milk powder, whereas Baldwin et al. (1980) observed that greater degree of atomization decreased the solubility.

Verhey (1972) observed that the solubility index increased with higher inlet temperature. Vilder (1981) observed that dry milk prepared by two stage procedure had a lower solubility index than the one prepared by the conventional spray drying method with an inlet air temperature of 195°C and outlet air temperature 92°C. King and Sanderson (1970) stated that the poor solubility of milk powder can be avoided by decreasing the outlet temperature of drying air. According to Brummelhuis (1975), the solubility index increased as the outlet temperature is raised. At the higher outlet temperature, 95°C or above, overheating appeared, especially at the end of drying process. This resulted in higher solubility index and caused by denaturation of proteins.

CHAPTER - 3

OBJECTIVES AND PLAN OF WORK

3. OBJECTIVES AND PLAN OF WORK

The review of literature in the preceding chapter indicates that there is very scanty published information on thandai. Also, no attempt has been made to standardize the product mix so far. It is envisaged that manufacture of thandai mix powder in ready-to-reconstitute form will provide dairy industry an attractive alternative for utilization of milk for product diversification. Scope, therefore, exists to develop a suitable process for standardization of ready-to-reconstitute thandai mix powder which can be readily reconstituted in water to make thandai as and when desired. The following objectives were, therefore, set forth.

3.1 OBJECTIVES

- i) Formulation of ready-to-reconstitute thandai mix powder by dry blending.
- ii) Feasibility of production of thandai mix powder by spray drying.
- iii) Estimation of cost of production of thandai mix powder.

3.2 PLAN OF WORK

To fulfil the objectives, the following plan of work was adopted:

3.2.1 FORMULATION OF THANDAI MIX POWDER BY DRY BLENDING

Six formulations of thandai mix powder, prepared with different levels of raisins, aniseed and white pepper by dry blending with whole milk powder

or dairy whitener, sugar, almond and saffron. The most appropriate formulation was selected.

3.2.2 PRODUCTION OF THANDAI MIX POWDER BY SPRAY DRYING

Thandai mix concentrate of 30 percent TS obtained by blending a mixture of almond, raisins, aniseed, white pepper and sugar, in ground form, with concentrated milk (22% TS) was employed for the manufacture of thandai mix powder by spray drying process. Saffron was dry blended with the spray dried products.

3.2.3 SENSORY EVALUATION OF RECONSTITUTED THANDAI

Sensory evaluation of reconstituted thandai was carried out by a panel of trained judges using 9-point Hedonic Scale. The best formulation was selected on the basis of sensory characteristics of the reconstituted product.

3.2.4 ANALYSIS OF THANDAI MIX POWDER

The final formulated product was analysed for -

3.2.4.1 Chemical Composition

- i) Moisture
- ii) Fat
- iii) Protein
- iv) Ash
- v) Total carbohydrate (by difference)

3.2.4.2 Physical Characteristics

- i) Bulk density
- ii) Wettability
- iii) Dispersibility
- iv) Solubility index

3.2.5 STATISTICAL ANALYSIS

The data generated as a result of sensory evaluation was subjected to test of significance at 1 and 5 percent levels of confidence.

3.2.6 COST ESTIMATION

The cost of production for 100 kg thandai mix powder was estimated to ascertain the profitability of the new technology.

CHAPTER - 4

MATERIALS AND METHODS

4. MATERIALS AND METHODS

The materials used and the methodology employed in the present study, relating to the standardization of the method of manufacture of ready-to-reconstitute thandai mix powder and estimation of cost of the standardized product are dealt with in this chapter.

4.1 PREPARATION OF THANDAI MIX POWDER

A flow diagram conceptualizing the process employed for the manufacture of dry blended ready-to-reconstitute thandai mix powder is given in Figure 4.1.

4.1.1 SELECTION OF RAW MATERIALS/INGREDIENTS

The sources of various ingredients used in the investigation are delineated hereunder:

4.1.1.1 Whole Milk Powder

Spray processed whole milk powder was manufactured in the Experimental Dairy of N.D.R.I.

4.1.1.2 Dairy Whitener

Fresh batches of Nestle's Everyday Dairy Whitener were procured from the local market and utilized as an alternate source of milk solids in the formulation.

4.1.1.3 Refined Sugar

Commercially available sugar conforming to the ISI specifications (IS:1151-1958) was used as sweetner.

4.1.1.4 Almond

Fresh, edible, sweet almonds were purchased from a reputed dealer.

4.1.1.5 Raisin

Raisins were procured from the market. The seeds were removed and raisins dried at 45°C before use.

4.1.1.6 White Pepper

Fresh white pepper were purchased from the local market. All the foreign matter was removed before using the peppers.

4.1.1.7 Aniseed

Fresh, good quality aniseed was purchased from the local market.

4.1.1.8 Saffron

Good quality, properly packaged saffron was procured from Delhi.

4.1.2 PROCESS OF MANUFACTURE

4.1.2.1 Dry Blended Thandai Mix Powder

i) Standardization

The ingredients, i.e., almond, raisin, aniseed and white pepper were taken in different proportions on the basis of preliminary investigations with either whole milk powder or dairy whitener for the formulation of following six different compositions:

FORMULATION	MILK SOLIDS	ALMOND:RAISINS:ANISEED:PEPPER (%)
PW1	Whole Milk Powder	0.5 : 0.125 : 0.125 : 0.125
PW2	Whole Milk Powder	0.5 : 0.25 : 0.25 : 0.25
PW3	Whole Milk Powder	0.5 : 0.375 : 0.375 : 0.325
PD1	Dairy Whitener	0.5 : 0.125 : 0.125 : 0.125
PD2	Dairy Whitener	0.5 : 0.25 : 0.25 : 0.25
PD3	Dairy Whitener	0.5 : 0.375 : 0.375 : 0.325

Accordingly, the dried ingredients were weighed for preparing one litre of thandai for each formulation as per Table 4.1.

ii) Blending

For the dry blending of ingredients, the following procedure was adopted:

- a) Firstly, almond, raisin, white pepper, aniseed and saffron were grinded in Sumeet Food Processor.
- b) After reduction of these ingredients to powder, granulated sugar was added and the mixture was again grinded, for intimate mixing.
- c) This was followed by addition of whole milk powder or dairy whitener and finally the ingredients were mixed in stainless steel blender. The blender was sterilized before use. Mixing was done for 5 min to ensure thorough mixing.

iii) Cooling

The blended product was cooled to room temperature before packaging.

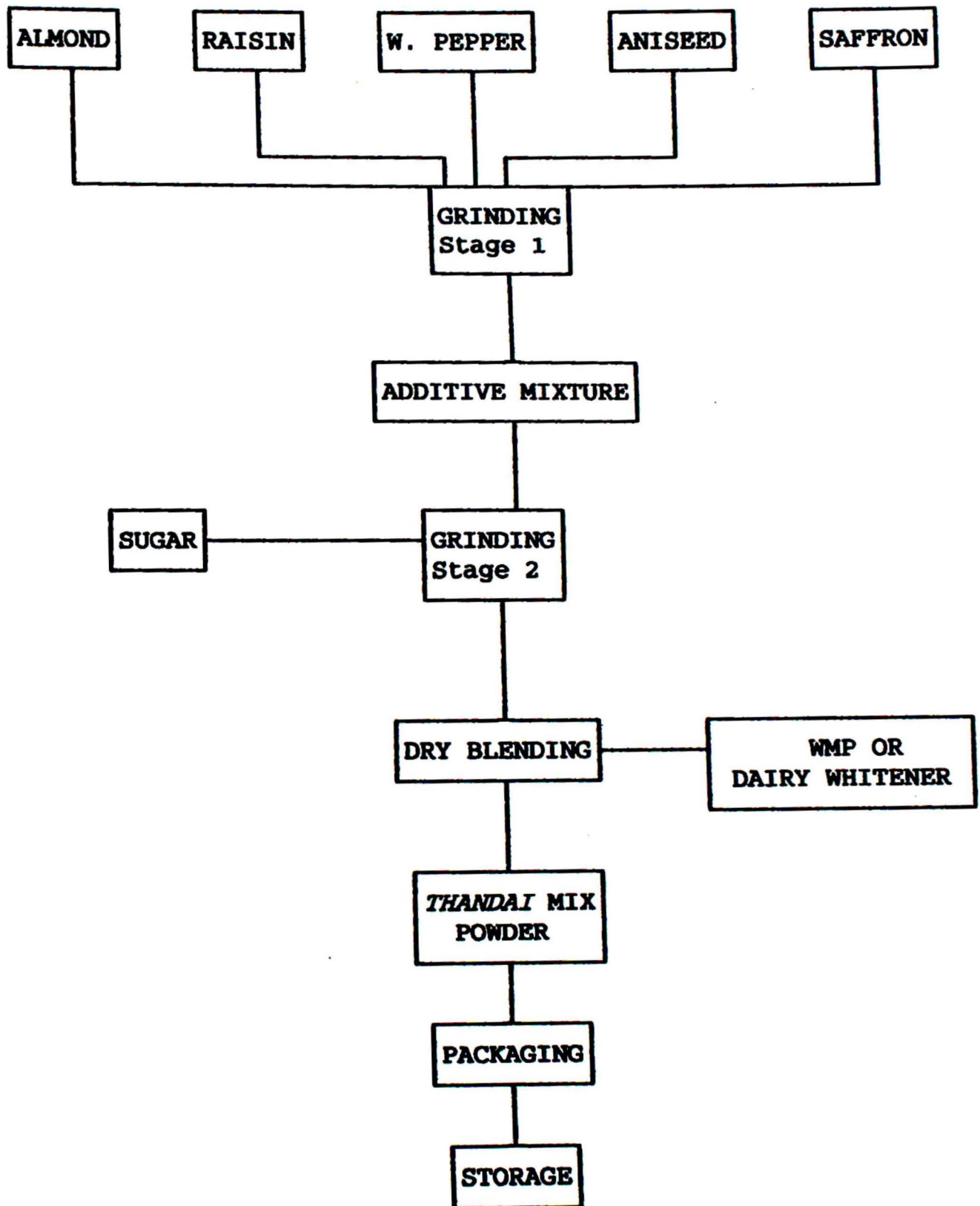
iv) Packaging

About 500 g samples were filled in metallized polyester-LDPE laminated pouches having 12 micron thickness of metallized polyester and 300 gauge LDPE. The pouches were then sealed using manual sealing machine.

Table 4.1 Formulation of *thandai* (in grams)

Formulation	Source of milk solids	Sugar	Almond	Raisin	Aniseed	W. Pepper	Saffron
a) Whole Milk Powder:							
PW1	115	75	5	1.25	1.25	1.25	0.1
PW2	115	75	5	2.5	2.5	2.5	0.1
PW3	115	75	5	3.75	3.75	3.25	0.1
b) Dairy Whitener:							
PD1	143.75	46.25	5	1.25	1.25	1.25	0.1
PD2	143.75	46.25	5	2.5	2.5	2.5	0.1
PD3	143.75	46.25	5	3.75	3.75	3.25	0.1

Figure 4.1 Schematic diagram for manufacture of ready-to-reconstitute thandai mix powder (Dry Blending Process)



4.1.2.2 Production of Spray Dried Thandai Mix

i) Standardization

The standardized milk (Fat:SNF::1:2.83) was used for making spray dried thandai mix powder so that the reconstituted thandai have 3 percent fat and 8.5 percent SNF.

ii) Homogenization

The standardized milk was preheated at 65°C and homogenized in a two stage homogenizer, at 2500 and 500 psi in the first and second stage, respectively.

iii) Forewarming

The standardized milk was forewarmed at a temperature of 90°C in a plate heat exchanger.

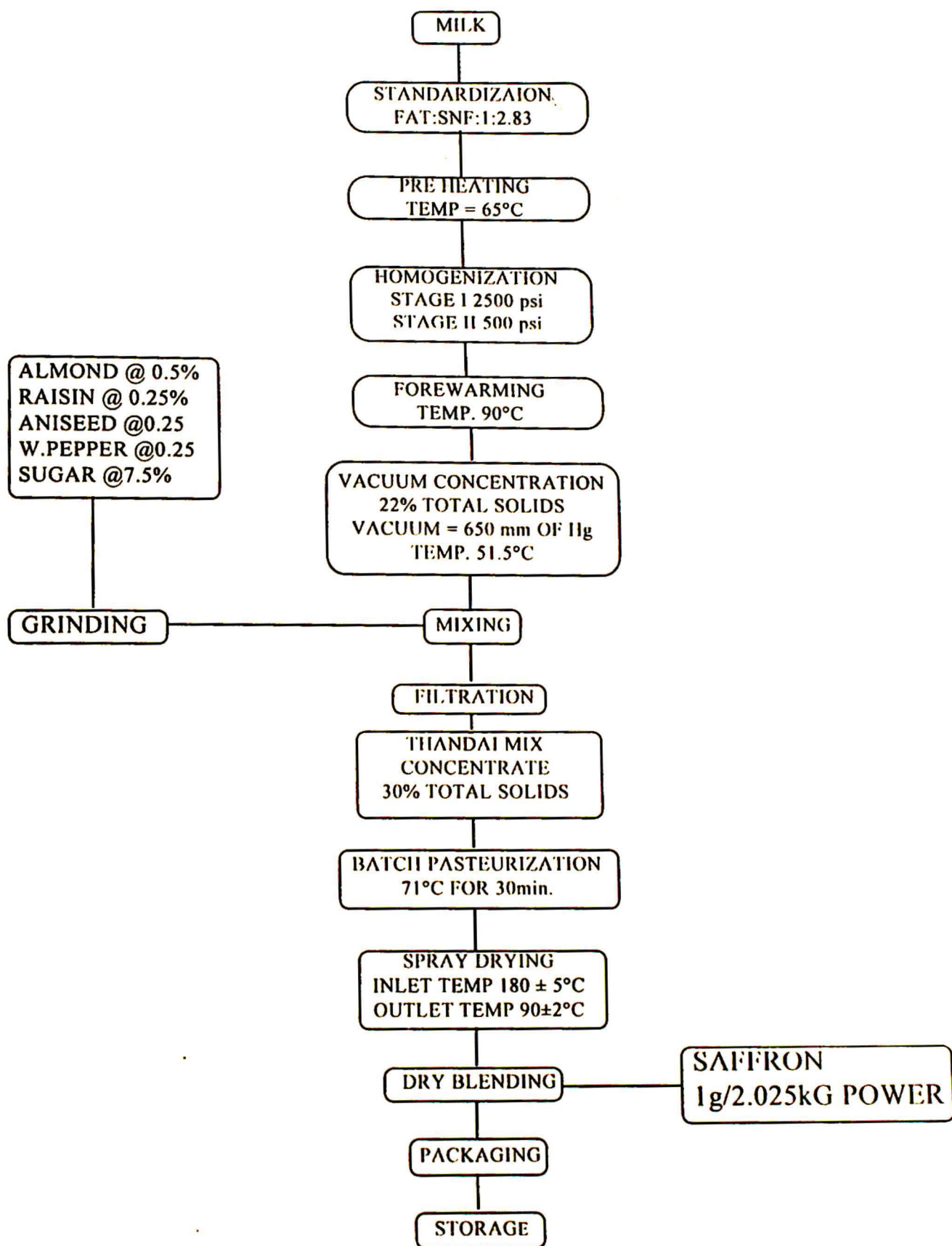
iv) Concentration

The forewarmed milk was concentrated to 22 percent total solids in a vacuum pan, at a vacuum of 650 mm of Hg, corresponding to the boiling temperature of 51.5°C. The increase in concentration was periodically checked by means of a refractometer.

v) Admixing with Sugar and Other Powdered Ingredients

Refined sugar @ 7.5 percent of the initial standardized milk and the best proportion of thandai ingredients (except saffron) in ground form were added to concentrated milk to get a concentrated thandai mix with approximately 30 percent total solids. After stirring thoroughly, the mix was filtered through muslin cloth.

Fig. 4.2: Flow diagram for manufacture of *thandai* mix powder by spray drying



vi) Batch Pasteurization

The thandai mix concentrate (30% TS) was then batch pasteurized at 71.7°C for 30 min and cooled to 60°C.

vii) Spray Drying

The thandai mix prepared as above was dried in a spray drier (Anhydro, Denmark). The inlet and outlet air temperature was maintained at $180 \pm 5^\circ\text{C}$ and $90 \pm 2^\circ\text{C}$, respectively. The feed was admitted to the drier at the rate of 20 litres/hour through an atomizer at 25,000 rpm. The thandai mix powder was collected and temporarily packed in polyethylene bags.

viii) Dry Blending of Saffron

Saffron was grinded to fine powder in Sumeet Food Processor and was blended with spray dried product @ 1 gm/2.025 kg so that the reconstituted thandai contains 0.01 percent saffron.

ix) Packaging

The product was packed as described in Section 4.1.2.1 (iv).

4.2 ANALYTICAL METHODS

Various methods of analysis followed during the manufacture and in estimation of physical properties of the thandai mix have been discussed in this section.

4.2.1 RAW MILK

- 1) Organoleptic tests were performed as per ISI Bulletin No.IS:1479, Part-I (1960).
- 2) COB tests were performed as per ISI Bulletin No. IS:1479, Part-I (1960).

- 3) Fat content was estimated by Gerber Method as per ISI Bulletin No. IS:1224, Part-I (1977).
- 4) Titratable acidity was determined using the ISI procedure of IS:1479, Part-I (1960).
- 5) SNF content was estimated as described in ISI Bulletin No. IS:1183 (1965).

4.2.2 WHOLE MILK POWDER

4.2.2.1 Fat

Fat content in terms of percentage was determined by Mojonnier method as per MIF (1959) for whole milk powder.

4.2.2.2 Total Solids

Total solids content was estimated by gravimetric method as per the ISI method described in IS:SP:18:Part-XI (1981).

4.2.3 THANDAI MIX CONCENTRATE

4.2.3.1 Total Solids

The total solid content of concentrated thandai mix was determined as per the ISI method described in IS:SP:18:Part-XI (1981).

4.2.4 THANDAI MIX POWDER

4.2.4.1 Moisture

Moisture content was estimated by gravimetric method as per IS:SP:18:Part-XI (1981).

4.2.4.2 Fat

Fat percentage was determined by Mojonnier Fat Extraction Apparatus as described in IS:SP:18:Part-XI (1981).

Approximately, 1 gm of sample was accurately weighed in a 50 ml beaker. To this, 10 ml conc. HCl was added and heated on waterbath till casein gets dissolved. After cooling, the contents were transferred to Mojonnier tube with 10 ml alcohol and mixed well. This was extracted once using 25 ml of diethyl ether and petroleum ether each and twice using 15 ml of each solvent. The ethereal layer from each extraction was collected in a pre-weighed aluminium dish, after centrifugation. This was evaporated to dryness to remove all traces of solvent and the weight of residue was recorded. The fat was calculated as follows:

$$\text{Percent Fat} = \frac{\text{Weight of residue}}{\text{Weight of sample}} \times 100$$

4.2.4.3 Protein

The protein content was estimated by semi-micro Kjeldahl method (Meneffee and Overman, 1940) using Kjeltex Automatic Digestor and distillation equipment.

0.2 grams of sample was weighed in the protein tube, 8 ml of concentrated sulphuric acid and one digestion tablet (1.5 g K_2SO_4 and 0.0075 g Se) were added to the tube. Digestion was carried out in the Kjeltex unit (Digestion System 12) till the contents become crystal clear. Distillation was carried out in the Automatic Kjeltex System 1020 distillation unit where 40 percent NaOH was injected into the digested material and the distillate was collected in 25 ml of saturated boric acid solution to which 10 drops of mixed indicator had been added. The distillate (ammonia borate complex) was titrated against N/50 HCl, the end point being change in colour from green to a purple violet. The volume of HCl used was recorded. A blank estimation was also carried out using all the reagents except the sample. Protein percent was calculated by the formula:

$$\text{Percent Protein} = \frac{0.0288 \times (\text{Sample titer} - \text{Blank titer})}{\text{Weight of sample in grams}} \times 6.38$$

4.2.4.4 Ash

Ash content was estimated by incinerating the samples at 550°C in a muffle furnace as per the ISI method described in IS:SP:18:Part-XI (1981).

4.2.5 PHYSICAL PROPERTIES OF THANDAI MIX POWDER

4.2.5.1 Bulk Density

For bulk density determination, the method of Sjollemma (1963) was followed. A 100 ml graduated cylinder of tared weight was taken. The funnel was placed over the cylinder opening and the dry powder was allowed to flow freely to the 100 ml mark. The net weight was taken and the results expressed as g/ml (loose bulk density). Further, the powder was tapped on a rubber mat till constant volume was obtained. The volume was read in ml and the packed bulk density expressed as g/ml.

4.2.5.2 Wettability

The wettability was tested by the method developed by Muers and House (1962) and was employed with some modifications. The modification was necessary due to the non-availability of satin drill specified by them (225 g/sq.m) having about 30 threads/cm in the wrap and 20 in the weft. The fabric used in present investigation was satin drill of 221.6 g/sq.m having about 28 thread/cm in the wrap and 19 in the weft. A tray of 21.1 x 16.3 cm (length x breadth) was used instead of the size 20 x 15 cm used by them. The method is as follows:

A piece of fabric (conforming to the above specifications) measuring about 10 x 10 cm was stretched over one end of the body of a metallic can

(6.5 diameter and 4.5 cm height), open at both ends and was held with a rubber band. Another open end can (5 cm dia and 7 cm height) was placed as spacer in a position centrally on the cloth. The tray was marked at a height of 2.5 cm from the bottom and filled with distilled water to this point at $40 \pm 2^\circ\text{C}$. A triangle of 0.4 cm thick glass rod with sides 8 cm long was placed in the dish to prevent close contact of cloth with the bottom of the dish.

The two cans were assembled and 1 g of powder was transferred to the inner can and spread over the 5 cm circle of cloth evenly with a hair brush. The inner can was then removed and the outer can lowered into the dish to rest on the glass triangle and held in place until the water level in the can ceased to rise. A stop-watch was simultaneously started when the cloth touched the water and was stopped when the powder wetted completely. The mean of 3 readings was taken.

4.2.5.3 Dispersibility

The method given by American Dry Milk Institute (1965) was adopted for determining the dispersibility. For the present investigation, an electrical mixer (400 rpm) was used instead of Hubert-Kitchen mixer.

A brass bowl (13 cm height, 13 cm top dia, and 24 cm inner dia) fitted with the outlet of 0.5 inch dia at the bottom was taken. To this, a rubber tube fitted with a pinch cock was attached.

Four hundred ml of water at 40°C was placed into the bowl and 50 g of powder was transferred to the surface of water. This was stirred by the electronic mixer at 400 rpm for 90 sec. The contents of the bowl were removed through the outlet into a 72 mesh sieve and collected in a measuring cylinder (500 ml) and the volume made upto 500 ml. Two ml aliquots were transferred to pre-weighed aluminium dishes and evaporated to dryness and cooled in a

desiccator and total solids was estimated. The weight of the solids obtained multiplies by 50, gave the dispersibility in grams.

4.2.5.4 Solubility Index

It was determined by ADMI (1965) method. Thirteen grams of thandai mix powder was reconstituted in 100 ml of distilled water at 24°C and stirred in a solubility index mixer for 90 sec. The reconstituted thandai was taken in 50 ml centrifuge tubes and centrifuged at 2,500 rpm for 90 sec. The supernatant was discarded. Again, the tube was filled with distilled water and centrifuged. The volume in ml of the sediment at the bottom was recorded as solubility index.

4.3 SENSORY EVALUATION OF RECONSTITUTED THANDAI

Reconstituted thandai was evaluated for its acceptability, during the process of standardization, by a panel of trained judges selected on the basis of triangle test, using a 9-point hedonic scale (Table 4.2) (Amerine et al., 1965).

The thandai should have uniform appearance and an appealing colour. It should be slightly more viscous than milk. There should be balance between flavour of white pepper and aniseed and that of saffron. Product should have medium sweetness, slight sharp taste of white pepper. It may have small amount of sedimentation.

4.3.1 RECONSTITUTION

The reconstitution of the powder for sensory evaluation of thandai was done as follows:

The thandai mix powder was made into a paste and added to water (45°C). The thandai was then chilled and served at 6-8°C for sensory evaluation by the judges.

Table 4.2 Score card for sensory evaluation of reconstituted thandai.

Name of the Judge _____

Date _____

A) Score on the basis of 9-point hedonic scale as under:

Like extremely	9
Like very much	8
Like moderately	7
Like slightly	6
Neither like nor dislikes	5
Dislike slightly	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

B) Score of samples:

Characteristics	Sample Nos.				
	1	2	3	4	5

Flavour

Colour and Appearance

Consistency

Overall acceptability

C. Remarks, if any:

SIGNATURE OF JUDGE

The thandai mix powder to water ratio for reconstitution of different formulations is given below:

PW 1 and PD 1	1 : 3.93
PW 2 and PD 2	1 : 3.81
PW 3 and PD 3	1 : 3.76

4.4 STATISTICAL ANALYSIS

The data obtained from the sensory evaluation was subjected to analysis of variance by Randomized Block Design.

4.5 COST ESTIMATION

The cost of dry blended thandai mix powder/kg and cost of reconstituted thandai per 200 ml was estimated as per the guidelines of "Cost Estimation of Dairy Products" (Singh and Kalra, 1979).

CHAPTER - 5

RESULTS AND DISCUSSION

5. RESULTS AND DISCUSSION

The results of the present study have been presented and discussed under the following headings:

- 5.1 Standardization of method of manufacture of thandai mix powder by dry blending.
- 5.2 Studies on the feasibility of production of thandai mix powder by spray drying.
- 5.3 Estimation of the cost of production of thandai mix powder.

5.1 STANDARDIZATION OF METHOD OF MANUFACTURE OF THANDAI MIX POWDER BY DRY BLENDING

5.1.1 MANUFACTURING PROCESS

Dry blending, a process of standardization, was selected specially for small scale operation, simple technology and low cost of processing. The ingredients used in dry blending were in dry form which could easily be got mixed by dry blending process. In dairy industry, dry blending is used in the manufacture of different product mixes. Usually, the spare capacity of dry blender can be used for production of thandai mix powder. The sizing of each of the ingredients was controlled with the help of sieve in order to allow proper reconstitution of ingredients in water. The thandai mix powder was packed in laminated pouches and stored at 30°C for further use and studies.

5.1.2 SENSORY EVALUATION

Each of the six types of freshly prepared thandai mix powders were reconstituted with water in the ratio given in Section 4.3.1 and subjected to sensory evaluation to ascertain their acceptability on 9-point hedonic scale. The average of sensory scores assigned by different judges are presented in Table 5.1. The test of significance by analysis of variance and Duncan's Multiple Range Test (Duncan, 1960) is given in Tables 5.2 and 5.3, respectively.

5.1.2.1 Flavour

The observations revealed that the average flavour score varied from a minimum of 6.52 (PD1) to a maximum of 8.30 (PW2). The formulation made by dry blending of whole milk powder with other ingredients, viz., almond, raisins, aniseed and white pepper @ 0.5, 0.25, 0.25, 0.25 percent, respectively, was liked most by all the judges because of the typical thandai flavour. Other formulations scored lower ratings, although, they were acceptable from flavour standpoint. The formulation, PW1 and PD1 scored lesser because of lack of typical flavour of thandai. The quantities of white pepper and aniseed were insufficient (0.125 and 0.125%, respectively) than the optimum levels of 0.25 percent for both. The drink prepared from formulations PW3 and PD3 were also rated lower because of the presence of intense, sharp and pungent flavour particularly, due to higher proportion of white pepper.

The flavour of thandai reconstituted from formulations based on whole milk powder, PW1, PW2, PW3 was superior to that containing dairy whitener, PD1, PD2, PD3, respectively. This may be attributed to the presence of higher fat content in whole milk powder that has probably contributed to superior flavour of thandai.

The analysis of variance showed that the flavour of six formulations was significantly different at 1 percent level. The mean flavour scores were

Table 5.1 Sensory score* of thandai reconstituted from dry blended formulations

Formulation	Sensory attributes			
	Flavour	Colour and Appearance	Consistency	Overall Acceptability
PW1	6.78	7.93	7.60	6.90
PW2	8.30	8.10	7.90	8.25
PW3	7.33	8.03	7.80	7.32
^D PW1	6.52	7.78	7.36	6.63
^D PW2	7.83	7.81	7.65	7.91
^D PW3	6.92	7.68	7.55	6.92

* Average of five trials

Table 5.2 Analysis of variance of sensory attributes of six formulations of *thandai* manufactured by dry blending process

Source of Variation	d.f.	Flavour		Colour and Appearance		Consistency		Overall Acceptability	
		M.S.S.	F-Value	M.S.S.	F-Value	M.S.S.	F-Value	M.S.S.	F-Value
Among trials	4	0.404	1.595	0.3772	2.300	0.572	2.168	0.644	2.300
Among products	5	13.865	54.703**	0.359	2.189	0.560	2.124	12.142	43.346**
Among judges	5	1.198	4.722**	8.799	53.573	1.472	5.584**	1.278	4.561
Interaction Products x Judges	25	0.427	1.684	0.494	3.011*	0.354	1.343	0.056	1.627*
Error	140	0.253	-	0.164	-	0.264	-	0.280	-

* Significant at 5 percent level of significance

** Significant at 1 percent level of significance

Table 5.3 Test of significance for sensory attributes of *thandai* of different formulations by Duncan's Multiple Range Test (DMRT)

Sensory Attribute	PW1	PW2	PW3	PD1	PD2	PD3
Flavour	6.783 ^{ab}	8.300 ^b	7.333 ^{cd}	6.5167 ^a	7.833 ^{db}	6.9167 ^{ac}
Overall acceptability	6.900 ^{ab}	8.250 ^b	7.316 ^{cd}	6.633 ^a	7.910 ^{db}	6.9167 ^{ac}

Note: The mean values with different superscript in each row differ significantly (P<0.05)

compared by Duncan's Multiple Range Test. The test revealed that the flavour score of PW2 was significantly ($P < 0.01$) higher than that of PW1, PW3, PD1 and PD3, whereas, the flavour score PW2 and PD2 was of the same order.

5.1.2.2 Colour and Appearance

The colour and appearance scores of different formulations varied within a narrow range of 7.68 to 8.10. There was no significant difference between colour and appearance irrespective of the formulations. The colour and appearance score was solely dependent on the quantity of saffron added and was not affected by the formulations.

5.1.2.3 Consistency

The consistency scores of the six formulations ranged between 7.36 to 7.90. The amount of water added to each formulations was calculated in a way that the final total solids in all the products was constant. The analysis of variance of the scores indicated that the difference was insignificant.

5.1.2.4 Overall Acceptability

The overall acceptability score of PW2 was the highest (8.25) followed by that of PD2 (7.91). PW3 and PD3 had a sharp, biting taste and scored 7.3 and 6.92, respectively. These scores were higher than that of PW1 and PD1, which lacked the typical flavour and taste of thandai. The overall acceptability of six formulations varied significantly as is evident from the analysis of variance. The significance of difference between any two of the overall acceptability scores was tested by Duncan's Multiple Range Test (Table 5.3).

From the foregoing information, it is concluded that all the six types of reconstituted thandai were of acceptable quality on the basis of sensory score. However, thandai reconstituted from PW2, i.e., the blend of whole milk powder,

sugar, saffron and other thandai ingredients, viz., almond, raisin, aniseed, white pepper in the ratio 2:1:1:1, was found to be the best. Presence of whole milk powder improved the flavour and was, therefore, preferred over the dairy whitener. The average flavour, colour and appearance, viscosity and overall acceptability scores for most acceptable reconstituted thandai (PW2) were 8.3, 8.1, 7.9 and 8.25, respectively. The final reconstituted formulation scored more than 8 ("Liked very much") on the 9-point hedonic scale.

5.1.3 GROSS COMPOSITION OF THANDAI MIX POWDER

The chemical composition of the most acceptable thandai mix powder employing PW2 formulation has been presented in Table 5.4. The average composition has been calculated from three trials conducted successively under identical conditions. The average content, in percent, was - moisture, 2.62; total fat, 17.59; protein, 17.05; ash, 3.09 and total carbohydrate (by difference), 59.65. The minimum and maximum range of these constituents has also been indicated in Table 5.4.

5.2 PRODUCTION OF THANDAI MIX POWDER BY SPRAY DRYING

In order to study the feasibility of manufacture of thandai mix powder by spray drying, the best combinations obtained by dry blending process were adopted. The ingredients used in the preparation of spray dried thandai milk comprised of standardized concentrated milk (Fat, 6.2%; SNF, 17.55%), 7.5 percent sugar (100% addition before drying), almond, raisin, aniseed and white pepper in the ratio 2:1:1:1. The drying of the thandai mix concentrate (30% total solids) in Anhydro spray drier was carried out at an inlet air temperature of $180 \pm 5^{\circ}\text{C}$ and an outlet air temperature of $90 \pm 2^{\circ}\text{C}$. The detailed procedure is given in Section 4.1.2.2.

The thandai mix powder prepared by spray drying and dry blending processes were compared for their physical properties and sensory quality.

Table 5.4 Gross chemical composition of *thandai* powder (PW2)

Constituents (%)	Range		Average (%)
	Minimum	Maximum	
Moisture	2.46	2.78	2.62
Fat	17.33	17.85	17.59
Protein	16.51	17.62	17.05
Ash	3.00	3.44	3.09
Total carbohydrate (By difference)	58.63	60.25	59.65

5.2.1 PHYSICAL PROPERTIES

The spray dried thandai mix manufactured along with dry blended thandai mix powder (control) were analysed for their physical properties, viz., bulk density, wettability, dispersability, solubility index in order to evaluate their solubility characteristics as affected by process of manufacture.

The results showing the average values of physical characteristics of thandai mix powder obtained in three trials are presented in Table 5.5. These properties have been discussed individually as under along with the statistical interpretation (Table 5.6).

5.2.1.1 Bulk Density

The bulk density of powder depends on the particle size. The smaller the particle size, the more easily they will pack, resulting in higher bulk density. Roller dried milk has bulk density 0.3 to 0.5 g/ml and spray dried 0.5 to 0.6 g/ml. In the present experiment, the bulk density is slightly higher than the milk powders because of the presence of sugar and other ingredients. The bulk density of dry blended product (0.69 g/ml) is higher than that of spray dried product (0.60 g/ml). This can be attributed to the presence of higher amount of occluded air in the spray dried product.

The result of statistical analysis revealed that there was significant difference ($P < 0.01$) between the bulk densities of products manufactured by different processes.

5.2.1.2 Wettability

The wettability of spray processed thandai mix was found to be better than that of thandai mix powder manufactured by dry blending. This can be attributed to more intimate mixing of sugar with other compounds of mix during spray drying process. In an experiment on the manufacture of khoa powder, Ranganadham (1988) has reported wettability of 11.5, 15, 30 sec for

Table 5.5 Effect of manufacturing process on physical properties* of *thandai* mix powder

Type of <i>thandai</i> mix powder	Bulk density (g/ml)	Wettability (sec)	Dispersibility (g)	Solubility index (ml)
Dry blended (PW2)	0.69	45.20	41.69	1.39
Spray dried (PS2)	0.60	40.25	44.20	1.34

* Average of the three trials

Table 5.6 Analysis of variance of the effect of manufacturing process on physical characteristics of *thandai* mix powder

Source of Variation	d.f.	Bulk density		Wettability		Dispersibility		Solubility index	
		M.S.S.	F-Value	M.S.S.	F-Value	M.S.S.	F-Value	M.S.S.	F-Value
Among products	1	0.0123	49.2**	36.7545	33.875**	9.425	32.839**	1.01705	8136.4**
Error	4	0.00025		1.085		0.287		0.000125	

**** Significant at 1 percent level of significance**

tray, roller and spray dried product, respectively. The wettability in the present case is higher because of large particle size of various ingredients. This is demonstrated by the observation that the bulk densities of dry blended product was higher than the spray dried product. The fineness of the grinding is, therefore, expected to influence the wettability of the product.

The analysis of variance indicated that wettability of thandai mix powder was significantly influenced ($P < 0.01$) by the process of manufacture.

5.2.1.3 Dispersibility

The average dispersibility of thandai mix powder has been presented in Table 5.5. It may be seen that the dispersibility of spray processed thandai mix powder (44.2 g) was better and significantly different ($P < 0.01$) than dry blended product (41.69 g). According to Sarmah (1979), roller dried whole milk powder has got 15.69 g dispersibility. The dispersibility of spray processed whole milk powder varies from 25 to 35 g. In the present case, the dispersibility is much higher for the mix. This could be attributed to the presence of about 60 percent carbohydrate (including sugar) in the mix. Sugar as such is highly soluble in water thus increasing the dispersibility to the observed in the present investigation.

5.2.1.4 Solubility Index

From Table 5.5, it could be observed that the average value for solubility index for spray processed thandai mix powder was 1.34 ml and that of dry blended was 1.39 ml. According to Mruthyunjaya (1982), the solubility index of spray processed whole milk powder is 1.05 ml. In the present case, the solubility indices of both the products were higher because of presence of aniseed and white pepper, in particular, which results in sedimentation. The solubility index of dry blended product was comparatively higher than the

spray processed product and the difference between the two was significant ($P < 0.01$). This can be attributed to filtration of concentrate before spray drying.

5.2.2 SENSORY EVALUATION OF SPRAY DRIED PRODUCT

In two types of thandai mix powder were reconstituted with water in the ratio 1:3.81 (on w/w basis) and subjected to sensory evaluation to compare their acceptability on the basis of 9-point hedonic scale. The average scores assigned by the judges are presented in Table 5.6. The test of significance at 1 and 5 percent levels of significance is given in Table 5.7.

5.2.2.1 Flavour

The flavour score of thandai reconstituted from dry blended thandai mix PW2 (8.27) was higher than that reconstituted from spray dried product, PS2 (7.27). The difference between the flavour scores was significant at 1 percent level of significance. This is attributed to loss of flavour components of aniseeds and white pepper during spray drying.

5.2.2.2 Colour and Appearance

The average sensory score and the analysis of variance indicated that the difference in colour and appearance scores was not significant. This is due to the fact that saffron, the principal colouring agent was dry blended into the spray dried product at a fixed level.

5.2.2.3 Consistency

The consistency scores between the two types of mixes showed a very negligible difference because the total solids in the two reconstituted products were maintained at the same level.

Table 5.7 Comparison between thandai from dry blended mix and thandai from spray dried mix in terms of sensory scores

Code	Type	Flavour	Colour and Appearance	Consistency	Overall Acceptability
PW2	Dry blended	8.27	8.03	8.00	8.07
PS2	Spray dried	7.27	7.93	7.90	7.20

Table 5.8 Analysis of variance of sensory scores of *thandai* from spray dried and dry blended mix

Source of Variation	d.f.	Flavour		Colour and Appearance		Consistency		Overall Acceptability	
		M.S.S.	F-Value	M.S.S.	F-Value	M.S.S.	F-Value	M.S.S.	F-Value
Among trials	2	0.339	3.767	0.108	1.519	0.100	1.102	0.108	2.053
Among products	1	7.500	83.050**	2.845	2.845	0.075	0.827	5.633	106.737**
Among judges	4	0.112	1.253	0.908	12.740**	0.533	5.878**	0.096	1.816
Interaction Products x Judges	4	0.146	1.624	0.258	3.623*	0.033	0.367	0.071	1.342*
Error	18	0.020	-	0.071	-	0.091	-	0.053	-

* Significant at 5 percent level of significance

** Significant at 1 percent level of significance

5.2.2.4 Overall Acceptability

It is concluded that both types of reconstituted thandai from dry blended thandai mix (PW2) and spray dried mix thandai (PS2) powder were of acceptable quality. However, on the basis of statistical analysis, reconstituted thandai from PW2 was found to be more acceptable. The overall acceptability of the two products was significantly different at 1 percent level.

The spray processed thandai mix powder lacked the full flavour of thandai, probably because of the loss of flavour volatiles with the exhaust air.

Spray drying technology would provide manufacturer an opportunity to vary the composition with respect to fat and protein. The microbiological quality of spray dried product is expected to be far superior because of the heat applied during processing. As soon as this product becomes popular, the regulatory agencies would like to set the microbiological limits. Spray drying is expected to satisfy that requirement. This method is also useful for controlling the physical parameters of the mix by adjustment of ingredients or the unit operations. It may be necessary to examine the possibility of reducing the loss of flavour volatiles by way of other approaches such as dry blending of flavour ingredients after spray drying or addition of encapsulated flavour volatiles generally present in the ingredients.

5.3 COST ESTIMATION FOR THANDAI MIX POWDER

The cost of the thandai mix powder was calculated under two heads, i.e., cost of raw materials and cost of manufacture. Further calculations were done to arrive at the cost of one serving containing 200 ml reconstituted thandai.

5.3.1 COST OF RAW MATERIALS

Calculations were based on an estimated production of about 100 kg thandai mix powder per day. The cost of raw materials, thus, calculated has been presented in Table 5.9.

Table 5.9 Estimated cost of raw materials utilized per day.

Raw material	Quantity (Kg)	Rate (Rs/Kg)	Cost of raw material (Rs)
1. Milk based:			
a) Whole milk powder	56.7621	130	7379.07
2. Non-milk based:			
a) Almond	2.4679	270	666.333
b) Raisin	1.2339	220	271.458
c) Aniseed	1.2339	50	61.695
d) White pepper	1.2339	170	209.763
e) Saffron	0.0493	50000	167.620
f) Sugar	37.0187	12	444.224
Total			9200.166

5.3.2 COST OF MANUFACTURE

For the purpose of computing the cost of manufacture, the investment in personnel, depreciation, utilities (electricity, water, etc.) were considered at each step of manufacture as detailed below:

5.3.2.1 Weighing

i) Labour (@ Rs. 5.00/hr)	=	Rs. 5.00/hr x 1.0 hr
	=	Rs. 5.00
ii) Depreciation		
a) Weighing balance	=	$\frac{\text{Cost of balance (Rs)}}{\text{Expected life (days)}}$
	=	$\frac{5000}{20 \times 365}$
	=	Rs. 0.68
b) Miscellaneous items (scoops, utensils, etc.)	=	$\frac{\text{Cost of items (Rs.)}}{\text{Expected life (days)}}$

$$= \frac{400}{10 \times 365}$$

$$= \text{Rs. } 0.10$$

SUBTOTAL (1) = Rs. 5.78

5.3.2.2 Grinding

Grinding charge

$$= \text{Qty./day(kg)} \times \text{Market rate(Rs./kg)}$$

$$= \text{Rs. } 43.2379 \times 0.60$$

$$= \text{Rs. } 25.94$$

SUBTOTAL (2) = Rs. 25.94

5.3.2.3 Blending

i) **Labour (@ Rs. 5.00/hr)**

$$= \text{Rs. } 5.00/\text{hr} \times 2.5 \text{ hr}$$

$$= \text{Rs. } 12.50$$

ii) **Depreciation**

$$= \frac{\text{Cost of blender (Rs.)}}{\text{Expected life (days)}}$$

$$= \frac{100000 \times 2.5}{20 \times 365 \times 8}$$

$$= \text{Rs. } 4.28$$

iii) **Electricity**

$$= \frac{\text{Blending time} \times \text{HP} \times 0.746}{0.8} \times \text{Rate/KW}$$

$$= \frac{2.5 \times 0.5 \times 0.746}{0.8} \times 2.0$$

$$= \text{Rs. } 2.33$$

SUBTOTAL (3) = Rs. 19.11

5.3.2.4 Packaging

i) **Packaging material (Metallized polyester-LDPE bag)**

Cost of one bag = Rs. 1.52

No. of bags required per day = 200

$$\begin{aligned} \text{Cost of bags used in a day} &= 1.52 \times 200 \\ &= \text{Rs. } 304.00 \end{aligned}$$

$$\begin{aligned} \text{ii) Labour (@ Rs.5.00/hr)} &= \text{Rs. } 5.00/\text{hr} \times 3 \text{ hr} \\ &= \text{Rs. } 15.00 \end{aligned}$$

$$\begin{aligned} \text{iii) Depreciation of Sealing Machine} \\ &= \frac{\text{Value of machine (Rs)} \times \text{Time taken in packaging (hr)}}{\text{Expected life (days)} \times \text{No. of hrs in a shift}} \\ &= \frac{50000 \times 3}{15 \times 365 \times 8} \\ &= \text{Rs. } 3.42 \end{aligned}$$

$$\begin{aligned} \text{iv) Electricity} \\ &= \frac{\text{Time taken in packaging} \times \text{KW consumed} \times \text{Rate/KW}}{\text{Efficiency}} \\ &= \frac{3 \times 0.5 \times 2.0}{0.8} \end{aligned}$$

SUBTOTAL (4) = Rs. 326.17

5.3.2.5 Handling Losses

$$\begin{aligned} \text{Losses during handling} &= 0.5 \text{ percent of the cost of raw material} \\ &= \frac{0.5 \times 9200.166}{100} \\ &= \text{Rs. } 46.00 \end{aligned}$$

SUBTOTAL (5) = Rs. 46.00

5.3.2.6 Miscellaneous

$$\begin{aligned} \text{i) Electricity (lighting, fan, etc.)} \\ \text{Electricity charges} &= \text{Rs. } 100/\text{month} \\ &= \text{Rs. } 3.33/\text{day} \end{aligned}$$

ii) Water charges = Rs. 60/month
 = Rs. 2.00/day

iii) Detergent, buckets, brushes, etc.

Detergents:

a) Soda per day = Rs. 2.50
 b) Teepol per day = Rs. 2.50
 c) Soap @ Rs. 30/month = Rs. 1.00

Depreciation:

a) Buckets (2 in No.) = $\frac{\text{Value of buckets (Rs.)}}{\text{Expected life (days)}}$
 = $\frac{140}{5 \times 365}$
 = Rs. 0.076

b) Brushes (2 in No.) = $\frac{\text{Value in Rs}}{\text{Expected life (days)}}$
 = $\frac{20}{6 \times 30}$
 = Rs. 0.11

c) Squeeze (1 in No.) = $\frac{\text{Value in Rs}}{\text{Expected life (days)}}$
 = $\frac{100}{365}$
 = Rs. 0.27

iv) Maintenance:

Cost of maintenance = Rs. 100/month
 = Rs. 3.33/day

Table 5.10 Cost calculation of *thandai* mix powder

Cost (Rs)	Cost for		Percentage of total cost
	100 kg mix	1 kg mix	
1	2	3	4
A. Raw Materials			
1. Milk based:			
a) Whole milk powder	7379.07	73.79	76.45
2. Non-milk based:			
a) Almond	666.33		
b) Raisin	271.46		
c) Aniseed	61.69		
d) White pepper	209.76		
e) Saffron	167.62		
f) Sugar	444.22		
	1821.08	18.21	18.87
Total	9200.15	92.00	95.32

Contd....

Contd....(Table 5.10)

	1	2	3	4
B. Manufacturing				
1. Weighing:				
a) Labour	5.00			
b) Depreciation	0.68			
		5.74	0.05	0.0592
2. Grinding		25.94	0.25	0.269
3. Blending:				
a) Labour	12.50			
b) Depreciation	4.28			
c) Electricity	2.33			
		19.11	0.19	0.197
4. Packaging:				
a) Packing material	304			
b) Labour charges	15			
c) Depreciation	3.42			
d) Electricity	3.75			
		326.17	3.26	3.377
5. Handling losses		46.00	0.46	0.476

Contd....

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Contd....(Table 5.10)

	1	2	3	4
6. Miscellaneous:				
a) Electricity	3.33			
b) Water	2.00			
c) Detergent, etc.	6.45			
d) Maintenance	3.33			
e) Depreciation of building	17.00			
f) Floor sweeping	-3.00			
		29.11	0.29	0.300
Total		452.07	4.52	4.55
Grand Total		9652.22	96.52	

v) **Floor Sweeping:**

Sweepings were sold to
poultry farm @ Rs. 10/kg

Amount of sweeping per day = 0.3 kg

Cost of sweepings = $-[0.3 \times 10]$

= Rs. 3.00/day

SUBTOTAL (6) = Rs. 12.11

The following table summarizes the cost calculation of thandai mix powder. The cost of thandai mix powder worked out to be Rs. 96.52 per kg, i.e., the sum of the cost of raw materials (Rs. 92.00) and the manufacturing cost (Rs. 4.52). It is evident from the table that approximately 95.32 percent of the total cost of raw materials, whereas, only 4.55 percent was spent on manufacturing.

5.3.3 COST OF RECONSTITUTED THANDAI

One kg thandai mix powder can be reconstituted to approximately 4900 ml of thandai, so, the cost of 200 ml of reconstituted product

$$= \frac{96.52}{4900} \times 200$$

$$= \text{Rs. 3.94}$$

$$\sim \text{Rs. 4.00}$$

CHAPTER - 6

SUMMARY AND CONCLUSION

6. SUMMARY AND CONCLUSION

Studies were conducted to standardize the formulation of a ready-to-reconstitute thandai mix powder containing all the ingredients including milk solids.

The first three basic formulations of thandai powder were prepared, comprising of almond, raisins, aniseed and white pepper in the ratio (%) 2:0.5:0.5:0.5 (PW1), 2:1:1:1 (PW2), 2:1.5:1.5:1.25 (PW3), by grinding each of them with saffron (0.1 g/lit) and blending with ground sugar (75 g/lit). Each of these mixes were added with whole milk powder (115 g/lit) in a blender. The corresponding products prepared by admixing dairy whitener were designated as PD1, PD2, PD3, respectively.

Each of the six types of thandai mix powder were reconstituted by mixing with water. The products were evaluated for various sensory parameters using a 9-point hedonic scale. On the basis of sensory scores and statistical analysis, thandai reconstituted from formulation designated as PW2 was found to be most acceptable. The cumulative sensory ratings for this product corresponded with "liked very much" category.

The average gross chemical composition of the most acceptable thandai mix powder (PW2) was: moisture, 2.62 percent; fat, 17.59 percent; protein, 17.05 percent; ash, 3.09 percent and total carbohydrate (by difference), 59.65 percent. The average wettability, dispersibility and solubility index values for PW2 were 45.2 sec, 41.69 g and 1.39 ml, respectively.

The feasibility of production of thandai mix powder by spray drying process was studied using optimum levels of thandai constituents and concentrated milk of known composition. The technology involved: standardization of milk (Fat:SNF::1:2.83), preheating to 65°C, homogenization at a pressure of 2500 psi in the first stage and 500 psi in the second stage, forewarming to 90°C and concentration to 22 percent total solids in a vacuum evaporator. The concentrated mix was thoroughly mixed with predetermined quantities of ground almond, raisins, aniseed, white pepper and sugar. After filtration, thandai mix concentrate (30% total solids) was then batch pasteurized at 71.7°C for 30 min and cooled to 60°C. The concentrate was finally spray dried at an inlet air temperature of $180 \pm 5^\circ\text{C}$ and an outlet air temperature of $90 \pm 2^\circ\text{C}$, with an atomizer speed of 2500 rpm.

The spray processed thandai mix powder was found to be superior from the standpoint of wettability, dispersibility and solubility characteristics. However, on the basis of sensory evaluation of reconstituted thandai, thandai mix powder prepared by dry blending process was found to be more acceptable than the product reconstituted from spray dried milk.

The cost of production of dry blended thandai mix powder worked out to be Rs.96.52 per kg. While the cost of 200 ml reconstituted thandai is Rs.4.00 per serving. This is amenable to small scale operation.

It can be concluded that it is possible to prepare thandai mix powder of acceptable quality by dry blending and spray drying which upon reconstitution would yield a product similar to traditional thandai.

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