DEVELOPMENT OF DIETETIC BEVERAGES

ASHA M. JAVALAGI

DEPARTMENT OF RURAL HOME SCIENCE
UNIVERSITY OF AGRICULTURAL SCIENCES
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DEVELOPMENT OF DIETETIC BEVERAGES

ASHA M. JAVALAGI

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Dedicated to

My Beloved Parents and Grandpa.

Department of Rural Home Science,
UNIVERSITY OF AGRICULTURAL SCIENCES,
Bangalore

CERTIFICATE

This is to certify that the thesis entitled "Development of Dietetic Beverages" submitted by Miss Asha M. Javalagi for the degree of MASTER OF HOME SCIENCE in FOOD AND NUTRITION to the University of Agricultural Sciences, Bangalore is a record of *bona fide* research work done by her during the period of her study in this University under my supervision and guidance and the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar titles.

Bangalore,
April , 1985.

(VAIDEHI, M.P)
Associate Professor & Head,
Department of Rural Home Science.

APPROVED BY

Chairperson ____________________
(VAIDEHI, M.P)

Members:
1 ____________________
(K. ATMARAM)
2 ____________________
(BHAWANI BELWADY)
3 ____________________
(K.M. BOJAPPA)
4 ____________________
(MUSHTARI BEGUM, J)

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ASHA M. JAVALAGI

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INTRODUCTION

I. INTRODUCTION

Beverages are important in human diet as they are pleasant and satisfying. Because of their aesthetic and refreshing qualities, they are in greater demand in public schools, cafeterias, snackbars, public eating places than homes where the beverage is consumed as breakfast and tea time item. Hence they need to be nutritious. Many of the beverages available in the market, attract the consumer mainly due to their colour and tactile sensations. However, these beverages do not supply nutrients. Although certain health beverages like Horlicks, Bournvita and so on to certain extent meet the nutritional requirements, they are priced high and are beyond the reach of common man. Thus, there is a plenty of scope for development of low cost beverage of high nutritional value.

Among the common beverages, tea is one of the widely consumed beverage. However, medical reports are apprehensive about tea, because of its high tannin and caffeine contents. This aroused awareness among the consumers who started demanding low tannin and caffeine containing beverages. Consumption of tea with added milk seemed to have created apprehensions in the minds of consumers regarding diabetes, artherosclerosis and cardiovascular diseases, owing to the high amount of calories derived from sugar and milk. Black tea of low tannin and caffeine contents and use of herbs seem to hold a good prospect. These beverages in addition to their therapeutic value appear to lessen the health problems associated with drinking too much of tea. The present investigation was aimed at studying the feasibility of replacing creamed tea with more nutritious herb blended teas.

Inadequate production of milk in developing countries and declining supply of non-fat dry milk for world distribution warrants the need for other protein beverages. Soy-beverages have the potential of combating protein under-nutrition in many parts of the world. Utilisation of defatted soy flakes obtained as a byproduct after industrial extraction of soy oil seem to be economical one. In the present study it is, therefore, intended to develop a beverage having higher amounts of protein to provide a high protein dietetic beverage.

In developing countries like India, the problem of protein-energy malnutrition seem to have remained unsolved in children. Due to the methods followed in the preparation of food for children at home these foods have been found to be bulky with low density of nutrients which reduced the intake of protein and energy from a given amount of food or beverage. Malting can be sought as a best alternative for, it is high density and low bulk having food. This is better food for convalescents, gastro-intestinal disorder patients, children, teenagers, expectant and nursing mothers. However, on these beverages studies regarding the preferential ratings and acceptability level have to be investigated. Major cereal grain malts are blended for studying their acceptability. The development of more nutritious beverages can be in two ways. One way is to directly add minerals, vitamins or soluble proteins to the beverages without affecting the original character of the beverage as much as possible. The other way is to blend foods rich in vitamins/minerals/proteins with the other foods to enrich it nutritionally.

The study was taken up with the following objectives:

1. To develop a beverage/beverage mix as a source of minerals and ascorbic acid (vitamin C); a beverage rich in protein and a beverage mix high in proteins and calories.

2. To study the acceptability of the developed beverages both at laboratory and consumer level.

3. To determine calcium, sodium, potassium, iron, copper, zinc, manganese, tannin contents of the herb blended tea without milk and protein in milk like soy beverages and proteins and calorie content of malt beverages.

REVIEW OF LITERATURE

II. REVIEW OF LITERATURE

Available literature has been presented under the following heads:

2.1. Herbs and herbal teas

2.1.1. History of herbs

Herbs and their teas are as old as civlization. Ancient physicians had broad repetoire of remedies based on herbs and recommended herbal teas to all the diseases starting from head ache to epilepsy. Every age has produced a distinct herbal culture reflected in religious ceremonies, cooking and medication. Today's medicinal lexicon still has a very large number of active principles deriving from herbal materials, while herb teas are still prepared throughout the world for the varied physiological effects. Herbs are staging a comeback. They have been appreciated for their flavouring, aromatic and medicinal qualities (Signore, 1979).

2.1.2. Medicinal value of herbs and spices

Ceres (1984) and Pruthi (1976) gave a concise report of the medicinal value of various herbs and spices.

Basil (*Ocimum sanctum*) leaf is considered to be stomachic, antihelminthic, alexipharmic, antipyretic, diaphoretic, expectorant, carminative, stimulant and pectoral. An infusion of the leaves is given for cephalgia, in the treatment of croup, and a common remedy for coughs. It has mild antiseptic properties.

Cardamom (Elettaria cardamomum): Infusion of cardamom seed with clove and ginger is helpful in combating digestive ailments. It is used as a powerful aromatic stimulant, carminative, stomachic and diuretic, checks nausea and vomitting.

Cinnamon (Cinnamomum zeylanicum): Cinnamon bark is a pleasant aromatic, astringent, stimulant and carminative and has property of checking nausea and vomitting. An infusion prepared cleans the mouth and throat.

Cloves (Eugenia caryophyllus): Clove is highly valued in medicine as carminative, aromatic and stimulant. Infusion is given for flatulance and dyspepsia. Because of its antiseptic and antibacterial properties, it is used in a number of pharmaceutical preparations.

Cumin: (Cuminum cyminum): Cumin seeds have long been considered as stimulant, carminative, stomachic and astringent. Infusion is useful in diarrhoea and dyspepsia and also for those with flatulant digestions.

Fennel seeds (Foeniculum vulgare) seeds are useful in diseases of chest, spleen and kidney. They are used as a corrective for less pleasant drugs. Fennel seeds are constituent of liquorice powder and its preparations. Its infusion is used as an enema for infants, for flatus expulsion and also in indigenous medicine given to increase lacteal secretion and to stimulate sweating. It also has a reputation of being an appetizer and a slimming herb.

Liquorice (Glycyrrhiza glabra): Liquorice tea prepared using root is used by qualified herbalists as an excellent drink for those with stomach ulcers. It is soothing, emolient and demulcent herb. It is used in colds and coughs.

Mace (Myristica fragrance): In India, mace is used more as a drug than as a condiment due to its stimulant, carminative, astringent and aphrodisiac properties. Pharmaceutical preparations for dysentry, stomach-ache, flatulance, nausea, vomitting, malaria, rheumatism, sciatica and leprosy (early stages) contain mace.

Mint (Mentha piperita and Mentha arvensis): Mints are used in many pharmaceutical preparations because of its menthol content, which is medicine for stomach disorders, headache, rheumatism and other pains. Leaf extractions are used in cough drops, inhalations, mouth washes, tooth pastes and expectorants. Infusions prepared out of dried leaves are administered as a tonic to the kidney and in diseases of liver, spleen and asthma. In China, infusions are used as carminative and antispasmodic. In Annam, used as an excellent diaphoretic and given in fever, indigestions, sore gums and tongue.

Tea leaves (*Camellia sinensis*): Camellia tea is perhaps the one known to everybody. It is a stimulant and astringent drink with definite nervine properties. It contains theine and tannins and regular practice of drinking strong tea is harmful to human system.

2.1.3. Chemical composition of herbs and spices

Farsman and Ahmadi (1978) estimated the flourine content of 8 tea varieties from Iran and reported it to range from 10.3 to 15.3 mg per 100 g of the leaves; while the beverage contained 0.89 to 1.15 µg/g with 69 to 87 per cent of extraction. 3.8 g of leaves supplied 0.34 to 0.44 mg of flourine and the authors claimed the practice of giving diluted tea to infants between breast feedings for dental benefits. Similar study on 213 subjects carried out for 3 days by Duckworth and Duckworth (1978) in U.K., showed that flourine intake via tea increased with the age and hence tea serves as a valuable source of flourine. Ophague *et al.* (1983) analysed the daily flourine consumption by 2-year old children. The foodstuffs consumed daily in different regions were analysed for flourine. It was observed that flourine concentration was highest in drinks and more in tea (0.94×10^6 mg/100 ml). Table 1 gives the mineral and vitamin C contents of herbs and spices.

Table 1: Mineral (g/100 g) and vitamin C contents of herbs and spices

Herb/spice	Total ash	Ca	P	Na	K	Fe	Vitamin C mg/100 g
Basil	16.7	2.1	0.47	0.04	3.7	0.040	61.3
Cardamom	5.0	0.3	0.21	0.01	1.2	0.012	12.0
Cinnamon	3.5	1.6	0.05	0.01	0.4	0.004	39.8
Cloves	5.0	0.7	0.11	0.25	1.2	0.010	80.9
Cumin	7.7	0.9	0.45	0.16	2.1	0.048	17.2
Fennel seeds	13.4	1.3	0.48	0.09	1.7	0.010	12.0
Mace*	1.6	0.18	0.10	-	-	0.0126	12.0
Mint*	1.9	0.2	0.062	-	-	0.0156	27.0
Amla*	0.5	0.05	0.02	-	-	0.001	600.0

Source: Pruthi (1976)

*Gopalan et al. (1980)

2.1.4. Physiological effects of tea

Caffeine and polyphenol fractions of tea are responsible for the clinical effects of the beverage. Caffeine is a vasodilator, having diuretic and stimulant properties and tea drinking has been recommended for the treatment of a variety of disorders. Polyphenols which constitute 48.5 per cent of total solids of a cup of tea are claimed to have a number of pharmacological activities. They possess the property of strengthening the walls of the blood vessels and regulating their permeability, increasing level of catecholamines, the capillary strengthening action, anti-inflamatory action, normalization of thyroid-hyper function causing thyrotoxicosis, protection against the harmful effects of exposure to radiation, bacteriostatic effect on a number of microbes and stimulation of folic acid biosynthesis (Stagg and Millin, 1975). Studies conducted by Scala (1974) on human volunteers revealed that tea enhanced discriminating ability, accuracy of tactile sensations and sensitivity of taste and smell. The subjects improved considerably in their response to oral questioning and mathematical problem solving. Tea is of value in treatment and restoration of fluid balance during vomitting and diarrhoea. Caffeine's relaxant effect on smooth muscles is useful in asthma and the diuretic property in treatment of cardiac oedema (Stagg and Millin, 1975).

Adverse effects of tea consumption

Regular consumption of strong tea has adverse effect on nutrient utilisation and health. Eggum et al. (1983) observed the effect of dietary tea on the protein and energy utilisation from soybean meal and barley in rats. The results indicated the negative effect on protein utilisation and digestible energy and black tea had a higher effect than green tea and coffee because of high tannin content which reacted with limiting amino acids of soybean meal and barley, reducing their biological value.

Vimokesant et al. (1982) observed antinutritional effect of tannins in tea which inactivated thiaminase. One gramme of tea leaves brewed in 100 ml of water for 5 minutes destroyed 0.21 mg of thiamine. Trials of Hilker and Somogyi (1982) on human subjects showed a reduction in thiamine excretion and blood transketolase enzyme by consumption of tea and coffee. The authors claimed that heavy drinkers may show symptoms associated with beri-beri.

Effects on health: Panda et al. (1981), conducted animal study to test the effect of tannic acid consumption. Six dietary treatments were assigned to 60 weanling rats. Diets I, II, III and IV contained 0, 0.25, 0.5 and 1.0 per cent pure tannic acid respectively. Diets V and VI contained 15 and 25 per cent tannic acid respectively. After 8 weeks of experiment, histopathological examination showed various lesions in small intestine, liver and kidneys and a positive correlation was observed with the concentration of tannic acid in the diet. It was concluded that, tea and coffee high in tannic acid may pose hazard to public health.

Morton (1979) claimed that catechin tannins and non-hydrolysable tannin have deleterious effects which are becoming more apparent. In a test, 26 out of 30 rats developed tumours when subcutaneously injected with tea tannins. A correlation between tea rice gruel consumption and incidence of oesophagel cancer was observed in a study conducted in Japan. Strong epidemiological and bioassay evidences exist link between catechin tannin and oesophageal cancer.

Boatella Riera et al. (1981) analysed the caffeine content of the beverage. In all the five trials, 98 per cent of caffeine was extracted from the leave during brewing and the average value of caffeine content of brews prepared from 15 commercial tea samples was 3.05 per cent sufficient to cause adverse effect on health.

2.1.5. Preparation of herbal teas and tea mixes

Kaper and Vries (1982) followed another method for the preparation of herbal tea mixture. The oily extracts from lemon, orange, rum, peppermint, bergamot, jasmine and rose flavours were mixed with aqueous extract of tea, to form an oil in water emulsion which was spray dried and mixed with dried tea extract, dust and leaf tea.

CFTRI (1982) reported development of lemon and ginger tea blends using natural essential oils as basic flavour components and other natural essential oils and oleoresins. When tested organoleptically, they were found to be acceptable. Similarly, 4 rose blend teas, 2 jasmine blend teas, mint flavoured teas incorporating dried leaves of _Mentha piperita_ and _Mentha arevensis_ were investigated.

Gogolishvili _et al_. (1983) prepared tea substitutes of improved biological and nutritive value that contained blend of a subtropical persimmon and dry cured lemon in the ratio of 92-95 per cent to 5-8 per cent. Tamchyna (1980) stressed the importance of decreasing sugar content of soft drinks with the use of natural substances potentiating the sensation of sweet taste without affecting the taste, used polydextrose as a low calorie sweetening agent in various formulated foods and the calories contributed was only 1 cal per g of the sweetner.

Tea bags containing a mixture of leaf tea and ascorbic acid were prepared by a group of workers (Multichemie, 1982). Each bag contained a quantity of tea sufficient to prepare one cup and the citric acid added intensified the flavour of tea. Various herbal teas contained essential oil extracted from fermented fruits or skins of ripe fruits or leaves of subtropical evergreen plants. Before extraction, materials were dried and ground. The oil extracted was added to tea leaves which was used in the preparation of the beverage (Anonymous, 1983).

Morse and Lisk (1980) analysed the elemental content of honeys from several nations. Samples of teas with added honey and sweetener were also analysed. The results showed iron and zinc concentration to be high which were derived from added honey.

2.2. Soymilk

Inadequate production of milk in developing countries and declining supply of non-fat milk for world distribution, demonstrates that the need for protein beverages remains critical. Soy beverages are potentially a principal resource to combat protein undernutrition in many areas of the world.

2.2.1. Sources for soymilk preparation

Different soy fractions are existing as a result of advanced processing techniques. Soy products with different protein and fat levels have been obtained which find a wide application in food systems.

In China, soymilk has been a well known product since thousands of years. It is generally made by soaking yellow soybeans in water overnight, then grinding with water. The milky fluid is separated by filtering the solid part through a cloth (Leo, 1975). Infants with specific enzyme loss like lactase, when fed with such type milk, often produced loose malodorous stools, which is because of undigestible sugars. Hence, defatted soy flour and isolated soy proteins with improved colour, odour, flavour and free from indigestible carbohydrates, are now being used in infant formulae in place of soybean extracts. These formulae seldom caused malodorous stools (Wilke et al. 1979).

2.2.2. Chemical composition of soymilk

Soybean milk is nutritionally superior to cow's and human milk in having more of linoleic acid (Fukushima, 1975). Khaleque and Wallace (1975) studied the nutritional quality of proteins of soymilks *in vitro*. Results on amino acid index of soybean milk was considerably lower than that of human and cow's milk and eggs which is due to the limiting amounts of sulphur containing amino acids.

Soybean milk called soylac prepared by Loma-Linda Co., Ohio, using hot water grinding method, contained 2.1 per cent protein, 3.8 per cent fat and 3.4 per cent total sugars (2.2% added), which was recommended for 7 per cent of all the American babies who are allergic to cow's milk and lactose intolerant (Shurtleff, 1981). Thirty varieties of soybeans grown in Philippines were made into milk using boiling water grind technique. The protein content of milk ranged from 2.29-3.53 with a mean of 2.72 per cent. The mean value for extraction of protein of the raw beans into milk was 78.5 per cent and that of fat was 52.4 per cent (Bourne et al., 1976).

Indian Standard Institution (I.S. 7482-1974) prescribes the requirements for protein based nutritive beverages, obtained from protein isolates or other oilseed protein sources optionally mixed with milk or milk powder or suitable amino acid, optionally flavoured, sweetened and pasteurized. The requirements for total solids, protein (N x 6.25) and fat are 11.5 per cent, 3.0 per cent and 1.5 per cent, respectively.

Prabhavat et al. (1978) tried to improve the nutritive value of regular soybean milk by blending with sesame milk. The defatted roasted sesame seeds were soaked for one hour at 60°C and ground using seed to water ratio of 1:1.6 v/v and 2 per cent sesame oil. The improved soymilk contained 2.3 per cent protein, 3.2 per cent fat and 68 cal per 100 g. There was increase in percentage of sulphur containing amino acids. Chemical scores increased from 54 to 106 (i.e., almost double) without reduction in the per cent of other essential amino acids.

Mittal and Steinkraus (1976) compared the proximate compositions of soymilk versus cow's milk. They found that, soymilk compared well with cow's milk in respect of protein. On an average, it contained 4 per cent protein, compared with 3.8 per cent of cow's milk, 2.4 per cent of fat compared with 4.9 per cent in cow's milk. The total ash content was 3.96 mg per g compared with 7.28 mg per g of cow's milk. An admixture of cow's milk with soymilk enhanced the total solid content, fat and macroelements but reduced protein level. Silva and Riveros (1980) using 70 per cent soy and 30 per cent sesame milk blends, reported higher nutritive value than single components.

2.2.3. <u>Therapeutic value of soymilk</u>

Soymilk is an efficient food of high acceptability, rapid digestibility and low cost (Mathew and Raut, 1981). Ten children 2-5 year old with different degrees of protein energy malnutrition (PEN) and other nutritional disorders were given 200 ml of soybean milk twice a day for 60 days. The milk contained 2.5 to 3.5 per cent protein, 0.5 to 1.0 per cent fat, 9 to 12 per cent carbohydrates (cane sugar) and 0.3 to 0.5 per cent of ash with a calorific value of

65 cals per 100 ml. The time required for children with PEM grades V, III and I to gain normal body weight, physique and mental alertness to match normal chronological age was 120, 90 and 60 days respectively.

Oliveria _et al_. (1981) gave five experi mental diets based on cow's milk, methionine enriched soymilk, soy-protein isolate (SPI) or methionine enriched SPI, to acutely malnourished children between the age of 12 and 36 months for 25 days. All the diets were designed to provide 1 to 5 per cent protein, 3.5 per cent fat and 7.5 per cent carbohydrates. Enriched soymilk contained DL-methionine at 1.5 g per 16 g of nitrogen. Nitrogen balance studies showed a similar intake for all children. Average nitrogen retention as per cent intake ranged from 31.8 to 34.7 in children given cow's milk, 10.5 to 15.3 in those given soymilk, which increased from 17.2 to 24.8 when methionine was added. When SPI was given, average retention values were 14.7 to 16.5 and 11.0 when methionine was supplemented.

Greendly and Abrams (1983) compared the action of soyprotein and casein of milk on metabolism of plasma lipo-protein and cholesterol in humans. Fourteen men during 2 periods, each of 1 month duration were studied. In the first period, the diet contained 30 per cent energy from fat, 55 per cent as carbohydrates and 15 per cent as casein protein. While in the second period, the diet was identical except for soyprotein in place of casein. This substitution showed no change in plasma concentration of cholesterol, triglycerides and lipoproteins. But in 3 out of 4 men suffering from hypertriglyceridemia, the soyprotein significantly decreased the plasma levels of triglycerides, while casein showed no change. Similar results reported from Calvert et al. (1981) showed a cholesterol lowering effect was achieved by increasing the proportion of soyprotein in milk contrary to the effect of casein. The reduced intestinal absorption of cholesterol and increased faecal steroid excretion are primarillyresponsible for antihypercholestrolemic effect of soyproteins compared with casein of milk.

Cystathione synthetase deficiency is a disorder of amino acid metabolism often characterised by hypermethioninemia and homocystinemia, with clinical systems of dislocated lenses, skeletal abnormality, and mental retardation. It is thought that, proper management consists of low methionine diet and high protein. Soymilk is an important solution to this problem. Soymilk tains approximately half (0.052 g/g total N) as much as in cow's milk (0.150 g/g total N). Drinking same amount of soymilk instead of cow's milk will reduce methionine intake to approximately 1/6th (Vivian Shih, 1970).

Soybean being a plant source, contains relatively large amount of unsaturated fatty acids and protein content of soymilk approximately equal to that of cow's milk (3.4-4%), hence can be used in atherosclerotic patients.

Chi-Yan-Chou (1983) fed a soybean, rice and egg formula to 100 infants including 4 prematures and 10 undernourished in China. Another group of 42 infants serving as control were fed with cow's milk or mother's milk. Feeding was continued till they attained an age of one year. The growth curves indicated that infants who received soybean formula achieved height equal to those of control within 7 months and weight by one year. Nitrogen retention value was equal to control and 1/3 of Ca was retained from test diets. It was concluded that the soyformula makes a very good replacement to cow's milk, especially for lactose intolerant children.

2.2.4. Acceptability studies

Soymilks prepared from whole soybeans and defatted soyflour were evaluated for flavour acceptability by a taste panel of 27 members. Fresh homogenised cow's milk was used as standard. Milk prepared from defatted soyflour with 2 per cent sugar added was rated slightly inferior to cow's milk in flavour while it was found to be acceptable to that of whole bean milk (Mittal and Stein Kraus, 1976).

Patil and Gupta (1971) developed a protein-rich beverage from soybean and whey at various ratios and subjected it to sensory evaluation using a taste panel of 10 members and 343 consumers. It was observed that flavoured beverages were more acceptable and pineapple flavoured and strawberry flavoured beverages were liked well (7.2 score on 9 pt. Hedonic Scale).

Acceptability of blends of cow's milk and soybean milk was studied by Blesa et al. (1982). Eight semi-trained testers were given 0, 20, 40, 50, 60, 80 or 100 per cent blended soymilk and milks contained salt, sucrose and vanilla essence. Six of tasters preferred mixture with 40 per cent soy and 60 per cent cow's milk. In an acceptability test, 56 out of 64 untrained persons found these proportions pleasant.

Ferreira and Shirose (1977) tried flavouring soymilk with various flavours for use in school meals. Samples of soymilks were flavoured with (a) strawberry, (2) chocolate, (c) red currant, (d) vanilla, (e) coconut, (f) banana and (h) pineapple were evaluated by a panel of adults and a group of approximately 100 children of 7-18 years from various socio-economic groups. Regarding flavour, the adults rated red currant as highest and strawberry as lowest, while for aroma, sample with coconut flavour scored highest and strawberry and chocolate to be lowest. Children evaluated the samples for overall liking and found strawberry to be most liked and coconut to be the least. Significant diffe[illegible]ence in preferences were observed between age groups and sexes of children but not between socio-economic groups.

Soybeverages differing in chalkiness and added with one of 3 partially hydrogenated oils were studied by a taste panel. The results indicated that, all the products containing oil supplements were judged to be whiter than control samples (soybeverage without added oil). Addition of corn oil to sterilized soybeverage significantly reduced chalkiness (Hitzman <u>et al</u>., 1982).

Soymilks were made less astringent by addition of skim milk, $CaSO_4$ or citric acid. Addition of $CaSO_4$ and citric acid were not sufficient to cause visible separation of soymilk solids but in mouth feel, warm temperature at 65°C resulted in loss of astringency compared at room temperature or 4°C (Chien and Snyder, 1983).

Sesame milk produced by grinding defatted roasted sesame using a ratio of 1:7 with water after soaking for one hour at 60°C. Addition of this milk to soymilk at 1:1.6 v/v and 2 per cent sesame oil improved nutritive value of the milk [illegible], the acceptability was reduced because of bitter taste and sesame odour (Prabhavat <u>et al</u>., 1978).

2.3. Malt beverages

2.3.1. Effect of malting on nutritive value of grains

Infants and invalid foods based on malted milk powders are being used as supplements to the diets of invalids. Process of malting is known to bring about favourable change in the nutritive value of the grains. It involves the conversion of stored nutrients to simpler forms which could be easily utilized by the human body. Starch gets converted to simpler carbohydrates, dextrins and maltose. Protein gets degraded into polypeptides, peptides and finally to amino acids. Fats will be brought down to fatty acids. Some of the bound iron is converted to a more readily available form. Phosphorus will be released from phytates. Bound vitamins will be converted to free form (Rajlaxmi, 1976). In addition, synthesis of water soluble vitamins and tocopherols take place. This process is known to occur due to enzymes which becomeactive during germination (Shastri, 1975). This is evident from Table II.

Fahmay et al. (1981) analysed the amino acid content of baby foods. The results indicated that the formula containing germinated seeds had highest amino acid content compared to other formulae.

Germination results in a significant increase of vitamin C content after 72 hours, thiamine and riboflavin after 48 hours. Trypsin inhibitor activity reduced within

Table II: Nutritive value of malted grains

Food	Per cent increase					Per cent decrease in phytate	Vitamin C mg/100 g
	Free sugar (%)	Amino nitrogen (%)	Vitamins				
			B_1	B_2	B_3		
Cereals	125	220	25	45	45	40	10
Pulses	100	300	20	55	50	35	70

24-48 hours of germination. The levels of methionine, threonine, tryptophan and total lysine did not change very much upto 72 hours of germination (CFTRI Annual Report, 1974).

2.3.2. Effect of malting on the physical characteristics of beverage

Brandtzacq *et al*. (1981) studied the viscosity of malted and unmalted grains. An increase in germination time from 30 hours to 48 hours reduced the viscosity of a 25 per cent gruel of flour boiled in water by 100 per cent for ragi and by 150 per cent for sorghum. A weaning food prepared from ragi and green gram in 70:30 ratio from malted and unmalted mixtures showed that, atleast 3 times as much of malted as of the unmalted mixture could be mixed into the same volume while maintaining the same viscosity.

CFTRI studies reported that, increasing the period of germination lowered starch gelatinization temperature and paste viscosity but improved *in vitro* digestibility (CFTRI Annual Report, 1980-81).

Mosha and Stanberg (1983) reported that gruels prepared from different ungerminated and germinated maize and sorghum in increasing amounts (5 to 25 per cent dry matter), showed that gruels with 10 per cent of flour had suitable eating consistency for small children, while

MATERIAL AND METHODS

III. MATERIAL AND METHODS

The beverage and beverage mixture studied were divided into two categories for convnience:

I. Clear beverages - Herbal teas

II. Milk like beverages - Blended soymilk and malt beverages

3.1. Materials for clear beverages

Herbal teas: Herbal teas were prepared with indigenous and commonly available herbs namely, dried Amla (*Emblica officinalis*), Cardamom (*Elettaria cardamomum*), Cinnamon (*Cinnamomum zeylanicum*), cloves (*Eugenia caryophyllus*), Cumin (*Cuminum cyminum*), Fennel seeds (*Foeniculum vulgare*), Japatre (*Myristica fragranse*), Liquorice (or Atimadhura) (*Glycyrrhiza glabra*), Mint (*Mentha arvensis*) and Tulsi (*Ocimum sanctum*) which were obtained from the local market, except tulsi, which was plucked from the college garden.

Sweetening agents: Sweetening agents used for the preparation of teas were cane sugar, saccharine tablets and honey (Coorg honey) which were procured from the local market.

Tea leaves: Commercial tea leaves of 'Gemini' brand were used.

3.2. Materials for milk like beverages

3.2.1. Soymilk blends: Defatted soy flakes were obtained from Mysore Snack Foods Private Limited, Bangalore. Sesame seeds, fresh coconut, skim milk powder (Anik spray) were obtained from the local market.

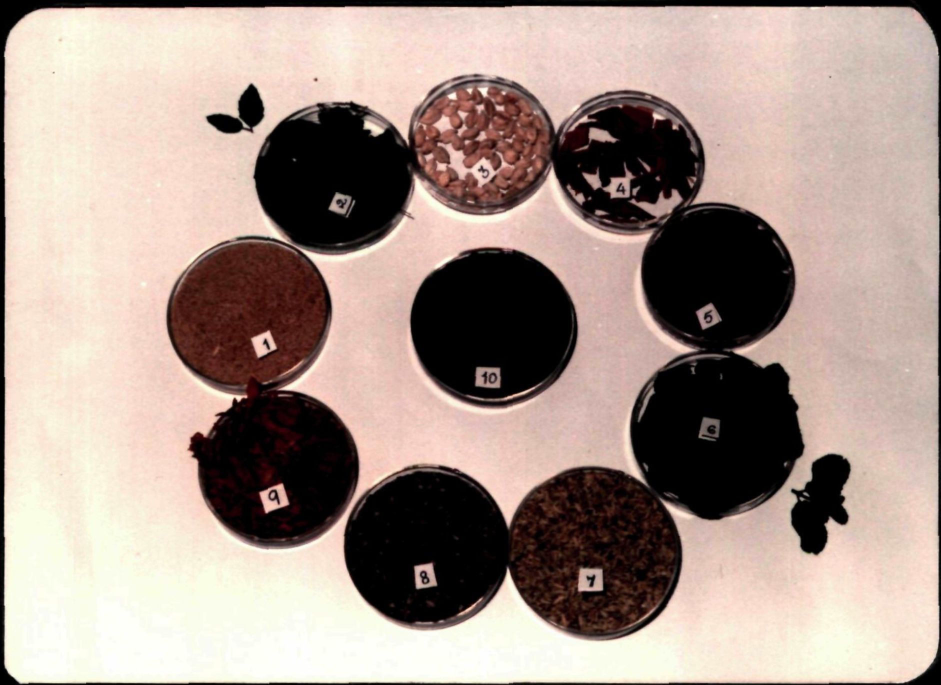

Fig. 1: Herbs and spices used for preparation of herbal tea mixes

1. Liquorice (Powder)
2. Tulsi (<u>Ocimum sanctum</u>)
3. Cardamom
4. Cinnamon
5. Cloves
6. Mint leaves
7. Fennel seeds
8. Dried amla
9. Japatre (Mace)
10. Tea leaves

Flavouring agents: Oriental flavour (a flavour developed at the Department of Rural Home Science, Univetsity of Agricultural Sciences, Bangalore, consisting of cardamom, kesari, japatre, nutmeg, paccha karpura, poppy seeds, cinnmon and cloves) were used as flavouring agent in the prepartion of flavoured soymilk. The mixture imparts yellowish-orange colour to the milk samples. Cane sugar was used for sweetening the milks.

3.2.2. Blended malt beverages

For malt preparation: Soft white wheat (*Triticum aestivum*), ragi (*Eleusine coracana*) and green gram (*Phaseolus aureus*) obtained from the local market were used for malting.

3.3. Materials for blending

Defatted soyflour: Defatted soy flakes obtained from Mysore Snack Foods Private Limited was ground to fine powder and passed through 80 mesh sieve and used for blending.

Defatted peanut flour: obtained from Mysore Snack Foods Private Limited, Bangalore. Cocoa powder (Cadbury's) and whole milk powder (Amul) purchased from local market were used for blending with malt powders.

Methods: About 200 combinations of herbs and spices were made and brewed into tea using tea leaves as base. The amount of tea leaves in these combinations was tried on

Fig. 2: Raw materials for preparation of soymilk

1. Defatted soyflakes
2. Sesame seeds
3. Skim milk powder
4. Fresh coconut

Fig. 3: Raw materials for preparation of blended malt powders

25, 50 and 75 per cent basis. These 200 samples of teas were tasted by the investigator and the major guide to evaluate characters of the product and to screen and select the samples presentable to taste panel members. Among the 200 samples tasted, 15 samples were found to be presentable and were used for further study. Hence the amount of tea leaves in the samples selected varied. Composition of the 15 samples selected for panel evaluation is given in Table III.

3.3.1. Method for preparation of tea

Weighed amounts (Refer to Table III) of samples were infused by pouring 100 ml of boiling water over the samples in 250 ml beakers and covered with petriplates. It was allowed to stand for 3 minutes and then filtered through a thin muslin cloth. Ten milligrammes of vitamin C was added just before evaluation.

In order to know the effect of temperature on the acceptability, these 15 tea samples were served both in hot and chilled conditions. The temperature of samples was maintained by keeping the bottles in hot water bath for hot samples and in ice bath for chilled samples. Thus 30 experimental samples were prepared and served to the panel members.

3.3.2. Method of preparation of soymilk

Defatted soyflakes were soaked for 6 hours changing

Table III: Composition of ingredients used in the preparation of herbal teas (100 ml)

Sample code	Composition of herbs	Quantity of herbs (g)	Total quantity of the herb mix (g)	Tea leaves (g)	Quantity of herb and tea mix (g)	Vitamin C (mg)	Sweetening agent	Quantity
A	Atm + Cin + Clv + Fen + Jap	0.2 each	1.0	1.0	2.0	10	Sacc	2 tabl.
B	Fresh Tul	0.1	0.1	0.7	0.8	10	Sacc	2 tabl.
C	Dried mint	0.1	0.1	0.7	0.8	10	Sug	2 g
D	Atm + Fen + Jap + Mt + Cum	0.1 each	0.5	1.0	1.5	10	Sug	1 g
E	Atm + Cin + Fen + Jap + Mt + Clv	0.1 each + 50 mg cloves	0.55	1.5	2.05	10	Sacc	2 tabl.
G	Atm + Cum + Fen + Jap + Mt	0.3 each	1.5	1.0	2.5	10	Hon	2 g
H	Atm + Cum + Cin + Clv + Fen	0.1 each	0.5	0.3	0.8	10	Hon	2 g
J	Aml + Cum + Cin + Mt + Tul	0.05 each	0.25	0.75	1.0	10	Hon	2 g
K	Aml + Mt + Tul + Clv + Cam	0.05 each	0.25	0.75	1.0	10	Sug	2 g
L	Atm + Tul + Mt + Clv + Fen	0.1 each	0.50	0.50	1.0	10	Sacc	1 tabl.
M	Atm + Aml + Mt + Tul	0.05 each	0.20	0.75	0.95	10	Sacc	2 tabl.
P	Atm + Aml + Fen + Mt + Jap	0.05 each	0.25	0.65	0.90	10	Sacc	2 tabl.
S	Atm + Aml + Mt + Tul + Fen	0.1 each	0.5	0.50	1.00	10	Sacc	2 tabl.
V	-	-	-	1.00	1.0	10	Sug	1 g
X	Fresh Tul + Dry Mt	0.2 each	0.4	0.6	1.0	10	Sacc	2 tabl.

Atm = Atimadhura; Aml = Amla; Cam = Cardamom; Cin = Cinnamon; Clv = Cloves; Cum = Cumin;
Fen = Fennel seeds; Jap = Japatre; Mt = Mint; Tul = Tulsi; Sacc = Saccharine tablets;
Sug = Cane sugar (g); Hon = Honey (g)

water once in the middle. Then they were washed thoroughly with distilled water and water was drained. Soaked flakes were ground using six parts of water in a Sumeet wet grinder. The milk so obtained was filtered through a muslin cloth. Three extractions of milk from the residual flakes were collected.

Preparation of sesame milk

Sesame seeds were soaked in water for 6 hours changing water once in the middle. They were washed thoroughly with distilled water and drained. The seeds were ground with six parts of water in Sumeet wet grinder. The milk was filtered through a muslin cloth. Only two extractions were collected from the seeds, since the third extraction might have imparted a bitter flavour tothe milk.

Preparation of coconut milk

Kernel of coconut collected from a fresh mature nut was used for the preparation of milk. It was ground and filtered through a muslin cloth. Three extractions of milk were collected using four parts of water. Amount of water was decreased in order to obtain a thick consistency.

Preparation of skim milk

Ten grammes of the skim milk powder was dissolved in 100 ml of warm water.

Soymilk blends

The prepared soymilk was blended with other milks in the proportions shown in Table IV.

Blended milks were heated in a sauce pan till it started boiling and then simmered for 15 minutes with continuous stirring and then five per cent cane sugar was added.

To know the effect of flavour and colour on the acceptability of soymilk, the above said milk samples were flavoured with 0.05 per cent of oriental flavour which also imparted yellowish-orange colour to the milk.

3.3.3. Blended malt powders

Preparation of malt powders

Wheat, ragi and green gram were soaked separately in distilled water for 16 hours. Water was changed twice in the middle in order to incorporate air. The soaked grains were washed and drained thoroughly and tied in a cloth and kept for germination in laboratory shelf at room temperature. Wheat and ragi were allowed to germinate for 48 hours while green gram was germinated for 32 hours. The germinated grains were air dried at room temperature. Then the grains were roasted on a slow heat to remove excess moisture and develop characteristic malty aroma. The grains were powdered and passed through 80 mesh sieve.

Table IV: Composition of blended soymilks

Sample code	Composition	Proportions
A_1	Soymilk + Skim milk	50: 50
A_2	Soymilk + Skim milk	70 + 30
B_1	Soymilk + Sesame milk + Skim milk	50 + 10 + 40
B_2	Soymilk + Sesame milk + Skim milk	60 + 10 + 30
C_1	Milk type B_1 + Coconut milk	90 + 10
C_2	Milk type B_2 + Coconut milk	90 + 10
D_1	Soymilk + Coconut milk + Skim milk	50 + 10 + 40
D_2	Soymilk + Coconut milk + Skim milk	60 + 10 + 30

Blending of malt powders

Malt powders were blended in different proportions with defatted soyflour and defatted peanut flour. Table V gives the combination and proportions of blends.

To each of the blends prepared, 5 per cent cocoa powder and 5 per cent whole milk powder were added and mixed thoroughly.

3.4. Sensory evaluation of developed beverages

3.4.1. Selection lab. panel members

Thirteen judges, four trained beverage tasters from Indian Coffee Board and nine from the Department of Rural Home Science, University of Agricultural Sciences formed the taste panel. The panel members were requested to evaluate each product for four sensory characters, namely, sweetness, appearance, flavour and astringency, using an evaluation sheet which consisted of two parts. In the first part, a six point scale with a frame of reference for each character was given. In the second part, judges were asked to rank the products from best liked to the least liked (Evaluation sheet furnished in Appendix I).

3.4.2. Coding and serving procedures

All the test products were coded and served in 50 ml wine glasses. Ten samples were evaluated per day in two

Table V: Composition of blended malt powders

Sample code	Composition	Proportion
A_1	Wheat malt + Defatted soyflour	70 + 30
A_2	Wheat malt + Defatted soyflour	60 + 40
B_1	Wheat malt + Defatted peanut flour	70 + 30
B_2	Wheat malt + Defatted peanut flour	60 + 40
C_1	Ragi malt + Defatted soyflour	70 + 30
C_2	Ragi malt + Defatted soyflour	60 + 40
D_1	Ragi malt + Defatted peanut flour	70 + 30
D_2	Ragi malt + Defatted peanut flour	60 + 40
E_1	Wheat malt + Greengram malt	70 + 30
E_2	Ragi malt + Greengram malt	70 + 30

Panel judges were requested to rinse their mouth with distilled water before judging the samples. Bread was supplied to each of the judges to remove any residual effects. Evaluation was done in duplicate with one day gap.

Fifteen experimental tea samples were served both in hot and chilled conditions. Ranking of tea samples was done in 3 sessions. At each session 5 samples were served both as hot and chilled. For blended malt beverages, 10 g of the test powders were stirred in 100 ml of hot cow's milk.

Flavoured and unflavoured soymilk samples were served hot.

3.5. Statistical analysis

Two-way analysis of variance was applied to find out whether the treatments/samples of teas differed significantly from each other (Sunderraj et al. 1972). Mean scores for each sample under each character was calculated and the overall mean for each sample was recorded. Before taking up the analysis of rankings (II part), Kendal's coefficient of concurrency was employed to find out the efficiency of judges to rank the beverages correctly when presented in duplicates. Since a 90 per cent agreement was observed, the analysis of rankings was done.

The ranks given by the judges (II part of evaluation sheet) for each sample were totalled. The sample having least number was concluded as best liked and the one having highest number as least liked.

Four of the herbal teas which were acceptable to the laboratory panel members along with one sample of black tea (Sample V - control), 4 of the soymilk's with a high proportion of soymilk and 3 of the malt powders acceptable to the laboratory panel were selected for consumer evaluation. The samples selected were as follows.

Herbal teas	- X_I, K_I, P_I & S_I	(Table III)
Soymilks	- A_2, B_2 and C_2	(Table IV)
Malted beverage powders	- A_I, B_2 & C_I	(Table V)

Consumer evaluation of the samples

Total of 92 students and staff of the University campus were selected for study. The consumers evaluated and ranked the samples served using an evaluation sheet (Appendix II). Three samples were served at a time in transparent wine cups.

Information obtained was analysed to find out, to what extent the beverages were liked. Ranking analyses was also done in the same way as for the laboratory panel's ranking.

3.6. Chemical analysis

3.6.1. Herbal teas

Sample selection: Nine of the best liked samples along with one sample of black tea (V) were selected for nutrient analysis. The samples selected were A, B, E, K, L, P, S, X and V. Calcium, sodium, potassium, iron, copper, zinc and manganese were estimated. Major elements Ca, Na and K were analysed using Digital Flame Photometer Model CL-22D. The readings on the electron digital meter for the stadard solutions of each mineral estimated were recorded at various concentrations. The quantity of Ca, Na and K in the experimental tea samples were calculated from regression correlation equation (Detailed procedure in Appendix III).

The samples were suitably diluted to fit within the sensitivity range of the digital meter.

Trace elements present in the samples were analysed using Atomic Absorption Spectrophotometer, Hitachi Model-508 by maintaining the standard conditions (Table VI).

The standard galvanometer readings of zinc, iron, manganese and copper were calibrated by preparing standard solutions of each of the element in grade levels. Galvanometer readings for each concentration level were recorded. Regression correlation equation was used to find the concentration of elements in experimental samples.

<u>Tannin</u>: Soluble tannin content of the samples was determined by measuring the blue colour formed by reduction of phosphotungstic acid by tannin like compounds in alkaline solution. A standard curve was developed by preparing tannic acid solution at different concentrations and a linear relationship curve was obtained by plotting the optical density (OD)

Table VI: Measuring conditions for Atomic Absorption Spectrophotometer. Hitachi Model 508

Element analysed	Hallow cathode lamp	Wave length A°	Slit		Discharge current (m A)
			EN	EX	
Zinc	Zinc	2139	2	2	10
Iron	Iron	2483	2	2	15
Manganese	Manganese	2795	2	2	10
Copper	Copper	3247	2	2	10

against the concentration. The samples were suitably diluted to fit into the curve obtained. The concentration of test samples was determined using standard curve (Stewart Allen, 1974).

Sample preparation for chemical analysis of herbal teas

The analysis was done to know the chemical composition of the beverage part of the sample. Hence, conditions used for brewing each sample was same as that served for laboratory and consumer panel evaluation, except that the samples were prepared with double distilled water and filtered through Whatman No. 1 filter paper.

3.6.2. Blended soymilk

Following four samples of soymilk were selected for analysis. Sample A_2 containing soymilk and skim milk at 70:30 proportions, sample B_2 containing soymilk, sesame milk and skim milk at 60:10:30 proportions, C_2 containing a blend of milk type B_2 and coconut milk at 90:10 proportions and sample D_2 having soymilk, coconut milk and skim milk at 60:10:30 proportions were selectedfor determination of total solids and protein contents.

Total solids: Total solids were determined by following ISI method (ISI, 1981).

Per cent total solids was determined using the formula.

$$\text{Percent toal solids} = \frac{W_2 - W_0}{W_1 - W_0} \times 100$$

where, W_0 = weight of empty plate

W_1 = weight of plate + sample

W_2 = weight of plate + dried sample

<u>Protein</u>: Protein content of soymilk was determined by standard microkjeldahl method. Fifty milligrammes of the moisture free sample of soymilk was used and a multiplication factor of 6.25 was employed (AOAC, 1980). Then protein content per 100 ml of the sample was calculated.

3.6.3. <u>Blended malt powders</u>

Sample A_1 containing a blend of wheat and defatted soyflour at 70:30 proportions, sample B_2 containing a blend of wheat malt and defatted peanut flour at 60:40 proportions, sample C_1 containing blend of ragi and defatted soyflour at 70:30 proportions and sampe C_2 having a blend of ragi and defatted soyflour at 70:30 proportions were selected for protein and total calorific value determination. Protein content was determined by the standard microkjeldahl method (AOAC, 1980). Fifty milligrammes of the moisture free sample were used for determination; and factor used for multiplication was 6.25.

Total calorific value of the samples was estimated using Bomb Calorimeter. One gramme of the sample was used for the determination (Appendix IV).

EXPERIMENTAL RESULTS

IV. EXPERIMENTAL RESULTS

Results of the sensory evaluation of the beverages by laboratory panel members is presented below:

4.1. Herbal teas

Table VII shows the results of two-way analysis of variance for sweetness, appearance, flavour and astringency.

From the ANOVA table obtained for the four characteristics it is seen that, there is a significant difference among the treatments/samples, regarding sweetness, appearance, flavour and astringency.

The mean scores for the characters of sweetness, appearance, flavour and astringency and their overall means are furnished in Table VIIIa. The overall mean value of the samples ranged from 3.7 (H_1) to 1.7 (A_0) out of the maximum score of 5. Table VIIIb presents the ranking of herbal tea samples hot and cold by the laboratory panel. Hot samples were mostly liked better than cold ones. These samples with high ranks had higher overall means of above 3.0, indicating that, in the characteristics studied also they were of high acceptability.

4.2. Milk like beverages

Table IX gives the analysis of variance for the sensory characters of milk like beverages evaluated by laboratory panel members.

Table VII: ANOVA for characteristics of herbal teas evaluated by laboratory panel members

Source	d.f.	M.S.Sq.			
		Sweetness	Appearance	Flavour	Astringency
Treatments	29	11.9110*	7.1531*	7.3935*	9.3119*
Judges	12	14.9110*	9.4885*	14.5120*	7.0038*
Judges x Treatments	348	2.2111*	1.0311*	1.0259*	1.2125*
Error	380	11.0333	0.8448	1.4820	1.3410
Total	769				

*Significant at 5 per cent level

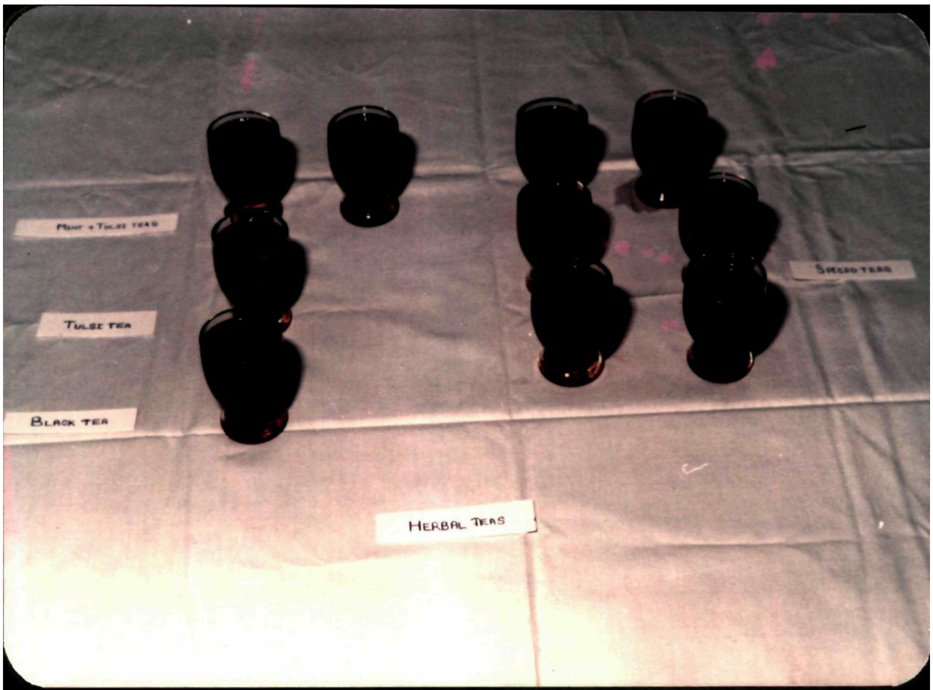

Fig. 4: Accepted samples of herbal teas

Table VIIIb: Mean scores, overall mean scores obtained by samples of herbal teas (Laboratory panel)

Sample code	Sweetness	Appearance	Flavour	Astringency	Total	Overall mean
A_1	1.615	3.1153	2.115	2.2692	9.1145	2.2786
B_1	2.384	3.5769	2.961	3.5384	12.4603	3.1150
C_1	2.115	3.5000	2.000	3.0000	10.6150	2.6537
D_1	1.230	3.1538	2.076	2.5000	8.9598	2.2399
E_1	2.038	3.1923	1.961	2.4230	9.6143	2.4035
A_0	1.653	2.0769	1.346	1.6153	6.6912	1.6728
B_0	1.461	2.576	1.769	2.1538	7.9598	1.9899
C_0	1.153	2.6153	1.807	2.3076	7.8829	1.9707
D_0	1.307	2.8076	2.500	2.9615	9.5761	2.3940
E_0	2.576	2.8076	2.346	2.8076	10.5372	2.6343
G_1	3.192	3.5000	2.230	3.5769	13.4989	3.3747
H_1	3.653	3.9232	3.423	3.9230	14.9220	3.7305
J_1	3.153	3.5000	3.269	3.3846	13.3066	3.3266
K_1	1.576	4.269	2.384	2.5769	10.8059	2.7014
L_1	2.884	4.1153	2.269	2.6923	11.9606	2.9901

continued..

Table VIIIb(contd.)

Sample code	Sweetness	Appearance	Flavour	Astringency	Total	Overall mean
G_0	1.923	2.0769	1.653	1.6923	7.3452	1.8363
H_0	2.230	3.2692	2.576	2.9615	11.0367	2.7591
J_0	1.807	2.8346	1.846	2.6538	9.1914	2.2978
K_0	1.576	3.1923	2.076	2.2307	9.075	2.2687
L_0	2.038	2.9615	2.076	2.0769	9.1524	2.2881
M_1	2.884	3.084	2.767	3.500	12.1914	3.0478
P_1	2.076	3.0769	2.615	3.3076	11.0755	2.7688
S_1	1.192	3.0769	2.615	3.0769	10.9608	2.7402
V_1	1.884	3.9615	2.692	2.7692	11.3067	2.8266
X_1	3.115	3.5769	2.884	3.7692	13.3451	3.3362
M_0	2.653	3.4615	3.115	3.1153	12.3448	3.0862
P_0	2.615	2.8076	3.000	3.1923	11.6149	2.9037
S_0	2.692	3.4615	2.730	3.3461	12.2296	3.0574
V_0	1.884	3.6923	2.538	2.8461	10.9604	2.7401
X_0	3.384	3.3846	3.076	3.5769	13.4215	3.5553

Sample codes subscripted with 'o' represent cold samples and superscripted with 'I' represent hot samples.

Table VIIIb: Ranking of herbal tea samples by the laboratory panel

Session I		Session II		Session III	
Sample	Rank	Sample	Rank	Sample	Rank
A_0	X	G_0	X	M_0	III
A_1	III	G_1	I	M_1	VI
B_0	IX	H_0	IV	P_0	V
B_1	I	H_1	II	P_1	VIII
C_0	VII	J_0	VII	S_0	IV
C_1	I	J_1	III	S_1	IX
D_0	VIII	K_0	VIII	V_0	VIII
D_1	VI	K_1	V	V_1	X
E_0	V	L_0	IX	X_0	I
E_1	IV	L_1	VI	X_1	II

Note: Highest liked had lowest rank

Sample codes subscripted with '0' represent cold samples and subscripted with '1' represent hot samples

Table IX: ANOVA for sensory characters of milk like beverages

Source	d.f.	M.S.Sq.			
		Sweetness	Appearance	Flavour	Astringency
Treatments	25	6.142	7.0182*	14.3222*	3.0934*
Judges	12	10.658	13.8634*	8.5623*	18.0434*
Judges x Treatments	300	0.5818	0.6286*	1.3807*	2.9641*
Error	338	296.1021	0.1760	0.1745	0.2396
Total	675				

*Significant at 5 per cent level

There was no significant difference between the samples regarding sweetness, while samples differed significantly in appearance, flavour and astringency.

The mean score and the rank obtained by the blended soymilk samples are presented in Table X.

It is observed that, the means ranged between 3.3 to 4.3 which were perceived to be moderately pleasant to very pleasant. A positive trend exists between the overall mean value and the ranks obtained by the samples.

The means for sweetness ranged from 3 to 4.7 which were perceived to be "sweetness just sufficient" to "excellent sweet". Means for appearance ranged from 3.0 to 3.9 which were perceived to be acceptably attractive to very attractive. The mean values for flavour ranged from 2.0 to 3.8 which means that the samples were moderately pleasant to very much pleasant. Astringency of the samples was "acceptable" (4.5 to 4.7).

4.2.2. Table XI gives the mean scores and ranks of the flavoured soymilks.

The overall mean for flavoured soymilks ranged from 4.0 to 4.9. They were very much pleasant to most pleasant or excellent. A positive trend existed between the mean and the rank it obtained. There was no significant difference

Table X: Mean scores and the ranks of soymilk based beverages

Sample code	Sweet-ness	Appear-ance	Flavour	Astrin-gency	Total	Over-all mean	Rank
A_1	4.7307	3.846	3.8076	4.73	17.1143	4.278	I
B_1	4.3076	3.538	3.3461	4.50	15.6917	3.922	II
C_1	3.8076	3.307	2.7692	4.653	14.5368	3.634	III
D_1	3.9615	3.230	2.5760	4.461	14.2285	3.557	V
A_2	3.6923	3.384	2.5380	4.461	14.0753	3.518	VI
B_2	3.1153	3.269	2.2690	4.461	13.1143	3.278	VIII
C_2	3.3076	3.153	2.4230	4.461	13.3446	8.336	VII
D_2	3.3846	3.500	3.2300	4.461	14.575	3.643	IV

Table XI: Mean scores, overall mean scores and rank obtained by samples of flavoured soymilk

Sample code	Sweet-ness	Appear-ance	Flavour	Astrin-gency	Total	Overall mean	Rank
A_1	4.692	5.000	5.000	5.000	19.692	4.923	I
B_1	4.576	4.961	4.923	5.000	19.460	4.865	II
C_1	3.846	4.423	4.115	4.730	17.114	4.278	V
D_1	3.653	4.384	4.000	4.615	16.652	4.156	VI
A_2	3.692	4.269	3.961	4.615	16.537	4.134	III
B_2	3.346	4.230	3.923	4.615	16.114	4.028	VIII
C_2	3.576	4.269	3.884	4.692	16.421	4.105	VII
D_2	3.961	5.000	4.576	5.000	18.537	4.634	IV

Fig. 5: Soymilks and flavoured soymilks

in character "sweetness" among the samples studied. The means for appearance and flavour ranged from 4.0 to 5.0. They were very attractive to most attractive and there was not much difference in astringency scores. It ranged from 4.6 to 5.0 i.e., no detectable astringency.

4.2.3. <u>Blended malt beverages</u>

Table XII shows mean , overall mean and the ranks obtained by blended malt beverages as evaluated by laboratory panel members.

The overall mean of all the characters in blended malt beverages ranged from 3.8 to 4.5. There was no significant difference among the samples. The mean values for sweetness ranged from 4.0 to 4.8; for appearance from 3.8 to 4.0 and for astringency 4.4 to 4.7. It was only for flavour that the range was from 3.0 to 4.5, which was perceived to be pleasant to very much pleasant. The best scored product was sample A_2 having a blend of wheat malt and defatted soyflour at 70:30 proportion.

4.3. <u>Consumer evaluation of beverages</u>

4.3.1. <u>Herbal teas</u>: It could be seen that majority of consumers had a feeling of neither likeness nor dislikeness towards the experimental teas. However, considerable number of consumers liked samples K_1, P_1, S_1. Sample V_1 which formed regular black tea was disliked by majority of the consumers.

Table XII: Mean, overall mean for the sensory characters and rank obtained by the blended malt beverages

Sample code	Sweet-ness	Appear-ance	Flavour	Astrin-gency	Total	Overall mean	Rank
A_1	4.7692	4.076	4.4615	4.6976	18.0043	4.5010	I
B_1	4.4615	3.923	4.0315	4.615	17.0310	4.2577	V
C_1	4.4615	3.807	3.7692	4.538	16.5757	4.1437	II
D_1	4.4615	3.923	3.9517	4.576	16.9122	4.228	IV
E_1	4.3460	3.884	3.9517	4.500	16.1867	4.0465	VIII
A_2	4.6153	3.923	3.9684	4.615	17.1217	4.2802	IX
B_2	4.1923	3.846	3.9517	4.500	16.4900	4.1225	IX
C_2	4.3846	3.846	3.615	4.500	16.3456	4.0862	VII
D_2	4.1153	3.846	3.1926	4.4269	15.5808	3.8952	X
E_2	4.1153	3.807	3.6976	4.5000	16.1199	4.029	VI

Fig. 6: Malted beverages

Results of ranking analysis showed that, sample X was best liked followed by K_1, P_1 and S_1. The Y_1 tea was the least ranked.

The highest ranked samples had largest number of consumers ranking it. On comparing the rank order done by the consumders to that of the laboratory panel, the order was found to be in good agreement.

4.3.2. Soymilk: Of the 92 consumers evaluated the flavoured soymilk, sample A_2 (soy + skim milk) was liked very much by 55 cconsumers, sample B_2 (soy milk + sesame milk + skim milk) by 10, sample C_2(soy + sesame + coconut + skim milk) by 30 and sample D_2 (soy + coconut milk + skim milk) by only 10 of the consumers. Sample A_2 was liked by 32 of the consumers, sample B_2 by 25, sample C_2 by 55 while 60 consumers liked sample D_2.

Sample A_2 was neither likednor disliked by only four consumers, sample B2 by 45 consumers, sample C2 by only 7 of them, wh ile sample D_2 by 16 of the consumers.

None evaluated sample A_2 as "do not like", while 12 did not like sample B_2, while only one did not like sample C2 and sample D2 by six of the consumers.

It is seen that majority of the consumers liked samples A_2 and C_2 very much, while majority of them just liked the samples D_2 and B_2. Very negligible number of consumers scored them lower than "I like".

Results of the rank analysis shows, sample A_2 to be best liked, followed by C_2, D_2 and B_2. This is evident from the number of consumers liking these samples.

4.3.3. Blended malt beverages

Sample A_1 (wheat malt + D.F. soyflour) was liked very much by 45 of the consumers, sample B_2 (wheat malt + D.F. peanut flour) by 17, while sample C_1 (ragi malt + D.F. soyflour) by only 15 consumers. Sample A_1 was liked by 35 of the consumers, sample B_2 by 50 and sample C_1 by 45 of the consumers. Seven of the consumers "neither liked nor disliked" sample A_1, Sample B_2 by 20 consumers and sample C_1 by 27 of them. Negligibly small number of consumders (3) marked sample A_1 as 'I don't like', so also sample C_1 by only six consumers while none evaluated sample B_2 as 'I don't like'. Sample A_2 was ranked first, C_1 second while B_2 was least liked. A positive trend was observed between the rank obtained by the sample and number of consumers liking it.

4.4. Chemical analysis

4.4.1. Herbal teas: Table XIII gives the results of mineral and soluble tannin contents of experimental tea samples.

Results of mineral estimations of teas showed that

Table XIII: Mineral and soluble tannin content (mg/100 ml) of herbal teas

Sample code	Ca	Na	K	Fe	Cu	Zn	Mn	Soluble tannin
A	2.32	7.18	41.40	0.0007	0.03	0.036	0.530	82.00
B	1.06	3.51	16.60	0.0007	0.03	0.044	0.683	82.00
E	2.01	5.35	40.66	0.0031	0.026	0.046	0.680	180.00
K	0.99	8.03	30.05	0.0005	0.020	0.051	0.960	72.00
L	1.00	6.88	30.00	0.0007	0.030	0.046	0.530	62.00
M	1.05	7.18	27.00	0.0007	0.011	0.036	0.720	80.00
P	1.57	4.74	21.90	0.0007	0.020	0.052	0.840	85.00
S	1.19	3.69	24.00	0.0007	0.020	0.034	0.680	70.00
X	1.31	2.30	48.40	0.0007	0.030	0.036	0.530	62.00
V	0.67	2.17	25.00	0.0037	0.019	0.020	0.630	145.00

calcium content ranged from 0.99 to 2.32 mg which is higher than the black tea (sample V - 0.67 mg). Potassium content increased in six of the experimental teas, while in sample B, it was considerably low (16.06 mg) and samples P and S contained almost equal amount of potassium (21.9 and 24 mg).

Copper content of 8 herb teas was higher than black tea (0.019 mg). The range of test samples was 0.02 to 0.03 mg. Only one sample had slightly lower copper (0.011 mg). Considerably higher amount of Zn was found in herbal teas, the content ranged from 0.036 to 0.051 mg, compared with 0.02 mg of black tea. Range for Mn content of herb teas was from 0.53 to 0.96 mg. Six of the experimental teas had higher Mn content than black tea (0.63 mg/100 ml) while in three samples it was found to be slightly lower (0.53 mg).

Iron content of the test samples was found to be lower than the black tea. However sample E had slightly higher iron (0.0081 mg).

Estimation of soluble tannin content showed that 8 of the herbal teas had lower tannin content than the black tea while only one sample (E) had higher value. All the samples contained 10 mg of ascorbic acid and saccharine as sweetener. Hence, the herbal teas having higher mineral concentration are expected to contain 10 mg of vitamin C and low calorific value.

4.4.2. Soymilk: Table XIV shows moisture, total solids and protein content of accepted soymilks.

Sample C had highest protein as well as total solids followed by sample A_2 and B_2. Sample D_2 contained least amount of total solids and protein (10 and 3.14%, respectively). A positive trend between the total solids and protein content of the samples was observed.

4.4.3. Blended malt powders: Table XV gives protein and gross energy values of the blended malt powders.

The protein content of sample C_2 found to be highest followed by sample A_1, B_2 and C_1 respectively. Sample C_1 had least amount of protein. The gross energy value was found to be highest in sample B_2 followed by samples A_1, C_2 and C_1. However, not much difference was observed between samples A_1 and A_2 regarding protein and calories, while in samples C_1 and C_2, a wide range in protein content was observed.

Table XIV: Moisture, total solid and protein contents of soymilk samples

Sample code	Moisture (%)	Total solid (%)	Protein (%)
A_2	88.00	12.00	4.823
B_2	89.90	11.85	4.590
C_2	87.00	13.00	4.951
D_2	90.00	10.00	3.140

Table XV: Per cent protein and gross energy composition values of blended malt powders

Sample code	Protein (g/100 g)	Gross energy composition cals.
A_1	25.4	390
B_2	24.0	397
C_1	22.8	377
C_2	26.4	382

DISCUSSION

V. DISCUSSION

The results of the laboratory panel evaluation, consumer panel evaluation and nutrient analysis are discussed here.

5.1. Laboratory panel evaluation of beverages

5.1.1. Herbal teas

The judges of the laboratory panel had given the verdict of clear acceptance levels with regard to the chief characters, namely sweetness, appearance, flavour and astringency.

The herbal teas were found to possess a generally desirable sweetness, which covers the sweetness requirement of a wide range of consumers. Honey added to the teas appears to be a good sweetener for herbal teas as evidenced by the higher scores received by honey sweetened samples G_1, H_1, J_1, X_1 and X_0. Even Steinsholf (1983) reported higher preference for honey sweetened icecream than sugar sweetened ones, as judged by 6-membered taste panel. Saccharine was found to be the next best sweetener followed by sugar. Thus, saccharine well accepted as a sweetener in herbal teas would also help towards low caloric dietetic contribution in these drinks.

Regarding appearance, the test samples were found to possess very attractive colour and clear appearance. The colour of samples ranged from greyed orange to greyed purple (172 to 178 respectively) when observed using Royal Horticultural Society colour charts. Most of this range may probably be because of japatre (Mace), which contributed reddish orange colour and cloves, cinnamon and tea leaves which contributed purple colour to the samples containing these ingredients at various proportions.

However, there is a wide range of consumers who prefer light red to dark red or purple colour soft drinks e.g., coca cola, thumps-up, black tea, red wine etc. Thus, the samples in the present study offered such a range to the consumer's demand and choice.

Flavour scores indicated that the herbal teas were moderately pleasant. It is known that, mint, tulsi, fennel seeds, cloves, cumin, liquorice and amla, possess plesant aromatic flavours. Samples H_1, J_1, M_1, P_1 and X_0 obtained higher score for flavour and declared as plesantly flavoured herbal teas. This might be because of the presence of one or more of the above said herbs in the tea blend formulation.

Astringency is one of the characters that makes tea a desirable refreshing drink (Wedzicha, 1979). The astringency scores obtained by the experimental teas ranged from strong astringency to acceptable astringency. Samples A_0 and G_0 were found to be strongly astringent because of the higher amount of tea leaves (1.0 g) present in the tea mix or blend. However, in rest of the samples, though the proportion of tea leaves in the tea mix was less (0.5 to 0.75 g), the samples were found to possess acceptable astringency. Probably, amla, tulsi, liquorice, cloves and fennel seeds contributed astringency to the accepted beverages.

The hot samples were found to recieve higher scores for all the sensory characters evaluated, while chilled samples were found to receive slightly lower scores. Thus temperature was another factor influencing the acceptability of herbal teas, because the temperature influences the volatility of essential oils and other flavour contributing principles and affects ability of tactile nerve ends to pick up these sensations. The diminished taste of cold foods may be due in part to the fact that molecules of substances which provoke sensations are more sluggish when cold and may anaesthetize the taste buds (Hallen Charley, 1970).

5.1.2. Blended soymilk

Sweetness of blended soymilk was found to be just sufficient to excellent. However, there was no significant difference between the samples. Sugar added to soymilk samples, apart from improving the acceptability would also help in better utilisation of protein from blended milks.

The results obtained by Gopaldas et al. (1974) showed that, sweetness is more influential for acceptance than flavour. But in the present investigation, it is clearly seen that, flavour is more important for acceptance of beverages.

However, a few of the unflavoured milks were also rated to be acceptably attractive to very much attractive.

The astringency scores obtained by the samples indicated that the samples were found to possess slight but acceptable astringency. None of the samples were rejected because of astringency. This might be because of the addition of skim milk to the samples which lowered astringency factor from soymilk. Soymilk and skim milk blends at 60:40 (A_1) showed no detectable astringency, while samples B_2, C_2 and D_2 containing sesame milk and coconut milk blends were found to possess slight astringency. Chien and Snyder (1983) in their attempt to reduce the soymilk astringency found that, skim milk, calcium-sulphate or citric acid crystals added to the milks were responsible for reduced astringency.

Flavoured soymilks were evaluated as very much attractive because of the colour contributed by the added oriental flavour mix. Consumers generally require not only a product which is nutritious but a product which is aesthetically acceptable also. The flavour scores indicated that these flavoured milks were perceived to be very much pleasant to extremely pleasant. Thus, it is desirable to flavour and colour the blended soymilk.

Ferreira and Shirose (1975) flavoured soymilks with seven various flavouring agents and got them evaluated by a panel of adults and a group of 100 school children. Adults scored red currant flavoured milk as best and strawberry as least, while coconut added milk ranked highest for aroma and chocolate as lowest. Children liked strawberry flavour most and coconut flavour as least. Unflavoured soymilks were rated to be unacceptable by both adults and children. However, in the present study, the unflavoured milks were also acceptable but with lower score.

5.1.3. Blended malt beverages

The blended malt beverages did not differ from each other in sweetness. The added sugar contributed acceptable sweetness level (4.0 to 4.7). All the samples appeared to be very much attractive (4.0). The oriental flavour added to the beverages might be responsible for higher appearance scores. Eisweiseprodukte and Schaeffers (1981) observed that, the spices and herbs having medicinal value, when incorporated into milk and protein rich beverages, enhanced their medicinal effects.

The results of flavour evaluation showed not much difference among the samples. However, sample D_2 with defatted peanut flour at 40 per cent level received lower scores while the sample D_1, containing defatted peanut flour at 30 per cent level was adjudged to be more pleasant. The flavour scores obtained by sample B_1 and B_2 indicated that when defatted peanut flour was blended with wheat malt at 30 per cent and 40 per cent levels, resulted in acceptable flavour. Thus, it is clear that, peanut flour at less than 30 per cent level could be blended with ragi malt while blending peanut flour with wheat malt even at 40 per cent level is successful.

In Hay et al. study (1983) a weaning food consisting of a blend of gelatinized corn meal and defatted soyflour was preferred for mouth feel and consistency and was rated good, compared with similar food having a blend of defatted glandless cotton seed flour which had significantly lower acceptability.

5.2. Consumer evaluation of beverages

5.2.1. Herbal tea

A majority of consumers classified herbal teas as "neither liked nor disliked". Nevertheless, sample K_1 (containing amla, mint, tulsi, cloves and cardamom), sample P_1 (containing Liquorice, amla, fennel seeds, mint and japatre) and sample S_1 (containing amla, liquorice, mint, tulsi and fennel seeds) were liked by the consumers. Negligible number of consumers did not like the herbal teas. This may be because the selected group of consumers were not habituated to drinking tea without milk and thus the experimental teas might have appeared to be very different in terms of flavour and colour. However, it is noticeable that these herbal teas were found to be liked better than black tea which was the control samples (with only tea leaves). Hannigan (1979) noticed an increasing preference by the consumers in U.S.A., for foods with distinctive tastes resulting from the use of herbs and spices, which led to the increased number of foods and dietetic beverages in the market. Flavoured teas and herbal teas were preferred and found to be the successful products in the U.S. market.

Hence, it can be expected that, such beverages as in the present study which are acceptable, if exhibited in the markets, can become successful products.

5.2.2. Blended soymilks

The evaluation of flavoured soymilks by the consumers showed that samples containing a blend of soymilk and skim milk at 70:30 proportion (A_2) and sample containing a blend of soymilk, coconut milk and skim milk (D_2) were being liked very much. Samples B_2 and C_2 containing sesame milk blend showed slightly lower acceptability by consumers. However, since sesame milk adds sulphur containing amino acids which are deficit in soymilk, the education of consumer about this may rise its acceptance and market value.

Similar studies were conducted by Prabhavat _et al._ (1979) and reported that, addition of sesame milk to soymilk though reduced its acceptability, the percentage of sulphur amino acids increased and chemical score raised from 54 to 106 without causing imbalance in essential amino acid pattern.

In the present study, sample A_2 containing soymilk and skim milk and sample D_2 containing soymilk and coconut milk, have been found to be very much liked by the consumer and hence may serve as high protein, as well as refreshing beverages. However, samples B_2 and C_2 containing sesame milk have better quality protein and even these beverages were not rejected by consumers and hence may serve as good quality protein beverages.

5.2.3. Blended malt beverages

All the three malt beverages evaluated were found to be liked by consumers. Negligible number of consumers found it slightly unpleasant.

It was observed that, milk like beverages were preferred to a greater extent by the consumers than herbal teas. However, the experi mental teas may be expected to be preferred by a consumer group, where black tea is in vogue. Further research in this respect is hence suggested.

A positive trend in the acceptability of beverages by the laboratory panel members and consumer panel members was observed and this is a confirming factor that the laboratory panel evaluation forms a necessary base for a successful product development.

5.3. Chemical analysis

5.3.1. Herbal teas

Results of mineral estimation showed that Ca, Na, K, Cu, Zn and Mn contents have been increased as compared with black tea (sample V). But iron content was found to be reduced slightly in eight of the teas. However, sample E which contained liquorice, fennel seeds, mint, japatre, cloves and cinnamon, was found to have slightly higher iron (0.0007 mg).

Isassa and Marquina (1980a) estimated macroelement content of ten samples of commercial black teas and their infusions using atomic absorption spectrophotometer. The infusions prepared by putting 2 g of tea leaves in 100 ml of boiling water for 2 minutes had on an average 0.09, 24.1 and 0.48 mg of sodium, potassium and calcium content respectively.

The same authors (1980b) estimated trace element content of same tea samples and reported that the infusions on an average contained 0.012 mg (12 ug), of Cu 0.0006 mg (0.6 ug) of zinc, 0.524 mg (524 ug) of Mn and 0.011 mg (11 mg) of calcium contents. The results of mineral estimations done for black tea (sample V) are slightly in agreement with the reported results. However, many of the available literatures for instance Samuel Lee (1979) claimed that, component extractions during brewing greatly vary and sometimes extractions will be never complete and part of the soluble extractives remain with the residual part. The temperature and type of water used for brewing the teas, the infusing time, type of tea leaves and the container are the deciding factors for the mineral composition of teas.

However, the experimental teas are having higher amounts of macro- and trace elements. Hence, can be classified as minerally rich teas. Kenney and Thimaya (1983) estimated copper content of regular teas, flavoured teas and herbal decaffeinated teas. Infusions were prepared by brewing one gramme material in 100 ml of boiling water and allowed to stand for 5 minutes in case of regular and flavoured teas while for 3-4 minutes in case of herbal decaffeinated teas. The estimations done on atomic absorption spectrophotometer reported that copper content ranged from 0.018 to 0.019 mg for regular and flavoured teas while 0.014 mg for herbal decaffeinated teas. Authors claimed that flavoured teas had highest copper content than any other teas estimated. For patients with severe dehydration, to whom immediate mineral replacement is necessary, such teas can be recommended instead of regular black tea or even the milk added tea, which is often disliked after recovering vomitings.

The tannin content of experimental teas has been reduced considerably. Black tea (sample V) was found to contain 145 mg of tannins per 100 ml of the beverage. Panda et al. (1979) estimated the tannin content of infusions from commercial teas and reported it to be on an average 159 mg per 100 ml. Authors claimed that tannic acid of tea is an incriminating factor for heart disease and warranted for low tannin containing teas. However, the tannin content of herbal/flavoured teas has been reduced to almost half (62 to 82 mg/100 ml) of that of regular black tea (sample V). This is a very promising answer for the consumers seeking low tannin containing teas.

Vitamin C content of the test samples can be expected to be 10 mg per 100 ml, which is resulted from addition of ascorbic acid crystals. Addition of vitamin C to tea is nutritionally valuable. Hejda and Kacovska (1978) reported that, vitamin C is better utilized in presence of tea rather than water. This is because of the tea polyphenols that have antioxidant effect on vitamin C, thereby leading to lower loss. It was also observed that, ascorbic acid aided in the higher extraction of soluble ferric ions from leaves while brewing. It was also claimed to have better absorption in the intestine. In another study by Ginter (1973), a correlation was observed between vitamin C deficiency and high blood cholesterol levels and atherosclerosis in guinea pigs. In another experi ment with rabbits, vitamin C added tea was administered and the results showed 34 per cent reduction in cholesterol level and about 40-50 per cent reduction in atherosclerotic plaques in arterial walls. This effect is due to the polyphenols of tea which have antioxidant effect on vitamin C, helping its better utilization by the body.

Since saccharine is used as a sweetening agent, the claorific value of experimental teas is expected to be very low. This is an advantage for the obese people as the teas have good palatability at the same time contributing very low amount of energy.

Beerboom (1979) reported that obesity is becoming a common disorder due to the occurrence of cardiovascular diseases, hypertension, respiratory illness and diabetes which are fatal to health. Author claimed, it is always difficult for the weight watchers to find suitable foods with good palatability and called for newer foods which can contribute low calories. Hence, beverages such as the ones in the present study with their advantages are palatable and thus will help in weight reduction practices.

5.3.2. Blended soymilk

Results of total solid and protein content of blended soymilk samples show that, three of the samples have protein higher than 4.5 g per 100 ml. Sample C_2 having soymilk, sesame milk, skim milk and coconut milk has highest amount of protein (4.95 g). This is because of use of defatted soyflakes, skim milk as well as sesame milk. Sample C_2 apart from having high protein, also has good quality protein, as soymilk and sesame milk have complementary effect on eacho other; sesame milk providing sulphur amino acids which are limiting in soyproteins. Prabhavat et al. (1978) reported the improved nutritive value of regular soymilk by addition of sesame milk. The percentage of sulphur amino acids were increased and chemical score improved from 54 to 106 without causing imblance in essential amino acids. However, sample A_2 having soymilk and skim milk blends at 70:30 proportions respectively and sample B_2 having soymilk, sesame milk and skim milk blends, also have good amount of protein. Sample D_2 having blend of soymilk, coconut milk and skim milk has comparatively lower amount of protein (3.14 g). However, its protein content agrees with the ISI specification (IS:7482:1974).

The ISI specifications for protein beverages derived from oilseeds claims for 3.0 per cent protein and 11.5 per cent of total solids. Thus, the samples A_2, B_2 and C_2

meet the ISI specification of protein and total solid contents and hence can be classified as high protein beverages. Such milks apart from serving as nutritious and pleasant beverages, also have wide therapeutic applications.

Feeding soymilk to infants has three advantages: Firstly, for babies who are ellergic to animal milk and who are lactose intolerant, soymilk is the only solution at present and they can be successfully fed, other than which, the condition of lactose intolerant babies is fatal (Torun, 1981). Secondly, babies with low birth weight, premature babies of low gestational age have lower lactase enzyme activity than full term babies and hence cannot be fed with mother's milk. For such babies again, soymilk serves as a promising solution, and soymilk can be fed to such infants till they acquire normal enzymatic activities (Bacchhuber, 1979). The third advantageous application of soymilk feeding is for jaundiced infants undergoing phototherapy. It was observed that, phototherapy reduces jejunal lactase activity resulting in loose stools when fed with mother's milk or cow's formulae. Sisson (1979) conducted experiments on feeding soy based infant formula (250 ml) and cow's milk formula (Similac) and concluded that, soy based infant formulae prevented diarrhoea and appearance of reducing substances in stools, when fed to jaundiced infants receiving phototherapy, in contrast to the adverse effects of cow's milk formulae.

Soymilk forms an efficient food of high acceptability for severely malnourished children (Mathew and Raut, 1981). It has antihypercholestrolemic effect which can be a very good solution for atherosclerotic patients (Greendly and Abraham, 1983). Persons with in-born errors of metabolism like cystathione synthatase deficiency can be successfully fed with soymilk (Vivian Shih, 1970).

5.3.3. Blended malt powders

The results of protein and energy compositions of blended malt powders showed that, the protein content varied from 22.8 to 26.4 per cent and gross energy values from 377 to 397 cals. Ten grammes of the malt powder stirred in 100 ml of milk can provide 2.28 to 2.64 g protein apart from milk protein.

Sample C_2 had highest protein (26.4%) and sample C_1 had lowest protein (22.8%). It is observed that blending defatted soyflour with cereal malts increases the protein content. Sample C_2 containing ragi malt and defatted soyflour at 60:40 proportion had higher protein than sample A_1, which contained wheat malt and soyflour at 70:30 proportions. It is clear from the results got for C_1 and C_2 samples that, protein content increased from 22.8 to 26.4 per cent when 30 per cent soyflour was increased to 40 per cent. Hence, defatted soyflour makes a very good blend with both ragi and wheat malt, same time improving the protein content drastically. While peanut flour though improves protein content of the blended malt powders, does not make an acceptable product with ragi malt.

A malted weaning food developed by Malleshi et al. (1982) consisting of malted ragi flour and malted green gram flour at 70:30 proportions reported a protein content of 11.5 per cent.

A weaning food consisting of gelatinised corn meal (45%), defatted soyflour (23%) and skim milk powder (15%) was prepared by Hay et al. (1983). The protein content estimated was 20.8 per cent and energy value of 372 cals. Since the mixture was found to be rich in protein and calories, it was used to feed growing as well as malnourished children.

In the present study, the blended malt powders have higher protein as well as energy contents than the reported values of Hay (1983) and Malleshi (1982), and hence can be used as protein and energy rich beverage mix. Since the blends contain cereal and oilseed proteins, the quality of protein is expected to be higher. Children in age of 1-2 years are weaned and their food often consists of cereals, millets, roots and tubers. But these foods having large amounts of starch, cause bulkiness by their water binding capacity and children cannot digest such foods since their digestive enzyme activity will be partially developed (Rajalaxmi, 1976). Under such conditions blended malt foods with low dietary bulk can be conveniently fed to weaned children, same time provide high amounts of protein and calories. For the same advantages, the children in the rapid growing age, hospitalized patients, convalescents, institutional residents can be recommended drinking blended malt beverages.

SUMMARY

VI. SUMMARY AND CONCLUSIONS

Review of beverages in today's market shows there is a considerable demand for developing variety with specific nutrients which can be used as dietetic beverages. In the present study, 15 types of herbal teas were developed using one or more of herbs/spices like liquorice, amla, cardamom, clove, cumin, cinnamon, fennel seeds, mint, japatre and tulsi at various proportions. In the process of development of high protein beverages, 4 types of blended soymilks at 50, 60 and 70 per cent levels were prepared using defatted soyflakes, sesame milk, coconut milk and s kim milk. Malted beverage mixes having 30 or 40 proportions of defatted soyflour or defatted peanut flour or green gram malt blended with wheat or ragi malts at 70 or 60 proportion were prepared with the intention of developing a high protein and caloric beverage mix.

The prepared beverages were evaluated by a taste panel of 13 judges for the product characters namely, sweetness, appearance, flavour and astringency. Herbal tea sample K_1 with a blend of amla, mint, tulsi, cloves and cinnamon along with 75% tea leaves was very much attractive in appearance. Sample H_1 with a blend of liquorice, cumin, cinnamon, ecloves and fennel seeds had pleasant flavour. Hot samples were rated higher than cold ones. Consumers evaluated the beverages for overall acceptability and found sample X_1 (a blend of Tulsi and dried mint with 60 tea leaves. The same sample had also been scored high by the laboratory panel. Chemical analysis indicated the experimental teas had higher amount of calcium, sodium, potassium, zinc, copper, manganese and ascorbic acid than the black tea. Soluble tannin content was 0.62 mg/100 ml compared with 145 mg per 100 ml of black tea. Saccharine used as a sweetner contributed low calorific values.

Blended soymilk samples evalutated by the lab-panel indicated that, samples had attractive appearance, pleasant flavour and acceptable astringency. Oriental flavour mix added to the milks increased their flavour and appearance scores. Sample A_I having a blend of soymilk and skim milk was found to be most attractive, most pleasantly flavoured milk with no detectable astrintency. Estimations of protein and total solid contents were found to meet the ISI specifications for protein beverages. Sample C_2 having a blend of soymilk, sesame milk, coconut milk and skim milk had highest amount of protein (4.95%) and total solids (13%). The results got were higher compared with the reported literatures.

Malted beverages evaluated by lab-panel members indicated that, all the samples were rated to be good. Sample A_I having wheat malt and defatted soyflour blends at 70:30 proportions was best accepted sample. Consumers liked all the samples very much. Nutrient analysis revealed that the beverage mix had higher protein and total calorie contents as compared with the published results. Sample C_2 consisting of ragi malt and defatted soyflour at 60:40 proportions had 26.4% protein and 382 cals.

To conclude, the beverages in the present study serve as successful dietetic drinks for patients with wide number of conditions and disorders, like for obesity, diabetis, heart patients, weight-watchers and similar conditions, herbal teas form promising dietetic drinks. For patients with severe dehydration to whom immediate mineral supplementation is necessary, minerally rich tea will be a promising solution. High protein soymilk can be successfully fed to lactose intolerant babies, premature babies, jaundiced babies undergoing phototherapy, atherosclerotic patients and children in the rapid growth period. Blended malt beverages with high protein and calorie density makes a good supplement for hospitalized patients, convalescents, teenagers, athletes, pregnant and lactating women and also as nourishing drink for growing children and adults.

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APPENDIX I

Score sheet for evaluation of beverages

Judge: Product: Date:

Instructions: Please score the samples as per the index. Rinse your mouth for after taste to disappear before judging the next sample

Index for scoring

Sweetness	Appearance	Flavour	Astringency
5 - Excellent	5 - Most attractive	5 - Extremely pleasant	5 - No astringency
4 - Just the way I want	4 - Very much attractive	4 - Very much pleasant	4 - Acceptable astringency
3 - Just sufficient	3 - Acceptably attractive	3 - Pleasant	3 - Slightly astringent but acceptable
2 - Not sufficient	2 - Moderately attractive	2 - Moderately pleasant	2 - Moderately astrinvent and slightly acceptable
1 - Just recognisable	1 = Slightly attractive	1 - Slightly pleasant	1 - Strong and unacceptable
0 - Not recognisable	0 - Not attractive	0 - Not at all pleasant	0 - Very strong

Characters	Codes	X	G	B	S	K	Z	A	P	T	M
1. Sweetness											
2. Appearance											
3. Flavour											
4. Astringency											

5. Rank the samples from the best liked to the least liked for overall acceptability **(1 to 10)**

Best liked 1____ 2____ 3____ 4____ 5____ 6____ 7____ 8____ 9____ 10____

APPENDIX II

Consumer Study

Product:

Name:

Date:

Instructions: Please taste the samples and tick mark (/) according to your feeling against the columns provided for each sample.

Sample code	I like it very much	I neither like or dislike it	I don't like it
Q			
R			
S			
T			

Rank the beverages in order of liking from high to low.

APPENDIX III

The quantity of mineral elements in the experimental samples was determined by the regression correlation equation. The methodology followed is as illustrated below.

e.g. Element : Iron

The galvanometer readings of the standard iron solution at various concentrations have been given in the following table.

Galvanometer readings of standard solutions of iron

Conc. (ppm)(X)	G.R. (Y)	X^2	XY
0.00	0.00	0.00	0.00
0.25	6.00	0.0625	1.50
0.50	13.00	0.25	6.50
1.00	26.00	1.00	26.00
1.50	39.00	2.25	58.50
2.00	51.00	4.00	102.00
4.00	90.00	16.00	360.00
9.25	225.00	23.56	554.6

n - Number of observations

X - Mineral concentration of the sample

Y - Galvanometer reading

b - slope of the curve

$$b \approx \frac{\Sigma XY - \frac{(\Sigma X)(\Sigma Y)}{n}}{\Sigma X^2 - \frac{(\Sigma X)^2}{n}}$$

$$= \frac{554.6 - \frac{9.25 \times 225}{7}}{23.56 - \frac{9.25 \times 9.25}{7}}$$

$$= \frac{554.6 - 297.321}{23.56 - 12.223}$$

$$= \frac{257.279}{11.337}$$

$$= 22.6937$$

$$a = \frac{\Sigma Y - b.\Sigma X}{n}$$

$$= \frac{225 - 22.6937 \times 9.25}{7}$$

$$= \frac{225 - 209.9}{7}$$

$$= 2.1571$$

$$Y = a + b.X$$

$$\therefore \quad X = \frac{Y - a}{b}$$

[X gives the elemental concentration of the experimental sample using galvanometer reading (Y) of the sample)

The preceding table gives the galvanometer readings for iron content in ppm and mg/100 ml of the experimental tea samples.

Galvanometer readings and iron content of the herbal tea samples

Sample code	G.R. (Y)	Conc. (ppm)(X)	Conc. X (mg/100 ml)
A	2.00	0.007	0.0007
B	2.00	0.007	0.0007
E	4.00	0.081	0.0081
K	2.00	0.007	0.0007
L	2.00	0.007	0.0007
M	2.00	0.007	0.0007
P	2.00	0.007	0.0007
S	2.00	0.007	0.0007
X	2.00	0.007	0.0007
Y	3.00	0.037	0.0037

The concentration of iron is the different samples were calculated with the formula $X = \frac{Y - a}{b}$

e.g. Sample A.

$Y = 2.00, \; a = 2.1571, \; b = 22.7$

$$\therefore \; X = \frac{2 - 2.1571}{22.7}$$

$= 0.007$ ppm

The same procedure has been followed for the rest of the minerals estimated.

APPENDIX IV

Determination of gross energy value of food stuffs using Bomb Calorimeter

Bomb standardization

1. Weigh 1 g benzoic acid pellet to nearest 0.1 mg in cup.
2. Place cup in circular electrode and attach 10 cm fuse wire to each of the electrodes by touching the fuse wire to the pellet.
3. Assemble bomb and fill with oxygen (20 atmospheric pressure).
4. Place bomb in bucket and bucket in jacket. Attach a contact wire and fill bucket with 1.5 liter of distilled water.
5. Close cover, lower thermometer thermistor units and start the motor for stirring.
6. Adjust jacket temperature to near bucket temperature, manually.
7. Allow four minutes at equilibrium temperature.
8. Note the initial temperature of bucket and ignite the fuse wire and watch the rise in temperature.
9. After 8 minutes, note the final temperature.
10. Release pressure from bomb slowly.
11. Rinse inside of bomb with distilled water and titrate with sodium carbonate using methyl orange indicator.

12. Measure the unburnt fuse wire and this gives the wire correction.

Calculation for standardization

$$W = \frac{Hm + a + b}{t}$$

where, W = energy equivalent of calorimeter

H = heat of combustion of benzoic acid (6.318 Kcal/g)

m = mass of benzoic acid pellet

a = ml of Na_2CO_3 used

b = calories used in ignition fuse wire

t = difference in true initial and true final bucket temperature

Sample determination

1. Weigh the given sample (around 1 g) on a piece of butter paper and note the weight of the paper also.

2. Repeat the steps as in standardization.

Calculation

$$H = \frac{tW - a - b - c}{m}$$

where, H = heat of combustion sample

t = true temperature difference

W = water equivalent of calorimeter

a = acid correction

b = paper correction

c = wire correction

m = weight of sample

Duplicate should agree within 0.1 Kcal/g preferably 0.05 Kcal/g.