UTILISATION OF SKIM MILK FILLED WITH COCONUT MILK FOR PREPARATION OF INDIGENOUS DAIRY PRODUCTS

By

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THESIS

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DECLARATION

I hereby declare that the thesis entitled **UTILISATION OF SKIM MILK FILLED WITH COCONUT MILK FOR PREPARATION OF INDIGENOUS DAIRY PRODUCTS** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or any other similar title, of any other University or Society.

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Certified that this thesis, entitled **UTILISATION OF SKIM MILK FILLED WITH COCONUT MILK FOR PREPARATION OF INDIGENOUS DAIRY PRODUCTS** is a record of research work done independently by Kum. Mini Jose under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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INTRODUCTION

India ranks as the world's third largest milk producer producing 54.9 million tonnes of milk annually. Milk produced in the country is far short of the requirement as the nutritional demand amounts to 65 million tonnes. Per capita consumption of milk in our country (178 grams/day) does not meet the minimum quantum of 210 grams/day recommended by the Nutritional Advisory Committee of the Indian Council of Medical Research (Dairy India, 1992).

Milk consumption pattern in India reveals that 45.7 per cent of the total milk produced is consumed as liquid milk. This leaves only 54.3 per cent of the total milk for the preparation of various dairy products. It also shows that 34 per cent of the milk produced goes for the manufacture of fat rich products like butter and ghee.

The major manufacturers of dairy products in India like Amul, Vijay and Sagar are forced to reduce the production of dairy products as a measure to increase the availability of fluid milk. The use of whole milk for the preparation of indigenous milk products like Paneer, Chhana, Rasagolla etc. is also to be reduced. In spite of this, butter and ghee are produced in large quantity. Manufacture of butter and ghee yields large quantity of buttermilk and skim milk which

are highly nutritive, largely containing solids not fat (SNF). This leaves an opportunity to economically utilize these by-products for the preparation of various indigenous dairy products.

While butter milk is consumed as a refreshing drink, only a small portion of skim milk obtained is effectively utilised. Unfortunately, the facilities available in our country for production of skim milk powder is limited and hence the major portion of skim milk obtained has been wasted. In surplus season skim milk will be available in plenty which is not properly utilised. Attempts are yet to be made for economic utilization of skim milk (Dairy India, 1992).

On the other hand, any product made out of skim milk is not properly relished by Indians, as they prefer fat rich products. Milk fat is an important constituent of all dairy products and has marked influence on consumer acceptance of these products.

Depending on the product, the most important quality characteristics contributed by fat are flavour, colour, richness, mouthfeel, softness, smoothness etc.

Unfortunately, the high cost of milk fat has made dairy products a luxury item, which cannot be afforded by people of low income group of the developing countries including India. Milk fat being highly expensive, its substitution with cheaper fats can substantially reduce the cost of the product. Since World War II large quantities of properly refined edible vegetable oils such as cottonseed, groundnut and coconut oils tailored to give a melting point similar to butter fat were used in vegetable fat frozen dessert, synthetic vegetable cream or margarine.

Attempts were made, in these circumstances, to produce an imitation product which have resemblence with milk or cream and this was achieved by blending skim milk with any fat or oil other than milkfat. These products were named as filled milk products. In other words, filled milk products are those products which are made by combining fats or oils other than milk fat with skim milk. In India, vanaspathi has been reported to be used to prepare filled cheese, filled chhana and rasogolla and filled ice cream.

In order to produce filled milk products at a lower cost than natural milk products, cheaper and easily available vegetable fat has to be selected. As far as Kerala is concerned, coconut is a valuable food crop

important in the general economy of the state and is available in plenty, with 58.7 per cent of total coconut production in India (Thampan, 1978). Coconut milk extracted from grated coconut approximates in nutritive properties the compositon of rich natural cream. Pleasant and sweet, it is endowed with an agreeable flavour. A comparison of cows milk with the coconut milk prepared from an equal quantity of water and gratings has shown that coconut milk is richer in fat and poorer in protein and sugar content.

The above qualities make coconut fat an ideal substitute for milk fat for the preparation of filled milk products. In the present study, an attempt has been made to convert skim milk into a value added product, by adding coconut milk and the filled milk thus prepared has been used for the preparation of certain indigenous dairy products.

Paneer also called chhana in certain parts of the country is an important indigenous variety of soft cheese which forms the base for a variety of culinary dishes, stuffing material for various vegetable dishes, snacks and sweet meats. Typically, paneer is marble white in appearance with somewhat spongy body, close knit texture possessing sweetish milkly acidic and somewhat nutty flavour. Since roughly 90 per cent of the fat and proteins,

50 per cent of minerals and 10 per cent of lactose contained in the original milk is obtained in a fairly concentrated form in paneer, its food value is fairly high.

There is a strong case for making paneer from skimmilk filled with coconut milk. Firstly, as milk fat is replaced by coconut milk fat, the paneer made out of it would be considerably cheaper than paneer made from whole milk. This would increase the popularity of the product amongst the masses. Secondly, it would provide a good avenue for the utilization of skim milk to produce a high quality protein rich product which otherwise is generally wasted at small scale. The fat extracted from milk can be used for other useful purposes.

Today, rasogolla has become a very popular milk sweetmeat, because of its pleasant and delightful taste, to all Indians irrespective of their caste, creed or religion. These are marble white balls, having a characteristic spongy body, smooth texture and served in sugar syrup. For the preparation of rasogolla, paneer is thoroughly kneaded and made into small balls which are subsequently boiled in clarified sugar syrup followed by slow cooling in comparatively less concentrated sugar syrup.

In order to bring down the price of rasogolla, attempts have been made to prepare them from filled milk. As skim milk filled with coconut milk are comparatively cheaper than whole milk, the paneer prepared from a combination of these two may result in the production of low cost rasogolla.

Instrumental and sensory evaluation may reveal the characteristic textural properties of Rasogolla. But evaluation of textural properties is difficult since, at present, this requires sophisticated instruments. As the textural character of Rasogolla indirectly gives an idea of its quality, measurement of textural quality by a simple method is a necessity.

Whey is an important byproduct during the manufacture of cheese, casein, chhana/paneer and coprecipitates. A variety of beverages consisting of plain, carbonated, alcoholic and fruit flavoured have been successfully developed and marketed all over the world, because they hold great potential for utilizing whey solids. In the absence of systematic surveys/statistics, the predicted figure for whey production is estimated at 3 lakh tonnes per annum and hence in India, great potential exists in utilisation of whey in whey drinks and beverages. A number of refreshing and low cost whey drinks are already in the market.

The thrust on whey utilization has been spurted by the stringent regulations imposed by the environmental pollution agencies all over the world. Other aspects relate to economic return from whey, which contains about half the solids of original milk, principally lactose with some valuable proteins and with much of the original mineral contents of milk.

Advantages of whey drink lies in their thirst quenching and refreshing properties in addition to higher nutritional qualities as compared to most of the soft drinks and fruit juices. The marketing of whey drink also can generate good profit margin.

In view of the above, the present study has been undertaken with the following objectives.

1. To assess the suitability of skim milk filled with coconut milk for the preparation of dairy products such as Paneer, Rasogolla and acid whey drinks.

2. To compare, the chemical, textural and organoleptic qualities of the product prepared from coconut fat filled milk with those prepared from whole cow milk.

3. To evolve a simple method to measure the textural qualities of the product.

4. To convert whey, the byproduct of paneer, into an acceptable soft drink.

Review of Literature

REVIEW OF LITERATURE

Extensive studies have been undertaken in different parts of the world to study the physico-chemical properties of various dairy products made by the partial substitution of the milk components with those available from plant and animal sources.

2.1. Substitution of milk fat

As per the observations made by Miller (1968), the reasons for growing acceptance of dairy substitutes were, long shelf life of finished products, which in turn minimised the storage and distribution problems and low cost of basic ingredients. To prepare filled milk products, the processor should make certain that the vegetable fats are bland in flavour and should produce a finished product with the desired eating qualities.

Brink et al. (1969) analysed four types of filled milk, one each of imitation milk and whole milk for total fat, saturated and unsaturated fatty acids, solids-not-fat, ash, vitamins and carbohydrate content. Filled milk and imitation milk contained more saturated fatty acids than whole milk. The nutritional value of imitation and filled milk was compared with that of whole milk.

Ganguli (1971) described the Filled Milk Acts (USA) as any milk, cream or skimmed milk whether or not condensed evaporated, concentrated, powdered, dried or desiccated to which has been added or which has been blended or compounded with any fat or oil other than milk fat, so that the resolving product is in imitation or semblence of milk, cream or skim milk, whether or not condensed, evaporated, concentrated, powdered, dried or desiccated.

Medora (1971) defined Filled Milk as the product made from skim milk powder and vegetable oils, added to it in the same proportion as the butter fat removed from the whole milk. It was also discussed that certain filled milk products like filled icecream and butter margarine mixture were made from milk and vegetable fats, especially coconut fat. These products were found to remain good for about 24 hours without refrigeration. As the prices were less it was brought within the reach of masses.

Bhandari et al. (1976) prepared flavoured filled milk having 3.5 per cent fat and 8.5 SNF using coconut oil and low heat spray dried skim milk powder as the major ingredients. The technological procedure adopted resulted in a product which showed semblence with natural flavoured milk in terms of homogenity and body.

Blohorn (1977) succeeded in producing a fat similar to the fat in natural milk by subjecting to transesterification a mixture of 65 per cent refined fractionated solid palm oil, 30 per cent refined coconut oil and 6 per cent industrial tributyrin.

In order to modify cow or buffalo milk in view of the virtues that human milk possesses attempts were made by Ganguli and Kuchroo (1979) to replace milk fat with vegetable oil. A combination of vegetable oils like corn oil, ground nut oil and its admixtures along with milk fat were found to distinctly improve the polyunsaturated fatty acid profile.

The necessity to produce a subsidised form of milk in order to meet the demand of the lower per capita income group was explained by Patil and Gupta (1979). Since toning the milk alone, will not help to reduce the cost, the authors have recommended the use of dairy analogs or by extending the available milk using vegetable sources. According to them, the surplus milk obtained during flush season could effectively be used for extending the milk to manufacture cheaper vegetable toned milk.

Blesa et al. (1980) reported that a mixture of 40 per cent soya milk and 60 per cent cow milk was "liked moderately" by a panel of 64 untrained persons. The biological values of the mixtures of these milks (75.5-77.5) were found to be nearer to that of cow milk (80) and were more than the biological value of pure soyamilk (66.4).

Jensen and Nielsen (1982) reviewed the importance of recombined milk products for developing countries with their beneficial effects on nutrition, as a significant source of animal protein, vitamins and essential fatty acids. According to the authors the relatively expensive milk fat may be usefully replaced with locally produced vegetable oils in the manufacture of recombined products called filled product. Filled milk of acceptable quality was made from soyabean oil, coconut oil and peanut oil. But the use of vegetable oils may result in unwanted changes in both organoleptic properties and/or nutritive value due to the composition of fatty acids in some of the fats.

Mann (1982) formulated blends from dairy ingredients and soyabean products, such as dried milk proteins/soya isolates, defatted soyabean meal/skim milk, soyaprotein/ caseinate, soyabeans/cheese whey curd, soyabeans/natural

cheese textured soya protein/dried whey products resembling meat and soya flour as a low fat dairy spread.

Efforts to develop low cost frozen desserts by substituting milk based ingredients like butter fat and skim milk solids with vegetable fat, soyabean, whey solids etc. were reviewed by Rajor and Patil (1983).

A detailed description of milk product substitutes including filled milk, imitation milk, protein concentrate beverages, soya yoghurt and imitation ice cream was given by Gupta et al. (1987). Main advantages of these products are low cost, owing to the utilization of selectively cheap ingredients, such as vegetable protein and fat, emulsifiers and stabilizers.

Prajapathi et al. (1987) studied the use of vegetable oils upto a level of 10-30 per cent for partial replacement of butter fat in manufacturing low fat dairy spreads. Incorporation of vegetable oil in a low fat dairy spread raised the level of polyunsaturated fat and also improved the spreadability at refrigeration temperature. Vegetable oils like coconut oil, palm, soyabean, sunflower, safflower and groundnut oils were used.

Use of vegetable fat incorporated milk for the preparation of various dairy products were reported to reduce the cost of the product (Gonc et al., 1988; Backman et al., 1989 and Rajor and Vani, 1991).

A study was carried out by Umesh et al. (1989) to prepare low cost soft serve ice cream by replacing milk fat with vegetable fat using vanaspathi at levels of 40, 50 and 60 per cent. Results of organoleptic evaluation revealed that vanaspathi could be used to replace milk fat in the manufacture of soft serve ice cream at levels of upto 60 per cent. By replacing 60 per cent of the milk fat with vanaspathi, the cost of the ice cream could be reduced by 15.68 per cent without loss in quality.

2.2. Use of coconut milk in filled milk processing

Analysis of coconut milk has shown that it contained 41.0 per cent moisture, 5.8 per cent protein, 38-40 per cent fat, 6.2 per cent minerals and 9-11 per cent carbohydrates. As per the figures reported in Philippines, coconut milk contained 56.3 per cent moisture, 43.7 per cent total solids, 1.2 per cent ash, 33.4 per cent fat, 4.1 per cent protein and 5.0 per cent invert sugar. A comparison of the

coconut milk prepared from an equal quantity of water and gratings with cow's milk has shown that while the coconut milk is richer in fat, it is poorer in protein and sugar content (Thampan, 1975).

Birosel and Ferro (1977) have described the manufacture, yield, composition, emulsion characteristics and creaming characteristics of coconut milk, an oil-in-water emulsion prepared by comminution and pressing of coconut flesh. Characteristics of coconut milk were compared with that of cow's milk.

Banzon (1978) analysed Philippines coconut milk and found that it contained 46.5 per cent water, 43.4 per cent fat, 4.8 per cent protein and 10.1 per cent SNF. Coconut milk was used for the reconstitution of dried skim milk into drinking milk, evaporated milk and sweetened condensed milk, but these products were found to have a slight coconut flavour.

Lupke (1979) has described a new product, 'creamed coconut' a hundred per cent coconut product, without any additives. Possible uses in the dairy industry included preparation of desserts, milk shakes, cream and semi-finished products.

A butter like product was developed from coconut milk involving pasteurization at 74°C, for 30 minutes, churning at 120 revolution per minute for 30 minutes at 18°C, working the 'butter granules' to 13 per cent moisture content to give a product with firm texture. The butter was stable for about 21 days when stored at 7-10°C. Fat recovery in 'butter' was 69.5 per cent (Escueta, 1980).

Davide et al. (1987) have shown that coconut milk extracted from a suitable coconut meat-water ratio could be blended with reconstituted skim milk to formulate a new type of low fat 'fresh' filled milk, even without the use of a stabilizer or emulsifier. The 'fresh' filled milk was found to have a pleasantly mild coconut flavour and smooth homogenous texture that remains good and organoleptically unchanged for seven days at 5-7°C. When standardized to 2-2.5 per cent vegetable fat, with no butter fat, the new product was whiter, costs less and approximates the gross composition of cow's milk standarized with skim milk to the same fat level.

Nair and Geevarghese (1988) succeeded in preparing a dairy analogue - Kera cream. Coconut milk blended with milk was used to prepare Kera-cream which resembled ice cream.

Agrawal et al. (1991) prepared 'coconut milk' which is a product made from non fat milk solids either of liquid or powder origin in which vegetable fats or oils have been incorporated in approximately the same proportion as in the butter fat of fresh milk. The preparation of coconut milk involved, basically a substitution of animal fat in milk by vegetable fat and manipulation of processing parameters to get a product similar to standard milk. It was prepared by blending skim milk powder with coconut milk of freshly grated coconut and pasteurized at 70-72°C for 10 minutes. It contained six per cent skim milk powder and 9.65 per cent total solids on sterilization and it can be utilized as coconut flavoured milk in food industry.

Definition of Paneer/Channa-

Chhana, which is more commonly known as paneer in certain parts of India refers to the milk solids obtained by the acid coagulation of boiled hot whole milk and subsequent drainage of whey (De, 1980).

According to Prevention of Food Adulteration Rules (1982) chhana or paneer is the product obtained from cow or buffalo milk, or a combination thereof by precipitation with sour milk, lactic acid or citric acid. It should not

contain more than 70 per cent moisture, and the milk fat content should not be less than 50 per cent of the dry matter.

According to Bureau of Indian Standard Specifications (1983), paneer is an important indigenous milk product prepared by the combined action of acid coagulation and heat treatment of buffalo or cow milk or a combination thereof. Milk solids suitably processed may also be used. The phenomenon of precipitation involves the formation of large structural aggregates of proteins in which milk fat and other colloidal and soluble solids are entrained with whey.

Shukla and Gill (1986) described paneer and chhana as similar products manufactured in the same way. According to them, the only difference between paneer and chhana was that after coagulation sufficient pressure was employed in case of paneer to drain off the whey.

Bandyopadhyay and Mathur (1987) defined paneer as a heat coagulated product from buffalo milk characterized by marble white compact body and closely knit texture. Whereas chhana was a product obtained by the 'heat-acid' coagulation of cow milk, characterized by soft and spongy body and granular texture.

Paneer and chhana are products which mainly consists of acid coagulated milk solids and is made from cow, buffalo or mixed milk. Chhana differs from paneer in that no pressure is applied to remove the whey. Both paneer and chhana were expected to meet the following legal requirements in India. Moisture (maximum) 70 per cent, Milk fat (minimum on dry matter basis), 50 per cent (Dairy India, 1992).

For the present study, the product prepared from cow milk by heat-acid coagulation, is termed as 'paneer' and the product was used for analysis and preparation of rasogolla.

2.3. Preparation of Paneer/Chhana

2.3.1. Type of milk

According to De and Ray (1954) chhana prepared using cow milk had moist surface, light yellow colour, soft body, smooth texture and mildly acidic flavour while buffalo milk when used for preparation of chhana, produced chhana with greasy surface, white colour, hard body and coarse texture. Cow milk chhana was found to be more suitable for Bengali sweet preparation than buffalo milk chhana as these were hard, coarse and less spongy.

De et al. (1971) carried out investigations on the utilization of high acid milk for the preparation of paneer. Products prepared were found to be similar in economic and nutritive values as that of control.

Kundu and De (1972) standardized the method of production of chhana from buffalo milk so as to obtain a product suitable for preparation of rasogolla.

Srivastva and Singh (1976) used sour and curdled milk alone or mixed with 0, 25, 50 or 75 per cent fresh milk. Out of the milks tested, only sour milk with 75 per cent fresh milk with pH 6.25 gave acceptable products. Neutralization of sour milk to pH 6.2 had no effect on chhana.

Jailkhani and De (1980) and Moorthy and Rao (1982) were able to prepare chhana from goat milk.

An attempt was made by Rajani and Sharada (1983) to find out the possible utilization of Clot-on-Boiling (COB) positive milk for preparation of paneer. They found that paneer of sweet curdled milk was as much acceptable as the products prepared by induced curdled milk. Sweet curdled

paneer had significantly higher biological value than induced curdled paneer.

Rao et al. (1984) prepared paneer from buffalo milk while Chawla et al. (1985) developed a 'low fat paneer' using buffalo milk that had been standardized with buffaloes' skim milk. Patil and Gupta (1986) and Rajorhia and Sen (1988) prepared good quality paneer from both cow milk and buffalo milk for the preparation of paneer.

According to Ghodekar (1989) buffalo milk was preferred over cow milk for the manufacture of paneer, since it contained higher levels of casein and minerals which helped to produce paneer having hard and rubbery body. Cow milk, recombined milk and addition of other non conventional solids (soybean) yielded a poor quality paneer with a soft and mellowy body.

Pal and Garg (1989 a) used sour butter milk in the manufacture of paneer and compared it with paneer made from buffalo milk standardized with skim milk and found that the butter milk paneer so prepared was as acceptable as the control paneer.

The effect of additives like sweet cream, butter milk on the quality aspects of paneer was also studied by Pal and Garg (1989 b). Good quality paneer resulted by using low fat milk (5.1 per cent) by mixing about 30 per cent butter milk to buffalo milk.

Kanawjia et al. (1990) standardized methods for the production of paneer using filled and fortified milk. Process modifications were established for paneer from cow and recombined or reconstituted milk.

Sensory quality of chhana prepared using cow milk, buffalo milk and goat milk was compared by Joshi et al. (1991). Buffalo milk produced significantly higher yield of chhana as compared to cow and goat milk. Chhana prepared from buffalo milk had hard body and coarse texture, while that prepared from cow and goat milk had soft body and smooth texture. Chhana from cow and buffalo milks had acceptable flavour whereas that from goat milk had slightly acidic flavour. The total sensory score also revealed that cow milk chhana was superior to buffalo milk and goat milk chhana.

Effect of blending buffalo and cow milk on the physicochemical quality of paneer was studied by Pal and Yadav (1991). They suggested that blending of buffalo and cow milk upto a ratio of 1:1 had no detrimental effect on the quality of paneer.

2.3.2. Fat content of milk

Bhattacharya et al. (1971) conducted studies on milks containing different percentages of fat for their suitability in paneer making. They observed that a level of fat higher than five per cent was suitable. Good quality paneer was prepared by Kundu and De (1972) using buffalo milk standardized to five per cent fat.

Moorthy and Rao (1982) studied various aspects of production and quality of chhana from goat milk. Goats milk with five per cent fat resulted in higher yields but milk with three per cent fat gave chhana with higher moisture content. Fat losses was least when milk fat was three per cent.

Buffalo milk standardized to six per cent fat was found to be ideal for preparation of paneer (Rao et al., 1984).

A low fat paneer was prepared by Chawla et al. (1985) using buffalo milk that was standardized with buffalo skim milk to six to 0.05 per cent fat. Paneer made from milk containing less than three per cent fat had unacceptable flavour and body and texture, whether tasted raw, fried or cooked.

Paneer was prepared from cows milk standardized to 3.0 per cent, 3.5 per cent, 4.0 per cent and 4.5 per cent fatby Vishweshwaraiah and Anantakrishnan (1986). Fat loss in whey increased with the increase in fat percentage of milk. Paneer obtained from milk with 4.5 per cent fat conformed to the required standards, while paneer from milk with lesser fat content did not conform to the standards. Milk with lower fat per cent eventhough not conforming to standards resulted in product with better sensory characteristics.

Organoleptic assessment of paneer samples conducted by Visweshwaraiah and Anantakrishnan (1987) showed that optimum fat content in the milk used for preparation was 3.5 per cent.

With a view to standardize the procedure for preparing paneer, Sachdeva and Singh (1988 b) optimised the processing

conditions. Optimum fat and solids-not-fat ratio was found to be 1:1.65.

Crossbred cow milk was standardized to 3.0, 3.5, 3.7, 4.0, 4.2 and 4.5 per cent fat and paneer was prepared out of it. Yield of fresh paneer increased with increased fat per cent in milk from 14.5 per cent using three per cent fat milk to 15.7 per cent using 4.5 per cent fat milk; moisture correspondingly decreased from 52.8 to 49.7 per cent and fat on dry matter basis increased from 45.9 to 57.4 per cent (Pruthi and Koul, 1989).

In an effort to produce paneer from mixed milk, Pal and Yadav (1991) blended buffalo and cow milk in a ratio of 1:1. Increasing level of cow milk in the blend resulted in higher retention of moisture due to decrease in the fat level; consequent increase in the protein content and a concomitant decrease in the total solid content of paneer.

Cow milk and buffalo milk were mixed in a ratio of 1:1 and standardized to a fat level of 3.5 per cent from which low fat paneer of good quality was prepared (Pal *et al.*, 1991).

2.3.3. Type and strength of coagulant used

Kundu and De (1972) while standardizing the method of production of chhana from buffalo milk, used one per cent citric acid solution to a pH of 5.7 to rapidly effect coagulation.

Effect of milk coagulants on the quality of chhana and chhana whey was studied by Singh and Ray (1977 b). Citric acid, lactic acid and sour chhana whey were used as coagulants. It was reported that chhana obtained with citric acid was soft and smooth without sour taste, whereas lactic acid and sour chhana whey gave hard and granular products with a slight sour taste. The yield of chhana was 20 per cent with sour chhana whey, and 19 per cent with citric acid and lactic acid. The chemical composition of chhana also varied depending on the coagulant used.

Effects of strength of coagulant on the quality and yield of chhana from buffalo milk was studied by Ahmed *et al*. (1981). Yield was highest with one per cent citric acid and lowest with 1.5 per cent. Acceptability of chhana decreased with increasing coagulant strength.

Moorthy and Rao (1982) observed that citric acid, when used as coagulant, resulted in higher yields of chhana from goat milk. On comparison with citric acid, lactic acid was found to result in least fat losses.

Rao et al. (1984) found that paneer obtained from milk which was coagulated with 0.3 per cent citric acid was higher in yield than other treatments. Irrespective of temperature used, the average yield of paneer decreased with increase in quantity of citric acid.

Chawla et al. (1985) used one per cent citric acid as coagulant for the preparation of 'low fat paneer' from buffalo milk. On the other hand, Vishweshwariah and Anantakrishnan (1986) used two per cent citric acid to prepare paneer from cow milk.

Certain non conventional, low cost coagulants as 0.6 per cent of hydrochloric acid or phosphoric acid and acidophilus whey were effectively used in the manufacture of paneer as substitutes for citric acid by Sachdeva and Singh (1987). Hydrochloric acid was found to be most economical. The use of citric acid solution in naturally soured whey or acidophilus whey reduced the requirement of citric acid and

increased the solids recovery without any loss of paneer quality.

According to Vishweshwariah and Anantakrishnan (1987) order of preference for coagulant for the preparation of paneer was citric acid followed by lactic acid, acetic acid and sour whey. Two per cent acidity of coagulant was best followed by 1.5 per cent, 3.0 per cent and 5.0 per cent.

Sachdeva and Singh (1988 b) used one per cent citric acid and a pH of 5.30-5.35 while standardizing the procedure for the preparation of paneer. Pruthi and Koul (1989) shared this view and used one per cent citric acid to prepare paneer.

Joshi et al. (1991) studied the effect of different coagulants on yield and sensory quality of chhana. The yield of chhana did not vary significantly due to different coagulants. Lactic acid, tartaric acid and citric acid produced chhana with soft body whereas lemon juice resulted in chhana with slightly hard body. On the basis of total sensory scores, lactic acid was the best coagulant.

2.3.4. Temperature of coagulation

Buffalo milk, standardized to five per cent fat, was brought to boil and promptly cooled to 70°C for coagulation at that temperature for preparation of chhana (Kundu and De, 1972).

The effect of coagulation temperature on the sensory quality of chhana was studied by Jailkhani and De (1980). Chhana prepared from coagulating milk at 80°C gave the highest scores for colour and appearance, body and texture and odour and taste when compared to those at 90°C and 70°C.

Ahmed et al. (1981) studied the effect of different coagulation temperatures on the yield and moisture content of chhana. Yield and moisture content of chhana were higher when milk was coagulated at 60°C, but acceptability was better following preparation at 70°C.

Paneer obtained from milk which was heated to 85°C and coagulated at 70°C was higher in yield. Average moisture of paneer samples prepared at 85°C was found to be the highest, the content being 51.05 per cent on the day of preparation (Rao et al., 1984).

Vishweshwariah and Anantakrishnan (1986) prepared paneer with better sensory characteristics by coagulating standardized milk at 80°C.

Sachdeva and Singh (1988 a) found that the total solids recovery in paneer increased with the increase in temperature of coagulation and was maximum at 80°C. Higher temperature of coagulation increased hardness. Coagulation at 90°C with the stabilizers incorporated in milk resulted in higher yield and imparted better body and texture to paneer, eliminating the cooling step at the same time.

According to Sachdeva and Singh (1988 b) heating milk to 90°C without holding and coagulation at 70°C yielded better quality paneer.

2.3.5. Yield, texture and composition of paneer

Yield of paneer obtained was calculated by De *et al.* (1971) and Srivastva and Singh (1976). De *et al.* (1971) prepared paneer from high acid milk and observed that the yield was 12-14 per cent, being slightly lower than that obtained from fresh sweet milk, which was 14.5 per cent. When sour and curdled milk were used by Srivastva and

Singh (1976) the yield of paneer obtained was 14.05 per cent whereas the yield was 14.7 per cent when 100 per cent fresh milk was used. The yield mainly depends upon the type of milk used, heat treatment, coagulant and its concentration and other aspects which are known to vary to a great extent (Ghodekar, 1989).

Methods for sensory evaluation of Indian milk products including chhana and paneer have been described by Pal and Gupta (1985). According to the authors, chhana should have a light yellow colour, mild acidic aroma and a soft slightly elastic texture, while paneer should have a white or dull white colour, mild acidic flavour and aroma and a firm cohesive elastic structure. Sensory defects of paneer and chhana were also discussed.

Mathur et al. (1986) described paneer as traditional cheese of India with a mildly acidic taste, spongy body and close knit texture. According to them, paneer was a good source of protein and had good digestability and palatability.

On analysis, chhana had 55.37 per cent moisture, 23.52 per cent fat, 17.26 per cent protein, 2.21 per cent lactose and 1.63 per cent ash (Jailkhani and De, 1980). Mahadevan (1991) analysed the composition of paneer prepared from cow

milk and buffalo milk. Cow milk paneer had 52-54 per cent moisture, 24-26 per cent fat, 16-19 per cent ash. Paneer made using buffalo milk had 50-52 per cent moisture, 28-30 per cent fat, 13-15 per cent protein, 2.2-2.4 per cent lactose and 1.9-2.1 per cent ash. Biological value of paneer was found to be 67 and digestability 97 per cent. Effect of fat levels, additives and process modifications on composition and quality of paneer was studied by Chawla et al. (1987). Titratable acidity of paneer was found to be 0.22 per cent.

Gera and Rajorhia (1979) devised an instrument for measuring the springiness of chhana. Using this instrument, the percentage of springiness of whole milk chhana at 20°C was about 63-66 per cent for buffalo milk, 42-49 per cent for cow's milk and 59-63 per cent for mixed (1:1 cows and buffaloes) milk chhana at various pH and temperature of the coagulation.

A rapid method for estimation of moisture of paneer was introduced by Pruthi (1984). A butter moisture tester was used for the purpose. The paneer samples tested showed a mean moisture content of 53.35 per cent versus 53.34 per cent by the standard gravimetric methods.

2.3.6. Shelf life of paneer

Bhattacharya et al. (1971) were able to store paneer for six days at 10°C without deterioration in quality but the freshness of the product was lost after three days.

It was observed by Arora (1979) that the paneer prepared from four, five and six per cent fat milk could be stored for not more than six days at 10°C, but could be stored for atleast 120 days at -13°C and -32°C without much deterioration of the quality.

An investigation was undertaken by Arora and Gupta (1980) to examine the approach of freezing for long term storage of paneer. Frozen storage resulted in marked rise in the Non-Protein-Nitrogen (NPN) content of paneer and pH of paneer and the product became more soft. The freshness of the product was lost and it became crumbly and fluffy because of freezing and thawing treatment.

According to Kulkarni et al. (1984) chhana kept well for three days in the presence of one and two per cent potassium sorbate solution and its steaming further improved the shelf life upto five days.

Preparation of vegetable paneer

Soy paneer processing parameters were standardized by Nasim et al. (1986), Soy paneer prepared by the use of citric acid had 74 per cent moisture, 15.5 per cent protein and 3.9 per cent fat. Consumer preference trials indicated that soy paneer resembled milk paneer and the product was highly acceptable.

Prakash and Iya (1986) made an attempt to prepare paneer from blended soymilk and mixed milk. Paneer made from whole milk blended with soya milk with 15 or 20 per cent solids had acceptable body, texture and flavour.

According to Grover et al. (1989) addition of 10-30 per cent cow milk to soya slurry increased the yield of paneer with higher total solids and lower protein content. Overall acceptability of soya paneer increased as the concentration of cow milk in soya slurry increased.

Kanawjia et al. (1990) showed that an acceptable product could be developed using skim milk and vanaspathi. Paneer thus developed contained 16-18 per cent protein, 22-23 per cent vegetable fat, 55-56 per cent moisture.

An investigation was undertaken to prepare soypaneer from soymilk and soymilk-skim milk blends by Arora and Mital (1991). Addition of skim milk to soymilk decreased yield but increased total solids, protein content and shear strength of soypaneer. Sensory evaluation trials showed that addition of skim milk to soymilk at a minimum level of 20 per cent yielded a product resembling milk paneer in appearance and textural characteristics.

The possibility of blending soya milk with buffalo milk for obtaining good quality paneer was examined by Babje et al. (1992). Addition of soyamilk to buffalo milk upto 20 per cent had no adverse effect on the quality of paneer and resembled that of milk paneer in taste, colour and springiness. However, the paneer prepared by blending soyamilk had higher protein content.

2.4. Preparation of Rasogolla

2.4.1. Type of milk

Jagtiani et al. (1960) found that best quality rasogollas could be made out of buffalo milk, when part of the calcium in the milk was first complexed by the additon of 0.25-0.3 per cent sodium citrate.

De (1976) compared rasogolla prepared from cow milk and buffalo milk. Chhana prepared from cow milk had mild acid flavour, light yellow colour, moist surface, soft and smooth body and good consistency for rasogolla preparation while chhana made using buffalo milk had mild acid flavour, whitish colour, greasy surface, slightly hard and coarse body and fair consistency for preparation of rasogolla.

Soni et al. (1980) made quality rasogollas from buffalo milk, while Moorthy and Rao (1982) used goat milk for the preparation of rasogolla.

Singh and Ganesh (1988) reported that good quality and cheaper in cost filled rasogolla can be prepared by utilizing sweet cream butter milk, skim milk powder and hydrogenated vegetable oil which was comparable in appearance, body texture flavour and overall quality to the conventional one.

An attempt was made to prepare good quality chhana suitable for rasogolla manufacture from buffalo milk by Rao et al. (1989). Rasogolla made from chhana obtained from buffalo milk diluted with 20 per cent water added with 0.3 per cent sodium citrate was equally acceptable to that obtained from cow milk chhana.

Sen (1989) conducted studies on rasogolla preparation and preferred cow milk over buffalo milk. The author also suggested certain modifications in buffalo milk for preparation of rasogolla.

Soya rosogolla was successfully prepared by Chakrabarti and Gangopadhyay (1990) from soyamilk and found that the product resembled the market rasogolla made from milk.

2.4.2. Fat percentage of milk used

According to the standardized method described by De (1976) for the preparation of rasogolla optimum fat percentage of milk should be four per cent.

Increasing the fat percentage in the milk from 3-4 per cent improved body and texture of rosogolla, but decreased fat recovery (Bhattacharya and Raj, 1980 a).

A pressure cooker method was described for the production of rasogolla by Bhattacharya and Raj (1980 b). The authors used four per cent fat milk, but also found that higher fat improved the body and texture without excessive loss of fat in cooking syrup.

Studies of the effect of different fat percentages in milk, on the quality of rasogolla produced from goat milk was conducted by Moorthy and Rao (1982). Better quality rasogolla was obtained from chhana made from four per cent milk. Production costs of chhana suitable for rasogolla making were least when goats milk of four per cent was used.

Singh and Ganesh (1988) prepared good quality filled rasogolla. They utilized sweet cream butter milk which was standardised to four per cent fat and 8.5 per cent solids not fat using hydrogenated vegetable oil and skim milk powder.

According to Sen (1989) optimum fat and solids-not-fat percentages required in case of cow milk for the preparation of rasogolla were 4.0 and 8.6 per cent, respectively. Buffalo milk when used five per cent fat was preferred while four per cent fat was optimum when goat milk was utilized in the preparation of rasogolla.

2.4.3. Effect of type and strength of coagulants on rasogolla

Effect of various coagulants on the physico-chemical properties of Rasogolla were studied by Singh and

Ray (1977 a). Rasogolla prepared from the milk coagulated with aged whey was found to be very satisfactory. Citric acid coagulated milk solids resulted in rasogolla containing high levels of total solids, fat, protein and sugar.

Rasogolla was prepared by Bhattacharya and Raj (1980 a), using 0.8 per cent citric acid solution as the coagulant, and Soni et al. (1980) used 0.5 per cent citric acid as coagulant. The product was acceptable in colour, appearance, taste and texture.

Rasogolla prepared from goats milk of three, four and five per cent fat using lactic acid, sour whey and citric acid as coagulant was compared with rasogolla made from cows milk of four per cent fat (Moorthy and Rao, 1982). Better quality rasogolla was obtained from chhana made from milk coagulated with lactic acid.

Rasogolla was made from chhana prepared from whole and standarized (3.0 and 5.0 per cent) buffalo milk by using whey and lactic acid solutions (1.0, 1.5 and 2.0 per cent) at coagulation temperature of 60, 70 and 80°C. Rasogolla prepared from chhana made from the two types of milk by coagulation with whey at all three coagulation temperatures

had a dull and creamy white general appearance and colour, poor body and texture and slightly caramel flavour, white rasogolla prepared from chhana made by coagulation of all three types of milk with lactic acid at all three coagulation temperatures showed normal creamy white appearance and colour and slightly soft body and spongy texture with pleasant flavour. It was concluded that good quality rasogolla may be prepared from chhana made from 5.0 per cent standardized buffalo milk coagulated with one per cent lactic acid (Kumar et al., 1988).

An attempt was made by Rao et al. (1989) to compare the effect of three coagulants namely, citric acid, calcium lactate and lactic acid, on the quality of rasogolla. Rasogolla made from chhana obtained from buffalo milk diluted with 20 per cent water, added with 0.3 per cent sodium citrate and coagulated with citric acid was equally acceptable as that obtained from cow milk chhana. Among the three coagulants studied, citric acid gave good quality rasogolla followed by calcium lactate and lactic acid.

Chakrabarti and Gangopadhyay (1990) prepared soya rasogolla from soya chhana using two per cent calcium lactate as coagulant and found that the product resembled market rasogolla made from milk.

2.4.4. Formulation of recipe

De (1976) used four per cent maida along with chhana to prepare rasogolla of acceptable quality.

For preparation of rasogolla, besides chhana and sugar, the other ingredients used were maida, suji and samunderi jhag (Soni et al., 1980). During preparation of filled rasogolla, 0.2 per cent sodium bicarbonate was added to chhana before kneading and making chhana balls.

Verma (1989) prepared rasogolla from buffalo milk. Chhana was ground to smooth paste and arrow root, semolina and baking powder were added at the rate of 6.0, 2.0 and 0.5 per cent respectively by weight of ground chhana. In case of preparation of rasogolla from cow milk, no additives were added to the chhana.

2.4.5. Strength of cooking syrup and cooking time

De (1976) suggested that while cooking the rasogolla balls the syrup should not be allowed to concentrate in order to maintain proper body and texture of the product. For this purpose, frequent sprinkling of water during the process of cooking has also been suggested.

Bhattacharya and Raj (1980 a) prepared rasogolla by adopting the traditional method, in which the chhana balls were gently dropped into boiling, freshly clarified 50-60 per cent sugar syrup and steam heated in a double jacketed kettle till the balls sank into the syrup, when steaming was discontinued. The optimum sugar concentraion was found to be 55 per cent and cooking time was 25-30 minutes.

Bhattacharya and Raj (1980b) prepared rasogolla also by adopting pressure cooker method. Chhana balls were cooked in freshly clarified 50-55 per cent sugar solution for 2-3 minutes at 1 kg/sq.cm pressure.

The concentration of cooking syrup used for cooking rasogolla was 80 per cent sugar solution (Soni et al. 1980) while Sen (1989) recommended the use of 50-60 per cent sugar syrup.

Verma (1989) used 55 per cent sugar syrup which was brought to boil in a stainless steel double walled jacketed steam kettle. Chhana balls were gently dropped into the boiling syrup. After every five minutes about 200 ml of hot water was sprinkled in the kettle to compensate for the loss of water due to evaporation. After 25 minutes of cooking heating was discontinued.

2.4.6. Texture and composition of rasogollas

Soni et al. (1980) prepared rasogolla from buffalo milk. Composition of the rasogolla was 37 per cent moisture, 51.9 per cent sucrose, 6.8 per cent protein and 4.2 per cent fat.

Bandyopadhyay et al. (1981) classified rasogolla into three types - ordinary rasogolla, sponge rasogolla and canned rasogolla. Ordinary rasogolla had 38.3 per cent moisture, 7.3 per cent fat; 43.6 per cent sucrose and 6.4 per cent total protein. Sponge rasogolla had 50 per cent moisture, 5.3 per cent fat, 37 per cent sucrose and 5.5 per cent total protein. Composition of rasogollas made out of buffalo milk was 37 per cent moisture, 4.2 per cent fat, 51.9 per cent sucrose and 6.3 per cent total protein.

Springiness, softness and voluminosity of rasogolla prepared were measured using precision penetrometer deviced by Verma (1989). The penetrometer was used to assess the textural quality of rasogolla.

2.4.7. Storage of rasogolla

Jagtiani et al. (1960) conducted studies on the preservation of rasogolla. Rasogollas prepared were canned

in syrups of varying sugar concentrations and keeping qualities compared after storage for upto six months at room temperature, 37°C and 55°C. The best results were obtained with storage at room temperature.

Soni et al.(1980) preserved rasogollas after cooking in 40 per cent sugar solution at 10°C.

Sen (1989) has recommended that 4-6°C and 8-12°C are the optimum temperature of storage.

After cooking rasogollas were transferred to clarified hot sugar syrup of 40 per cent concentration. For improving the shelf life, the product was transferred to a cold storage at 4-6°C (Verma, 1989).

Utilization of whey

Dordevic and Kolev (1967) have outlined the preparation of refreshing whey beverages. The process included removal of proteins, deodorization, addition of natural flavouring filtration, deaeration, pasteurization and filling with carbonation.

Study conducted by Singh and Mathur (1973) revealed that the chhana whey retained half of the total solids of milk composing the lactose, minerals and water soluble vitamin B complex in fairly good percentage and a small portion of milk protein and milk fat. Average composition of whey-Lactose 5.08 per cent, protein 0.37 per cent, fat 0.54 per cent, total solids 6.91 per cent, ash 0.53 per cent and acidity 0.46 per cent. It was also found that one kg chhana whey supplied about 267 calories of energy.

Nutritional and biochemical studies of whey products were conducted by Forsum and Hambracus (1977) to know the degree of protein denaturation and their protein nutritional qualities. The biological value and true digestibility of the proteins were high in all products although the individual whey proteins showed varying degrees of denaturation. All whey products contained a surplus of available lysine. It was concluded that the protein nutritional quality of the whey products was sufficient to be of nutritional significance in human diets.

Whole wheys were processed into soft drinks and the final beverage obtained was analysed for nutritive and sensory quality (Upadhayaya and Khan, 1981). Drinks were

made from paneer whey and analytical results for soft drinks were as follows: protein 0.28 per cent, lactose 5.143 per cent, Calcium (mg/100 ml), 58.771, Phosphorus (mg/100 ml) 10.574 per cent and pH 4.505. Paneer whey drinks recovered higher overall and flavour scores in sensory analysis than Gouda cheese whey drinks.

Technology, processing and marketing of whey drinks were described in detail by Prendergast (1985). Production methods based on fermentation and on direct acidification, carbonation, shelf life and packaging of whey drinks were discussed.

A study was undertaken by Gagrani et al. (1987) to utilize the whey in the preparation of fruit flavoured beverages and investigate their physico-chemical properties and acceptability. The acidity of clear whey free of proteins and fat was adjusted with citric acid to 0.25 and 0.5 per cent. Canned orange, pineapple, guava and mango juices were added at 10, 15, 20 and 25 per cent of whey beverage base. Highest scores were recorded in case of drinks with 0.5 per cent acidity and in case of 10 per cent of orange, 15 per cent of pineapple, 25 per cent of guava, and 15 per cent of mango.

According to Gupta and Mathur (1989) full utilization of whey has not been achieved in India, inspite of considerable technologies being evolved. The authors suggest the utilization of whey solids by combining with newly emerged fruit juice for the manufacture of beverages consisting of plain, carbonated, alcoholic and fruit flavours.

Paul (1990) described a wide range of nutritive beverages for product diversification and to enhance economic returns. According to the author, these type of beverages have several nutritional and therapeutic attributes. The utilization of whey for the manufacture of refreshing beverages also abates the problem of their economic disposal and permits reduction of the B.O.D. loads on sewerage.

In the light of nutritional and therapeutic value of whey, Krishnaiah et al. (1991) made an attempt to formulate three categories of flavoured acid whey beverage for human consumption (1) whey beverage was prepared by the addition of sugar 10 per cent and citric acid 0.2 per cent to the deproteinated acid whey. Orange essence to taste and orange colour to pleasing appearance were added and mixed

vigorously (ii) By mixing three parts of acid whey with adjusted pH to 6.8, one part toned milk and sugar and 10 per cent level with pineapple essence and yellow colour (iii) By mixing three parts of acid whey with adjusted pH to 6.8, one part of toned milk and sugar at 10 per cent level with banana essence and lemon yellow colour. On sensory evaluation the second and third categories of beverages were more acceptable than the first category due to added toned milk.

Methods for preparation of fermented whey beverages

The method described by Blazek and Sule (1961) involved the inoculation of whey with 2-5 per cent culture of lactose fermenting organisms such as Streptococcus lactis, S. diacetilactis, Saccharomyces fragilis, Torulopsis sphaerica etc. either singly or preferably in combination, incubation at 15-25°C to a pH 4.4-4.6, addition of ethanol, boiling cooling to 15-25°C and filtration. The filtrate, after adjustment of pH to 5, was flavoured and vitamins were added. The beverage was then diluted with water, reclarified, pasteurized, the pH adjusted to 5, and carbonated.

In an attempt to prepare special beverages from whey, Bambha *et al.* (1972) produced a nourishing soft drink - 'Whevit'. The manufacturing process consisted of steaming of whey, cooling and filtering, addition of citric acid, sugar syrup colour and yeast culture, *Saccharomyces cerevisiae* 0.5 - 1 per cent incubation, addition of flavour, bottling and pasteurization and storage at low temperature. pH of the drinks 4.2 - 4.3.

Soured milk beverage was prepared from whey by Grinene and Prantskyavichyus (1977). To increase the intensity of flavour and improve the quality of whey beverage, the inoculum used was a mixture of *Streptococcus cremoris* and *S. diacetilactis* added in an amount of 1.0-1.2 per cent of the weight of whey.

Techniques were developed by Szakaly *et al.* (1978) for large scale production of carbonated beverages (from permeates) non carbonated beverages (from sweet or acid whey and stabilizer) with fermentation for 3-5 hours at 42-45°C to pH 4.0-4.1 and ripening below 10°C. Apple, lemon and orange were found the best flavour. After pasteurization, the products could be kept for several weeks under refrigeration.

A whey beverage with 13 per cent total solids and pH 3.5-3.7 was made by Marhounova and Mergl (1980). The whey was incubated at 40°C with a two per cent lactobacillus starter for 15 hours to pH 3.5.

The suitability of Lactobacillus bulgaricus, Streptococcus thermophilus, L. bulgaricus and S. thermophilus of L. helveticus for the manufacture of fermented whey drinks were examined by Dordevic et al. (1982). Best results as regards organoleptic properties of finished product were obtained with L. helviticus. The drink contained 11.65-13.10 per cent total solids, 11.27-11.65 per cent total sugar, 0.66-0.78 per cent protein, 0.2-0.3 per cent fat and 0.42-0.46 per cent minerals.

Fernandez and Samanego (1984) found that coconut milk whey produced as a byproduct of latik (solid curd) can be used as a beverage when Lactobacillus casei was used as the starter and incubating for 24-48 h. The sour taste and nutty flavour was improved by the addition of sugar and flavouring extracts.

Gandhi (1984) made an attempt to convert surplus whey into a palatable, refreshing and economic acidophelus whey

drink fermented by Lactobacillus acidophilus and named as Acidowhey. Fat free whey was strained, cooled, filtered, inoculated with L. acidophilus and incubated at 39±1°C for 20-24 hours. Acidophilus whey was again filtered and sugar and pineapple flavour were added. The contents were mixed thoroughly and packed in bottles, pasteurized and then were stored at low temperature. Organoleptic tests of the product gave satisfactory results.

Srivastava and Lohani (1986) successfully developed a method for converting the mixture of paneer whey and buttermilk (50:50) into a palatable, refreshing, nutritious and low cost drink named as "Parag drink" using a mixed culture of L. acidophilus and S. thermophilus (55:45). The drink got excellent consumers response.

Gandhi (1989) reported the usefulness of whey as a base for the growth of some of the starter cultures in the preparation of several cultural products and beverages. According to the author lactic acid produced during fermentation imparted fresh flavour and suppressed the growth of pathogenic and spoilage organisms. Fermented whey beverages using 1. Kefir grains 2. 10 per cent culture consisting of L. bulgaricus L. acidophilus, L. casei, S. thermophilus, 3. L. acidophilus, S. lactis and yeast have also been discussed.

Materials and Methods

MATERIALS AND METHODS

Paneer, rasogolla and whey drinks were prepared using cows' milk as per the procedures described below. Filled milk was prepared using coconut milk as a source of fat and products were prepared as from cows' milk. The qualities of the products prepared from filled milk were compared with that prepared from cows' milk. Eight replications were done for each item and average values were calculated. These were statistically analysed using 't' test (Snedecor and Cochran, 1968) to arrive at a conclusion.

3.1. Analysis of milk

3.1.1. Collection of milk samples

Samples of fresh cows' milk, used in the study for preparation of paneer, rasogolla and whey drinks as well as for analysis were collected from the University livestock Farm.

3.1.2. Estimation of fat

The percentage of fat in milk was determined according to the procedure described by Bureau of Indian Standards (IS: 1224, Part I, 1977). Ten ml. of sulphuric acid (90-91

per cent) and 10.75 ml. of thoroughly mixed sample of milk were transferred to a butyrometer. One ml. of amyl alcohol was added. The mouth of the butyrometer was closed firmly with a stoppper. The contents in butyrometer were thoroughly mixed and centrifuged for four minutes and length of fat column which was equal to the percentage of fat in the sample was noted.

3.1.3. Standardization of milk

Five litres of cows' milk was preheated to 32°C and cream was separated using an alpha-laval cream separator. Milk was standardized to 4.0 per cent fat by mixing skim milk and cream in the required quantity according to the Pearson's square method. The standarized milk was used to prepare control samples of paneer, rasogolla and whey drink.

3.2. Preparation of paneer

Paneer was prepared as per the method suggested by Kundu and De (1972). The standardized milk was brought to boiling temperature . and promptly cooled to 70°C. Coagulation was then effected by addition of one per cent citric acid solution slowly, together with gentle stirring. Coagulated mass was allowed to remain in the whey for five

minutes and then separated from whey by straining through a muslin cloth. The muslin cloth with paneer was tied and hung up for 30 minutes for draining out the whey and cooling the paneer.

Samples of paneer were examined immediately after preparation for moisture, titratable acidity, fat, total protein and springiness. The samples of paneer were also evaluated organoleptically.

3.2.1. Estimation of moisture

The moisture content of paneer samples was determined according to the procedure laid out by the Bureau of Indian Standards (IS: 2785, 1964). Three grams of paneer were accurately weighed and transferred to a porcelain dish. The sample was uniformly spread over the bottom of the dish. The dish was then placed on a boiling water bath for 20 to 30 minutes and later transferred to a hot air oven at 102±1°C. After four hours, the dish was removed to a desiccator, cooled and weighed. The dish was again transferred to the hot air oven for a further period of one hour and later, the dish was cooled and again transferred to the desiccator. This process was repeated until constant weight with ±0.5 mg was obtained. From the loss in weight observed after

drying, the percentage of moisture in paneer (by weight) was calculated.

3.2.2. Titratable acidity

Two grams of paneer was dissolved in 25 ml. of distilled water and filtered. Ten ml. of the filtrate was titrated against N/10 NaOH using phenolphthalein as indicator. Acidity was expressed as per cent lactic acid.

$$\text{Per cent of acidity} = \frac{\text{Volume of N/10 NaOH used} \times 0.009 \times 100}{\text{Weight of paneer in the filtrate titrated}}$$

3.2.3. Fat

Weighed out nine gram of finely grated paneer in 9 gram 50 per cent Babcock bottle using a torsion balance. Nine ml. of soft water was added and mixed thoroughly by rotating motion. Added 17.5 ml. of sulphuric acid slowly through the sides to wash paneer from the neck into the body of the bottle. Mixed gently with a rotatory motion until paneer was completely dissolved. The bottle was then placed in a Babcock centrifuge and was centrifuged for five minutes. Sufficient amount of distilled water at 78°C was added so as to make up the volume upto 'zero' mark. Mixed

well, centrifuged for two minutes. Made up the volume with soft water at 78°C and allowed it to remain there for three to five minutes. Reading was then taken.

3.2.4. Total protein

Method used for the determination of total protein in paneer samples was essentially that of Kosikowskii (1978) with slight modifications.

Reagents: 1. Acetic acid solution:

Glacial acetic acid 25 ml. + distilled water 100 ml.

2. Catalyst mixture:

Potassium sulphate (K_2SO_4): 80 g, Copper Sulphate : 20 g.

3. Mixed indicator:

Two parts of 0.2 per cent alcoholic methyl red mixed with one part of 0.2 per cent alcoholic methylene blue solution.

2.5 g of grated paneer was ground well with a small amount of acetic acid solution and the volume was made upto 50 ml. with same solution. After keeping in a water bath at 50°C for 15 minutes, 4 ml. aliquot (equivalent to 200 mg of paneer) was transferred to Kjeldahl flask to which was added

one gram catalyst mixture and 10 ml. of concentrated sulphuric acid. The mixture was digested under moderate heat (80 to 90°C) for three to four hours. The digested sample was rinsed with 20 ml. of distilled water and transferred to the boiling flask of Kjeldahl distillation unit to which was also added 15 to 20 ml. of 50 per cent NaOH solution. Dry steam was then turned on and the mixture was boiled vigorously. About 40 ml. distillate was collected in 10 ml. saturated boric acid containing one or two drops of the mixed indicator. It was titrated against N/35 H_2SO_4 to a faint pink colour as the end point. Similar procedures were followed for blank using distilled water as sample. The total percentage of protein was calculated using the formula,

$$\text{Percentage of total protein} = \frac{(\text{ml. of } H_2SO_4 - \text{blank}) \times \text{Normality of } H_2SO_4}{\text{Weight of paneer sample}} \times 0.014 \times 6.38 \times 100$$

3.2.5. Sensory evaluation of paneer

Sensory evaluation of paneer was done on the day of preparation by a panel of five judges. The scheme proposed by Patil and Gupta (1986) was followed with slight

modification for the evaluation of paneer. Average score obtained from five judges for each replication was used for statistical analysis.

Proforma of score card for judging the organoleptic quality of paneer was as follows:

Proforma for evaluation of paneer:-

Date: Taster: Code No.

Encircle the score applicable

Attribute	Max. score	Defect	Slight	Distinct	Pronounced
Flavour	50	Sour/Acid	45	40	35
		Putrid/cheesy	37	30	**
		Rancid	37	33	**
		Stale	38	30	**
		Bitter	38	30	**
		Musty	37	33	**
		Yeasty	37	33	**
		Flat	44	40	30
		Foreign	38	35	30
		Smoky	43	40	30
		Feed/Weed	38	35	30
		Unclean/Utensil	38	35	30

Body & texture	40	Hard	37	33	29
		Crumbly	37	33	29
		Weak/soft	35	30	25
		Pasty	29	27	**
		Rubbery/Chewy	32	27	24
		Mealy/coarse	33	28	25
		Open	27	32	27
Colour & appearance	10	Dull	9.5	9	8
		Dry surface	9	8	7
		Surface skin	8	7	6
		Visible dirt/ Foreign matter	7	6	4
		Mouldy surface	**	**	**

** No grade

Guideline for grading on the basis of total score:

Grade	Total score
Excellent	91-100
Good	81-90
Fair	71-80
Poor	< 70

3.3. Preparation of Rasogolla

Rasogolla was prepared as per the method suggested by Verma (1989) with slight modifications. Paneer prepared was broken into bits and arrowroot powder and baking powder were added at the rate of six per cent and 0.5 per cent, respectively. It was then thoroughly kneaded to form a dough and made into small balls of ten gram each without any signs of cracks.

For the preparation of sugar syrup for cooking paneer balls, one kilogram of sugar was dissolved in two litres of water in a suitable sized vessel. The sugar solution was boiled and filtered to remove dirt.

For the cooking process, paneer balls were gently put in the boiling sugar syrup, taking care not to overcrowd the vessel. Closed the lid of the vessel and kept it as such for ten minutes. After ten minutes the lid was removed and cold water was sprinkled regularly in order to maintain the stringy consistency of sugar syrup. Cooking was continued for 20 minutes. After cooking rasogolla balls were transferred to 40 per cent sugar syrup and few drops of rose flavour was sprinkled.

3.3.1. Measuring the springiness of rasogolla

Springiness of rasogolla was measured as per the method described by Verma (1989) with slight modifications using Precision Penetrometer. The Penetrometer has a vertical pressing device of 155 grams as shown in Fig. 1.

To measure springiness, the rasogolla ball of 10g was placed in a petridish and pressing assembly is adjusted in such a position that it just touched the upper surface of the sweet ball (initial reading). The pressing assembly was then released and the ball allowed to remain under pressure exactly for 15 seconds. The distance (D_1) to which the assembly moved from the initial position was measured on the scale. The pressure on the ball was then released for exactly 60 seconds by lifting the assembly. The pressing assembly was adjusted so that it touched the surface of the ball again. The distance to which the assembly moved from initial position (D_2) was recorded from the scale. Springiness was then expressed as follows:

$$\text{Percentage springiness} = \frac{D_1 - D_2}{D_1} \times 100$$

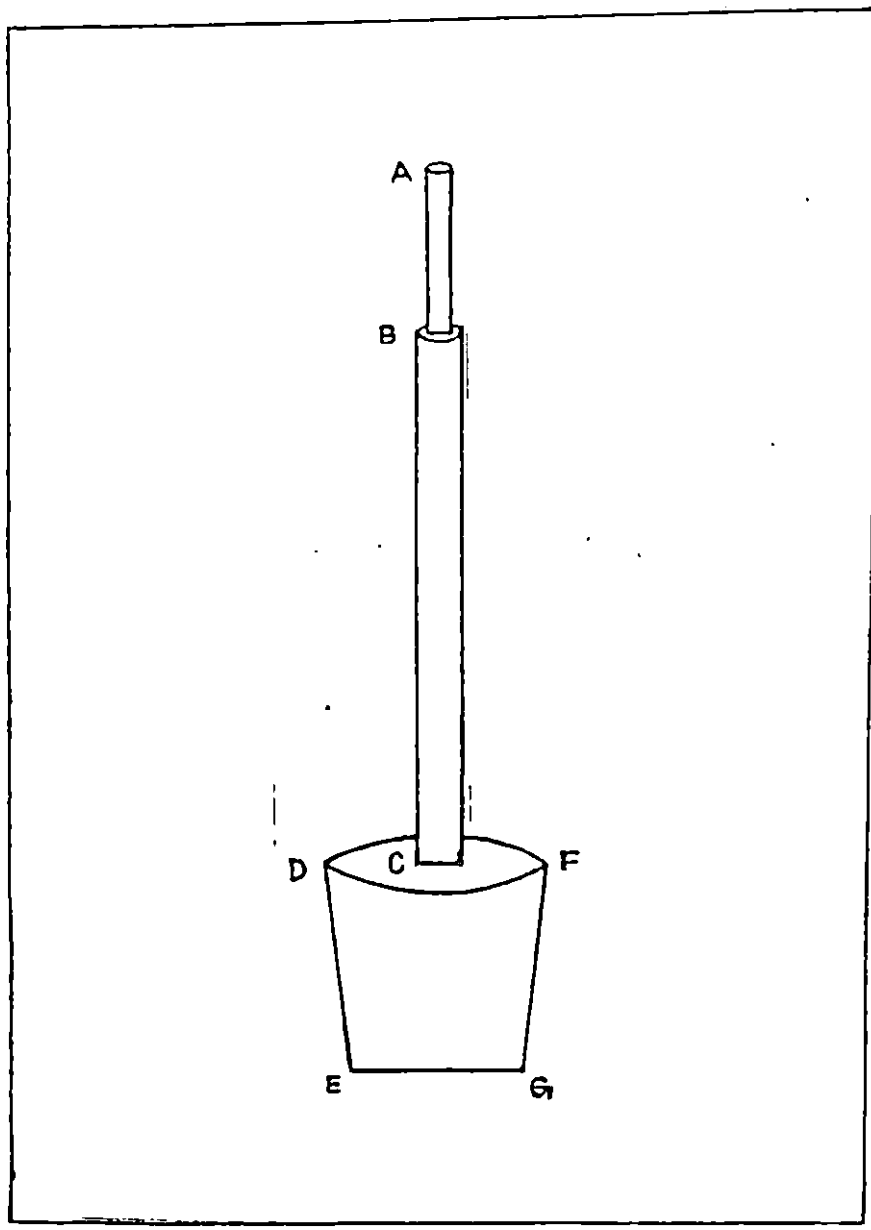


Fig.1. Vertical pressing device of Precision Penetrometer

AB = 20 x 3mm BC = 65 x 12 mm DE = 25 mm

DF = 27 mm EG = 21 mm

TOTAL WEIGHT - 155 g

3.3.2. Organoleptic evaluation of rasogolla

Organoleptic evaluation was done by a panel of five judges on the first, second and third day of storage to know its keeping quality. The proforma adopted was that proposed by Patil and Gupta (1986) with slight modifications. The score card is as follows:

Proforma for evaluation of rasogolla

Date: Taster: Code No.

Encircle the score applicable

Rasogolla

Attribute	Max. score	Defect	Slight	Distinct	Pronounce
Flavour	50	Putrid/Cheesy	37	33	**
		Rancid	37	33	**
		Stale	38	30	32
		Bitter	38	30	32
		Smoky	43	40	35
		Feed/weed	38	35	32
		Unclean/utensil	38	35	32

Body & texture	40	Hard	37	33	29
		Crumbly	37	33	29
		Pasty	29	27	**
		Mealy/coarse	33	28	25
Colour & appearance	10	Dull	9.5	9	8.5
		Dry surface	9	8	7
		Surface skin	8	7	6
		Visible dirt/ Foreign matter	7	6	5

** No grade

Guideline for grading on the basis of total score

Grade	Total score
Excellent	91-100
Good	81-90
Fair	71-80
Poor	< 70

3.4. Preparation of whey drinks

Whey drink was prepared according to the method suggested by Gandhi (1984) with slight modifications, using the whey obtained from paneer preparation. Whey was inoculated with pure active culture of Streptococcus lactis

(2 per cent) and incubated at 37°C for 18 hours. After incubation, sugar was added at 10 per cent level into the whey. It was heated to 80°C for one minute and filtered using a muslin cloth. Whey was then cooled to room temperature.

Mango flavoured whey drink was prepared by adding one ml. of mango flavour and three ml. of orange colour (one per cent aqueous solution) per litre of whey. The drink was stored in the refrigerator (5±1°C) before serving.

To prepare pineapple flavoured whey drink, 0.7 ml. of pineapple flavour and 4 ml.(one per cent aqueous solution) of apple green colour was added to one litre of whey. The prepared pineapple flavoured whey drink was stored in the refrigerator at a temperature of 5±1°C before serving.

Lemon flavoured whey drink was prepared by adding 1.3 ml. of lemon flavour and 4 ml. (one per cent aqueous solution) of lemon yellow colour per litre of whey. The drink was then stored in the refrigerator at a temperature of 5±1°C. before serving.

3.4.1. Estimation of pH of whey drink

pH of whey drink was measured by using a Digital pH meter (Md. Dalal).

3.4.2. Sensory evaluation of whey drink

The whey drink was evaluated for its sensory equality on the first, second and third day of storage at 5±1°C. The score card proposed in the Bureau of Indian Standards (IS: 7768-1975) was followed for the evaluation of whey drink with slight modifcations.

Proforma for evaluation of whey drinks

Date: Taster: Code No.

A. Assign scores for each sample for different characteristics:

Character	Maximum score	Sample score
1. Appearance	10	
2. Odour	20	
3. Flavour	40	
4. Body	30	

B. Indicate the degree of defects, if any, such as the following. Encircle the one applicable and deduct from appropriate attributes. Defects may be underlined.

Character	Defect	Degree of defect		
		Suspicious	Slight	Pronounced
1. Appearance	Suspended particles filth, foreign matter	2	4	10
2. Odour	Stale, abnormal	5	10	15
3. Flavour	Cooked, oxidized, rancid, metallic, neutralizer, feed, barny, cowy, flavour defects due to adulterants and other additives	5	10	20
4. Body	Ropy, curdy	5	10	15

C. Grading

Grade	Score	Grade
Excellent	90 and above	A
Good	80-89	B
Fair	60-79	C
Poor	59 and below	D

3.5. Analysis of coconut milk

3.5.1. Collection of coconuts

Mature coconuts (nuts of Cocos nucifera) required for the preparation of coconut milk were collected from the Kerala Agricultural University Farm, Mannuthy.

3.5.2. Extraction of coconut milk

The selected coconuts were dehusked and broken into two. The kernel was grated and extracted the coconut milk by pressing it under a screw press. After the first extraction of coconut milk, the coconut kernel was kneaded with water (30 per cent w/w) and was again pressed under the screw press for extracting the milk. The coconut milk extracted by the first and second extraction was mixed together.

3.5.3. Estimation of fat in coconut milk

Five grams of well mixed coconut milk was weighed in a cream butyrometer. Ten ml. of Gerber's sulphuric acid was mixed with ten ml. of distilled water in a beaker and while

hot poured about 18 ml. of the mixture into the butyrometer. One ml. of amyl alcohol was added and mixed well. After placing the rubber stopper in position, the butyrometer with the contents were centrifuged at 1100 rpm for five minutes. The length of the fat column obtained was the fat percentage of coconut milk.

3.5.4. Preparation of filled milk

To five litres of skim milk, coconut milk was added, so as to prepare filled milk with four per cent fat. The filled milk so standardized to four per cent fat was used to prepare experimental samples of paneer, rasogolla and whey drink.

3.6. Preparation of paneer from filled milk (Experimental)

Method adopted for the preparation, analysis and sensory evaluation of experimental paneer was same as that described in the case of control paneer (3.2).

3.7. Preparation of rasogolla from filled milk (Experimental)

Experimental rasogolla was prepared, analysed and evaluated for its sensory qualities, as per the procedures adopted for control rasogolla (3.3).

3.8. Preparation of experimental samples of whey drink

The mango, pineapple and lemon flavoured whey drinks were prepared, analysed and evaluated for their sensory qualities as in the case of control samples of whey drink (3.4).

3.9. Statistical analysis

The results obtained were subjected to statistical analysis using 't-test' (Snedecor and Cochran, 1968) for comparing the control and experimental samples of paneer, rasogolla and whey drink.

Results

RESULTS

Paneer, rasogolla and whey drinks prepared from cows' milk and filled milk (skim milk added with coconut milk), standardized to four per cent fat, were subjected to chemical analysis and sensory evaluation. The percentage of yield, fat, moisture, acidity, total protein and springiness of paneer were estimated. Springiness of rasogolla and pH of whey drink were also estimated.

In the case of sensory evaluation, flavour, body and texture and colour and appearance of paneer and rasogolla were scored separately. Appearance, odour, flavour and body of whey drinks also were evaluated by the panel of five judges. The scores awarded by different judges were averaged and tabulated.

The different parameters of control and experimental samples of paneer, rasogolla and whey drinks were compared statistically with the help of 't test'.

4.1. PANEER

4.1.1. Yield of paneer

The yield of both control and experimental samples of paneer are presented in Table 1. The average yield of

Table 1. Yield of control and experimental paneer

Replication	Percentage	
	Control	Experimental
1	14.8	14.09
2	15.9	14.13
3	16.0	14.57
4	14.8	13.21
5	16.85	14.65
6	15.60	15.30
7	16.00	15.80
8	16.33	16.09
Mean	15.79	14.73
SE	±0.25	±0.34

t value : 2.5037* Significant at 5 per cent level

control paneer was 15.79±0.25 per cent while the average yield for experimental paneer was 14.73±0.34. On statistical analysis the yield of control paneer was found to be significantly higher ($P < 0.05$) than the yield of experimental paneer.

4.1.2. Fat

Results presented in Table 2 shows the fat per cent of control and experimental paneer. Control paneer had an average fat content of 23.10±0.35 per cent, while experimental paneer had an average fat content of 23.75±0.46 per cent. The results were compared. No significant difference was observed between the average fat per cent of control and experimental paneer.

4.1.3. Moisture

The result shown in Table 3 indicates the moisture content of control paneer which had a mean value of 54.22±0.59 per cent. The table also shows the moisture content in experimental paneer with a mean value of 53.96±0.55 per cent. Statistical analysis of the data showed that the treatments are not significantly different from one another in respect of their moisture content.

Table 2. Fat percentage of control and experimental paneer

Replication	Percentage	
	Control	Experimental
1	25	25
2	24	25
3	23	24
4	22	24
5	23	23
6	22	23
7	23	24
8	23	22
Mean	23.10	23.75
SE	±0.35	±0.46

t value : 1.0765 Not significant

Table 3. Moisture content in control and experimental paneer

Replication	Percentage	
	Control	Experimental
1	50.00	51.33
2	51.25	52.17
3	53.67	52.93
4	53.91	52.50
5	54.83	54.49
6	54.08	53.58
7	54.00	52.00
8	54.00	55.67
Mean	54.22	53.96
SE	±0.59	±0.55

t value : 0.3203 Not significant

4.1.4. Acidity

The mean values of acidity of both control and experimental paneer were 0.253±0.02 per cent of lactic acid. The data showed no difference with regards to the acidity of control as well as the experimental paneer (Table 4).

4.1.5. Total protein

The results presented in Table 5 shows the total protein content of control and experimental paneer. Control paneer had an average total protein content of 16.08±0.06 per cent while total protein content of experimental paneer had an average value of 18.05±0.45 per cent. On statistical analysis the protein content of experimental paneer was found to be significantly higher ($P < 0.01$) than control paneer.

4.1.6. Sensory evaluation

The overall mean score and total score for flavour, body and texture and colour and appearance of control and experimental samples of paneer are presented in Table 6. The mean value of score obtained for flavour in case of

Table 4. Acidity of control and experimental paneer.

Replication	Percentage	
	Control	Experimental
1	0.3375	0.3375
2	0.2250	0.2250
3	0.3375	0.3375
4	0.2250	0.2250
5	0.2250	0.2250
6	0.2250	0.2250
7	0.2250	0.2250
8	0.2250	0.2250
Mean	0.2531	0.2531
SE	±0.02	±0.02

Table 5. Total Protein in control and experimental paneer

Replication	Percentage	
	Control	Experimental
1	16.33	18.12
2	16.08	18.63
3	16.08	18.76
4	15.95	16.71
5	16.08	16.84
6	16.33	19.01
7	15.95	19.90
8	15.82	16.33
Mean	16.08± 0.06	18.05± 0.45

t value : -4.3613** Significant at one per cent level

Table 6. Scores obtained for control and experimental paneer in sensory evaluation

Sample	Replication No.	Particulars			Total score
		Flavour	Body & texture	Colour & appearance	
Control	1	47	36	10	93
	2	42	39	10	91
	3	48	19	10	97
	4	50	40	10	100
	5	47	39	10	96
	6	47	39	10	96
	7	50	40	10	100
	8	47	39	10	69
Mean		47.30±0.88	38.90±0.42	10	96.10±1.09
Experimental	1	42	37	10	88
	2	37	39	10	86
	3	36	38	10	84
	4	44	38	10	92
	5	41	38	10	88
	6	44	36	10	90
	7	44	37	10	91
	8	41	38	10	88
Mean		41.10±1.09	37.60±0.32	10	88.40±0.92
t value		4.3238**	2.2856*	NS	5.414**

* Significant at 5% level
** Significant at 1% level
NS Not significant

control and experimental paneer samples were 47.30±0.88 and 41.10±1.09, respectively. On statistical analysis, scores obtained for the flavour of control paneer was found to be significantly higher than that of experimental paneer ($P < 0.01$).

Body and texture of control and experimental paneer on evaluation were found to have a mean value of 38.90±0.42 and 37.60±0.32, respectively. Scores obtained for body and texture of control paneer were found to be significantly higher than that of experimental paneer.

Both control and experimental paneer obtained a maximum score of 10 for colour and appearance.

The overall mean score for control paneer was 96.10±1.09 and that of experimental paneer was 88.40±0.92. On statistical analysis, control paneer was found to have significantly higher score than experimental paneer.

4.2. Rasogolla

4.2.1. Springiness

Springiness of rasogolla was measured using Precision penetrometer (Fig. 2)

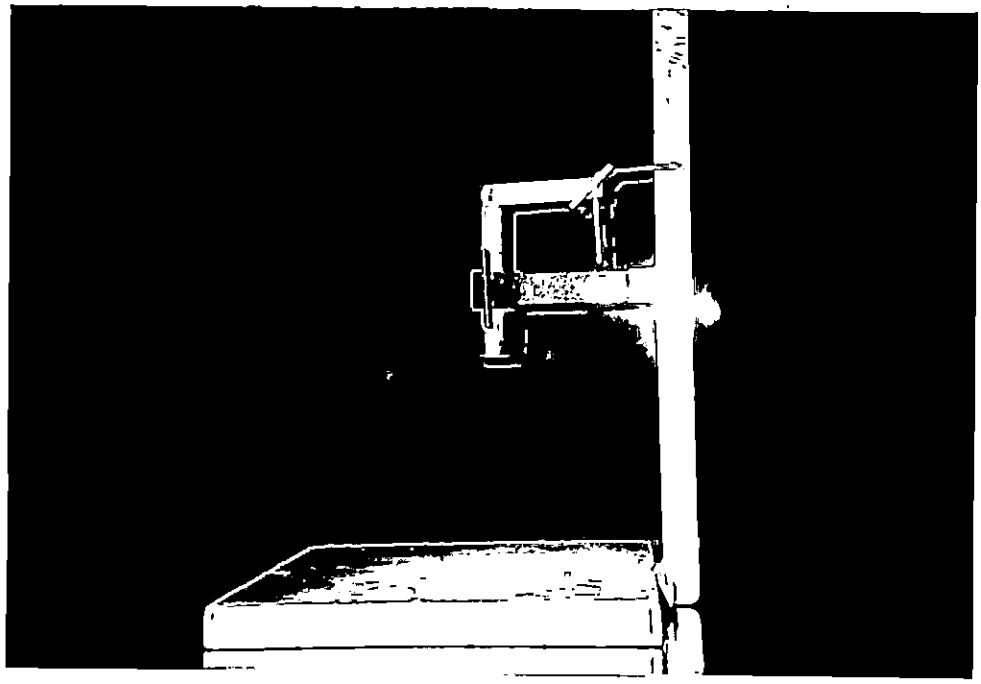


Fig.2. Precision penetrometer

The mean value of springiness of control rasogolla was 66.98±1.41 and that of experimental rasogolla was 63.53±1.24. Statistical analysis of the data presented in Table 7 showed no significant difference in springiness.

4.2.2. Sensory evaluation

Flavour, body and texture, colour and appearance of control and experimental rasogolla were evaluated on the first, second and third day of storage at room temperature. The experimental rasogolla prepared in the present study resembled the control rasogolla in appearance (Fig. 3). Scores obtained on the first, second and third day of storage are shown in Table 8, 9 and 10, respectively.

On the first day of sensory evaluation, the mean value of scores obtained for flavour of control and experimental rasogolla were 48.10±0.81 and 43.8±1.24, respectively. The mean scores obtained on the second and third day of storage for control and experimental rasogolla, respectively were 47.00±1.66, 45.40±2.12, 43.80±1.66 and 42.00±1.41.

Statistical analysis of the data were done to compare the scores obtained for flavour of rasogolla on the first,

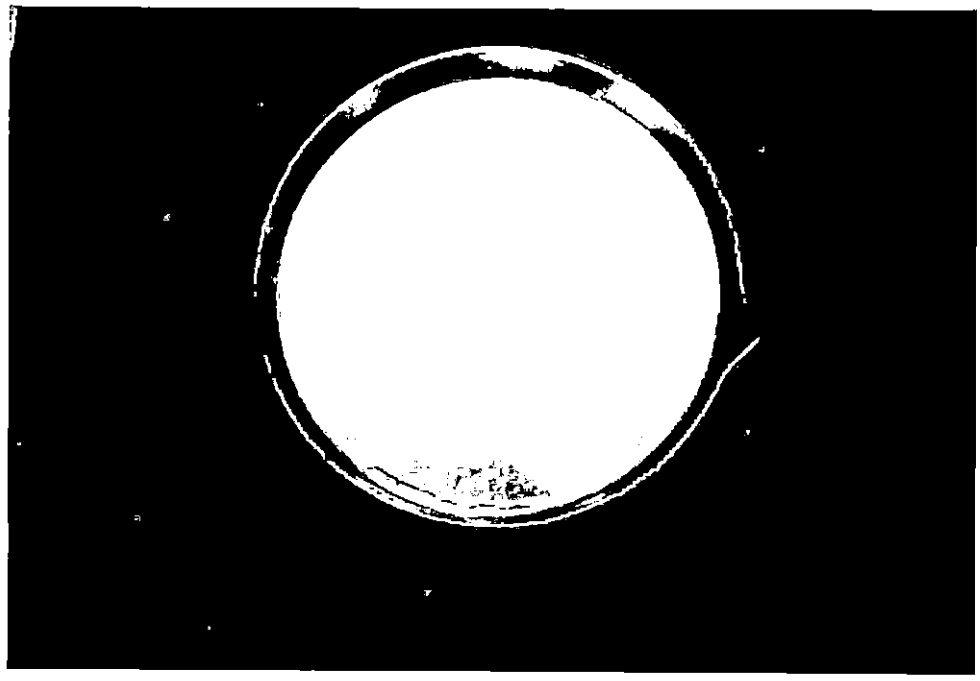


Fig.3. Rasogolla prepared from skim milk filled with coconut milk

Table 7. Springiness of control and experimental rasogolla

Replication	Percentage	
	Control	Experimental
1	67.57	60.00
2	75.00	60.00
3	66.66	60.00
4	62.62	63.33
5	66.66	66.97
6	67.50	66.96
7	61.82	62.50
8	68.01	68.45
Mean	$66.98 \pm \overline{1.41}$	$63.53 \pm \overline{1.24}$

t value : 1.8356 Not significant

Table 8. Scores obtained for control and experimental rasogolla on first day of storage

Sample	Replication No.	Particulars: Flavour	Body & texture	Colour & appearance	Total score
Control	1	44	36	10	90
	2	46	33	9	98
	3	47	39	10	96
	4	50	39	10	99
	5	50	39	10	99
	6	48	38	10	96
	7	50	40	10	100
	8	50	40	10	100
Mean		48.10±0.81	38.00±0.85	9.90±0.14	96.00±1.63
Experimental	1	45	33	9	87
	2	40	34	10	84
	3	43	37	9	89
	4	40	34	9	83
	5	41	38	9	88
	6	47	39	10	96
	7	44	34	9	87
	8	50	40	10	100
Mean		43.80±1.24	36.10±0.95	9.40±0.18	89.30±2.05
t values		2.9357*	1.4719NS	2.2563*	2.5594*

* Significant at 5 per cent level
NS Not significant

Table 9. Scores obtained for control and experimental rasogolla on second day of storage

Sample	Replication No.	Particulars			Total score
		Flavour	Body & texture	Colour & appearance	
Control	1	37	37	10	87
	2	43	37	9	89
	3	48	36	10	96
	4	50	39	10	99
	5	50	39	10	100
	6	48	37	10	95
	7	50	39	10	99
	8	50	38	10	98
Mean		47.00±1.66	38.50±0.42	9.90±0.14	95.40±1.73
Experimental	1	40	35	9	82
	2	40	36	9	82
	3	44	36	9	89
	4	47	35	9	91
	5	40	38	10	88
	6	50	39	10	99
	7	39	35	10	84
	8	50	39	10	99
Mean		43.80±1.66	36.50±0.85	9.50±0.18	89.30±2.40
t values		1.3869NS	1.3922NS	1.6550NS	2.0635NS

NS - Not significant

Table 10. Scores obtained for control and experimental rasogolla on third day of storage

Sample	Replication No.	Particulars			Total score
		Flavour	Body & texture	Colour & appearance	
Control	1	33	40	10	83
	2	40	34	10	84
	3	47	39	10	96
	4	50	40	10	100
	5	50	40	10	100
	6	47	39	10	96
	7	50	39	10	99
	8	46	38	10	94
Mean		45.40±2.12	38.60±0.71	10	94.00±2.40
Experimental	1	41	34	9	84
	2	40	33	9	82
	3	44	36	10	90
	4	44	37	9	90
	5	37	40	10	87
	6	50	40	9	99
	7	40	37	9	86
	8	40	38	10	88
Mean		42.00±1.41	36.90±0.88	9.38±0.18	88.30±1.80
t values		1.3277NS	1.5354NS	NS	1.9026NS

NS - Not significant

second and third day of storage. On the first day, the values obtained for control rasogolla was significantly higher than that obtained for experimental rosogolla ($P < 0.05$). On the second day and third day, no significant difference was noticed between the scores obtained for flavour of control and experimental rasogolla.

The mean value of scores obtained for body and texture of control and experimental rasogolla on the first day of storage was 38.00 ± 0.85 and 36.10 ± 0.95, respectively. On the second day, the values were 38.50 ± 0.42 and 36.50 ± 0.85 and on the third day the values were 38.60 ± 0.71 and 36.90 ± 0.88.

Statistical analysis revealed that the scores obtained for body and texture of control and experimental rasogolla on the first, second and third day of storage were not significantly different.

Table 8, 9 and 10 also showed that the scores obtained for colour and appearance of the control rasogolla on the first, second and third days of sensory evaluation were 9.90 ± 0.14, 9.90 ± 0.14 and 10.00, respectively. The scores for the experimental rasogolla were 9.40 ± 0.18, 9.50 ± 0.18 and 9.38 ± 0.18 respectively, on the first, second and third day of

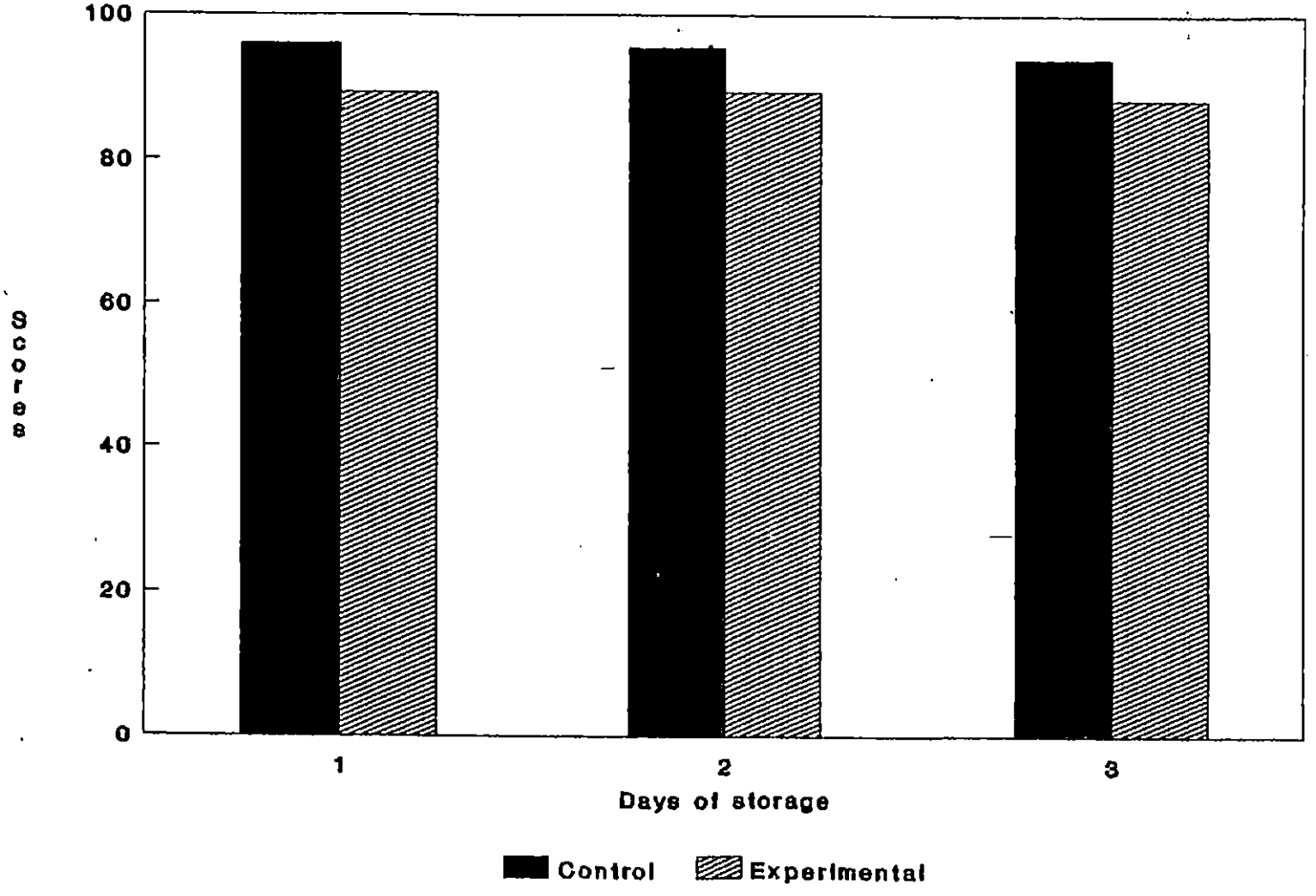
storage. On comparison, the scores obtained for control rasogolla on the first day for colour and apppearance was found to be significantly higher than the scores obtained for experimental rasogolla ($P < 0.05$). But no significant difference was noted on the second and third day of evaluation between the control and experimental rasogolla. The scores obtained for control and experimental rasogolla on the first, second and third day of storage were compared in Figure 4.

All the control and experimental samples of rasogolla were found to have a keeping quality of three days under storage at room temperature of 30°C. At the end of the third day of storage the average score obtained for samples of rasogolla prepared from standardized cow milk (control) was 94.00 and for those prepared from skim milk filled with coconut milk (experimental) was 88.30. Mould growths was observed in the samples stored for more than three days and hence discontinued the storage studies.

4.3. Whey drink

In the preliminary studies whey drinks with different flavour and colour were prepared by adding

Fig. 4 SCORES OBTAINED FOR CONTROL AND EXPERIMENTAL RASOGOLLA ON STORAGE



1. Mango flavour and orange colour
2. Pineapple flavour and apple green colour.
3. Lemon flavour and lemon yellow colour.

From the studies carried out on the acceptability of the three whey drinks, it was seen that pineapple flavoured and lemon flavoured whey drinks recorded maximum acceptance (above 80 per cent) while the mango flavoured whey drinks recorded least consumer acceptance (below 50 per cent). Based on these preliminary findings, the whey drinks with pineapple and lemon flavour only were prepared both from control and experimental paneer whey and subjected to further studies.

4.3.1. pH

The mean values of pH recorded for control whey drink was 4.142±0.03 while that of experimental whey drink was 4.136±0.03. Statistical analysis of the data presented in Table 11 for comparison of pH showed no significant difference between the samples of whey drinks.

4.3.2. Sensory evaluation

Whey drinks stored at refrigeration temperature were subjected to sensory evaluation on the first, second and

Table 11. pH of control and experimental whey drink

Replication	Control	Experimental
1	4.00	4.02
2	4.20	4.18
3	4.14	4.15
4	4.13	4.14
5	4.18	4.09
6	4.08	4.10
7	4.13	4.08
8	4.28	4.08
Mean	4.142± 0.03	4.136± 0.03

t value : 0.1424 Not significant

third day of preparation. Appearance, odour, flavour and body of pineapple flavoured control samples of whey drink were compared with that of experimental samples. Data are given in Table 12, 13 and 14.

Appearance of pineapple flavoured control whey drink had a mean value of 10.00, 9.80±0.18 and 9.40±0.18 on the first, second and third day of storage, respectively. Experimental whey drink obtained scores with a mean value of 9.75±0.18, 9.60±0.18 and 9.50±0.18, respectively for first, second and third day of storage. No significant difference was observed between the scores obtained for appearance of pineapple flavoured control and experimental whey drinks.

The mean value of scores obtained for odour of pineapple flavoured control whey drink were 19.00, 19.10±0.28, and 18.50±0.18 and that of pineapple flavoured experimental whey drink were 18.63±0.13, 18.90±0.28 and 18.60±0.18, respectively on the first, second and third day of storage. The difference in values obtained in the case of evaluation of 'odour' between the control and experimental samples was not significant.

On the first day of evaluation of flavour of whey drinks, pineapple flavoured control and experimental samples

Table 12. Scores obtained for pineapple flavoured control and experimental whey drinks on the first day of storage

Sample	Replication No.	Particulars				Total score
		Appearance	Odour	Flavour	Body	
Control	1	10	19	33	28	90
	2	10	19	39	29	97
	3	10	19	39	29	97
	4	10	19	39	29	97
	5	10	19	39	29	97
	6	10	19	38	29	96
	7	10	19	39	29	97
	8	10	19	39	29	97
Mean		10.00	19.00	38.10± 0.74	28.90± 0.14	96.00± 0.85
Experimental	1	9	19	38	29	95
	2	9	19	39	28	95
	3	10	19	39	29	97
	4	10	19	39	29	97
	5	10	17	37	29	93
	6	10	18	38	28	94
	7	10	19	39	29	97
	8	10	19	39	29	97
Mean		9.75± 0.18	18.63± 0.13	38.50± 0.28	28.80± 0.18	95.60± 0.57
		NS	NS	NS	NS	NS

NS - Not significant

Table 13. Scores obtained for pineapple flavoured control and experimental whey drinks on the second day of storage

Sample	Replication No.	Particulars				Total score
		Appearance	Odour	Flavour	Body	
Control	1	10	19	35	27	91
	2	9	18	37	27	91
	3	10	19	40	29	98
	4	10	20	40	30	100
	5	10	20	40	30	100
	6	10	19	39	29	97
	7	10	20	39	28	96
	8	9	18	38	27	92
Mean		9.80± 0.18	19.10± 0.28	38.50± 0.64	28.50± 0.46	95.60± 1.34
Experimental	1	9	18	37	27	91
	2	9	18	38	27	92
	3	10	19	39	29	97
	4	10	20	38	30	98
	5	10	20	40	30	100
	6	10	19	19	35	92
	7	10	19	35	29	93
	8	9	18	38	27	92
Mean		9.60± 0.18	18.90± 0.28	37.50± 0.64	28.40± 0.64	94.40± 1.20
		NS	NS	NS	NS	NS

NS - Not significant

Table 14. Scores obtained for pineapple flavoured control and experimental whey drinks on the third day of storage

Sample	Replication No.	Particulars				Total score
		Appearance	Odour	Flavour	Body	
Control	1	9	18	35	28	90
	2	9	18	37	28	92
	3	10	19	39	29	97
	4	9	19	38	28	94
	5	9	18	38	28	93
	6	10	18	37	29	94
	7	10	19	38	28	95
	8	9	19	38	28	94
Mean		9.40 ± 0.18	18.50 ± 0.18	37.50 ± 0.42	28.30 ± 0.18	93.63 ± 0.73
Experimental	1	9	19	38	29	95
	2	9	18	35	28	90
	3	10	18	34	29	91
	4	9	19	37	28	93
	5	9	18	37	28	92
	6	10	19	35	28	92
	7	10	19	35	29	93
	8	10	19	38	28	95
Mean		9.50 ± 0.18	18.60 ± 0.18	36.10 ± 0.57	28.40 ± 0.18	92.60 ± 0.64
		NS	NS	NS	NS	NS

NS - Not significant

obtained scores with a mean value of 38.10±0.74 and 38.50±0.28 , respectively. On the second day, control whey drink had an average value of 38.50±0.64 and experimental whey drink had a mean value of 37.50±0.64. On the third day, control and experimental whey drinks obtained scores with a mean value of 37.50±0.42 and 36.10±0.570, respectively. Statistical analysis of the values obtained showed that the treatments were not significantly different from one another in respect of scores obtained for flavour of whey drinks on the first, second and third day of storage.

Body of pineapple flavoured control whey drink obtained scores which had a mean value of 28.90±0.14, 28.50±0.46 and 28.30±0.18 and experimental whey drink which had a mean value of 28.80±0.18, 28.40 ±0.64 and 28.40±0.18 on the first, second and third day of storage, respectively. The statistical analysis of the data related to the 'body' of pineapple flavoured control and experimental whey drink showed no significant difference between them.

The overall scores obtained in sensory evaluation of pineapple flavoured control and experimental whey drinks were compared. The total scores obtained for pineapple flavoured control sample on the first, second and third day

of storage were 96.00±0.85, 95.60±1.34 and 93.63±0.73 while that of experimental whey drink were 95.60±0.57, 94.40±1.20 and 92.60±0.64, respectively. The overall scores obtained by pineapple flavoured control and experimental samples were found to be similar, on statistical analysis.

The control and experimental samples of lemon flavoured whey drink were also compared similarly. Data are given in Table 15, 16 and 17.

The scores obtained for appearance of lemon flavoured control whey drink had a mean value of 9.75±0.18, 9.75±0.18 and 9.38±0.18 while experimental sample had a mean value of 9.50±0.18, 9.38±0.18 and 9.63±0.18 on the first, second and third day of storage, respectively. No significant difference was observed between the scores obtained for appearance of control and experimental whey drinks.

Odour of lemon flavoured control and experimental whey drink had obtained scores with a mean value of 18.63±0.63 and 18.38±0.14 on the first day, 18.63±0.13 and 18.50±0.18 on the second day and 18.63±0.18 and 18.38±0.18 on the third day of storage, respectively. On statistical analysis, the scores obtained for 'Odour' of control and experimental whey drinks were found to be similar.

Table 15. Scores obtained for lemon flavoured control and experimental whey drinks on the first day of storage

Sample	Replication No.	Particulars				Total score
		Appearance	Odour	Flavour	Body	
Control	1	10	19	39	29	97
	2	10	19	39	29	97
	3	10	19	39	29	97
	4	10	17	37	29	93
	5	10	19	39	29	97
	6	9	19	39	28	95
	7	9	19	38	29	95
	8	10	18	38	28	94
Mean		9.75± 0.18	18.63± 0.63	38.50± 0.28	28.80± 0.18	95.60± 0.54
Experimental	1	9	18	35	28	90
	2	9	19	38	29	95
	3	10	19	33	28	90
	4	10	19	39	29	97
	5	9	19	38	29	95
	6	10	19	38	29	96
	7	10	19	39	29	97
	8	9	19	38	29	95
Mean		9.50± 0.18	18.38± 0.14	37.25± 0.63	28.75± 0.14	94.38± 0.54
		NS	NS	NS	NS	NS

NS - Not significant

Table 16. Scores obtained for lemon flavoured control and experimental whey drinks on the second day of storage

Sample	Replication No.	Particulars				Total score
		Appearance	Odour	Flavour	Body	
Control	1	10	19	39	29	97
	2	10	18	38	28	94
	3	10	19	39	29	97
	4	9	19	39	28	95
	5	10	19	39	29	97
	6	10	17	37	29	93
	7	10	19	39	29	97
	8	9	19	38	29	95
Mean		9.75± 0.18	18.63± 0.13	38.50± 0.28	28.80± 0.18	95.60± 0.50
Experimental	1	9	19	38	28	94
	2	10	18	37	29	94
	3	9	19	38	28	94
	4	9	18	37	28	92
	5	10	19	38	28	95
	6	9	18	38	28	93
	7	10	19	39	29	97
	8	9	18	35	28	90
Mean		9.38± 0.18	18.50± 0.18	37.50± 0.42	28.30± 0.18	93.63± 0.73
		NS	NS	NS	NS	NS

NS - Not significant

Table 17. Scores obtained for lemon flavoured control and experimental whey drink on the third day of storage

Sample	Replication No.	Particulars				Total score
		Appearance	Odour	Flavour	Body	
Control	1	10	19	38	28	95
	2	9	19	38	29	95
	3	9	19	38	28	94
	4	9	18	35	28	90
	5	10	19	35	29	93
	6	9	18	35	28	90
	7	10	19	38	28	95
	8	9	18	37	28	90
Mean		$9.38 \pm 0.18^{-}$	$18.63 \pm 0.18^{-}$	$36.75 \pm 0.45^{-}$	$28.25 \pm 0.18^{-}$	$92.75 \pm 0.68^{-}$
Experiment	1	10	19	39	29	97
	2	9	19	38	28	94
	3	10	18	34	29	91
	4	10	18	34	29	91
	5	10	18	37	28	94
	6	9	18	35	28	90
	7	10	19	35	28	92
	8	9	18	35	28	90
Mean		$9.63 \pm 0.18^{-}$	$18.38 \pm 0.18^{-}$	$35.88 \pm 0.42^{-}$	$28.50 \pm 0.18^{-}$	$92.38 \pm 0.78^{-}$
		NS	NS	NS	NS	NS

NS - Not significant

The mean value of scores obtained for flavour of lemon flavoured control whey drinks were 38.50±0.28, 38.50±0.28 and 36.75±0.45 and scores for that of experimental samples were 37.25±0.36, 37.50±0.42 and 35.88±0.42 on the first, second and third day of storage, respectively. The statistical analysis of the data related to flavour of lemon flavoured control and experimental whey drinks showed no significant difference between them.

Body of lemon flavoured control whey drink on sensory evaluation, obtained scores with a mean value of 28.80±0.18, 28.80±0.18 and 28.25±0.18; and experimental whey drinks obtained scores with a mean value of 28.75±0.14, 28.30±0.18 and 28.50±0.18 on the first, second and third day of storage, respectively. Statistical analysis revealed that the scores obtained for 'body' of control and experimental whey drinks on the first, second and third day of storage were not significantly different.

The overall scores of lemon flavoured control whey drinks had a mean value of 95.60±0.54, 95.60±0.50 and 92.75±0.68 and experimental samples had a mean value of 94.38±0.54, 93.63±0.73 and 92.38±0.78 on the first, second and third day of storage, respectively. The overall scores

obtained by lemon flavoured control and experimental samples were found to be similar, on statistical analysis.

Both pineapple and lemon flavoured control and experimental samples of whey drink were found to have good keeping quality and consumer acceptance for three days under storage at refrigeration temperature.

Discussion

DISCUSSION

The valuable skim milk, which finds limited use, can be effectively utilized for developing vegetable fat filled milk and in turn can be converted to valuable products.

An attempt has been made in the present study, to compare the quality of paneer, rasogolla and whey drinks prepared using cow milk and skim milk filled with coconut fat. Results of the findings are discussed in the following paragraphs.

5.1. Paneer

5.1.1. Yield

The overall mean percentage yield of control paneer obtained in the present investigation was 15.79±0.25 and that of experimental paneer was 14.73±0.34 (Table 1). The yield of paneer prepared from crossbred cows' milk standardized to 3.0 per cent fat and 4.5 per cent fat were reported to be 14.5 per cent and 15.7 per cent, respectively (Pruthi and Koul, 1989).

The yield of control paneer was found to be significantly higher than the yield of experimental paneer.

The decrease in the yield of experimental paneer observed in the present study is in agreement with the findings of Grover et al. (1989), Arora and Mital (1991) and Babje et al. (1992). They reported that the yield of paneer decreased with increased levels of soy milk in the soy milk-skimmed milk blend, used for the preparation of filled milk.

5.1.2. Fat

The overall mean values of fat per cent in control and experimental paneer was 23.10±0.35 and 23.75±0.46. No significant differences were noticed between the treatments. The fat percentage obtained in the case of control paneer is in accordance with that of Vishweshwariah and Anantakrishnan (1986). The percentage of fat was found to be maintained almost equal in both the treatments because milk was standarized to four per cent fat for preparation of paneer in both the treatments. The control and experimental paneer were found to have a milk fat content of not less than 50 per cent of the dry matter and thus meeting the PFA standards.

5.1.3. Moisture

The paneer prepared using cow milk and skim milk filled with coconut milk on an average contained 54.22±0.59

per cent and 53.96±0.55 per cent moisture, respectively (Table 3). Statistical analysis of the data showed no significant difference between the treatments. The moisture content of control paneer and vegetable paneer recorded are comparable to the earlier observations of Kanawjia et al. (1990).

5.1.4. Acidity

The titratable acidity of paneer was determined. The overall mean value of acidity of control and experimental paneer was found to be similar, the value being 0.253±0.02 per cent of lactic acid (Table 4). The value was found to be in agreement with the observations made by Chawla et al. (1987) who used one per cent citric acid as coagulant for the preparation of 'low fat paneer' from buffalo milk.

5.1.5. Total protein

Mean protein content of control paneer was 16.08±0.06 per cent and that of experimental paneer was 18.05±0.45 per cent (Table 5). On statistical analysis, the protein content of experimental paneer was found to be significantly higher than that of control paneer. The trend of increase in the total protein content of vegetable fat-filled paneer

when compared to whole milk paneer is in agreement with the findings of Babje et al. (1992). The increase in protein content in the experimental paneer may be due to the increased protein content of the filled milk. Coconut milk used for fat substitution in the milk used for experimental paneer preparation contained 5.8 per cent protein (Thampan, 1975). The addition of coconut milk resulted in an increase of about 0.3 per cent total protein in the filled milk, over and above that of cows' milk.

The lower yield of experimental paneer, inspite of its higher protein content and same moisture and fat content, when compared to control paneer, may be due to the loss of excess carbohydrates and minerals in the whey when filled milk is used for paneer preparation. Compared to cows' milk filled milk contains 0.9 per cent carbohydrate and 0.79 per cent minerals more which are also lost along with whey increasing the loss of total solids along with whey and thereby reducing the yield of experimental paneer prepared out of it.

5.1.6. Sensory evaluation of paneer

On sensory evaluation, control paneer got a mean total score of 96.10±1.09 and was graded as 'excellent'.

Experimental paneer got a mean total score of 88.40±0.92 and was of 'good' grade (Table 6).

Results show that a low total score was obtained for the experimental paneer. This may be explained by the fact that the experimental paneer scored less for flavour and body and texture. The difference in the score obtained were more for flavour, than for body and texture. The low score obtained for flavour of experimental paneer may be due to the natural flavour of coconut fat which might have been marked as a foreign flavour by the panel of judges. This observation is in accordance with the findings of Banzon (1978). Eventhough, coconut fat filled milk paneer obtained a low score in the present investigation the natural coconut flavour may not be considered as a defect by Keralites as they highly relish the coconut flavour.

Low score obtained for body and texture of experimental paneer may be due to the formation of weak or soft and pasty coagulum as opined by judges. The low melting point of coconut fat may result in its presence in liquid state at room temperature, which may explain the soft and pasty nature of filled milk paneer.

The low score and grade obtained by vegetable fat filled milk paneer in the present experimental project when compared to whole milk paneer on sensory evaluation was found to be in agreement with the observations of Babje et al. (1992).

5.2. Rasogolla

5.2.1. Springiness

Springiness of rasogolla is an indicator of the textural quality of the product.

The mean value of springiness of control rasogolla was 66.98±1.41 and that of experimental rasogolla was 63.53±1.24. Statistical analysis of the data presented in Table 7 showed no significant difference in springiness between the control and experimental samples of rasogolla. The result is expected, as per the findings of Babje et al. (1992). In their experimental studies with filled milk (Soy milk) paneer they reported no difference in springiness between the control paneer and experimental paneer.

5.2.2. Sensory evaluation of rasogolla

Use of whole milk standardised to four per cent fat resulted in the production of 'excellent' quality rasogolla with excellent flavour, body and texture and colour and appearance (Table 8) on first day of storage. This is evident from the appreciably high total score of 96.00±1.63 awarded to the above said rasogolla sample on the basis of organoleptic evaluation by a panel of judges. Experimental rasogolla prepared from filled milk got a lower total score of 89.30±2.05 with lower score for flavour and colour and appearance and was graded as 'good' quality. No significant difference was observed between the scores obtained for body and texture of control and experimental rasogolla. This is in agreement with the findings of Singh and Ganesh (1988) who reported that filled rasogolla was comparable in body appearance, texture, flavour and overall quality to the conventional one.

The comparatively lower score obtained for flavour for experimental rasogolla may be due to the coconut flavour which might have been mistaken as a foreign flavour. Colour and appearance of experimental rasogolla scored less which may be due to a dull surface observed in case of experimental sample. Dull appearance may be due to the

difference in source of fat in the milk used for rasogolla preparation. Body and texture of control and experimental rasogolla prepared in this research work were found comparable.

Rasogolla prepared using control sample of milk was graded high even on the second and third day of storage at room temperature with average scores of 95.40 and 94.0 respectively. Similarly, the experimental rasogolla maintained their good quality on the second and third day of storage (Table 9 and 10). Storage period was found to have no effect on flavour, body texture and colour and appearance of both control and experimental rasogolla. This observation is well in accordance with that reported by Jagtiani et al. (1960) who studied the keeping quality of rasogolla. Scores obtained for control and experimental rasogolla on storage are compared in the Fig. 4.

The results observed indicated that both control and experimental samples of rasogolla had a shelf life of three days under storage at room temperature (30°C). Mould growth was observed in the samples stored for more than three days and hence discontinued the storage for longer periods.

5.3. Whey drinks

5.3.1. pH

The mean value of pH of control and experimental whey drinks are shown in Table 11. The mean pH of control whey drinks was 4.142±0.03, whereas the mean pH of experimental whey drinks was 4.136±0.03. No significant difference was observed between them. The above findings coincide with the observations of Bambha et al. (1972).

5.3.2. Sensory evaluation of whey drinks

Overall mean scores obtained for the pineapple flavoured whey drinks on the first, second and third day of storage at refrigeration temperature (5±1°C) is given in Table 12, 13 and 14 respectively. Pineapple flavoured control whey drink obtained a total score with a mean value of 96.00±0.85, 95.60±1.34 and 93.63±0.73 and pineapple flavoured experimental whey drink obtained a total score with a mean value of 95.60±0.57, 94.40±1.20 and 92.60±0.64 on the first, second and third day of storage, respectively. Both the control and experimental whey drinks were graded as excellent on the first, second and third day of storage. Similar observations were reported by Blazek and

Sule (1961). Bambha et al. (1972) and Gandhi (1984) for acid whey drinks.

The high score obtained for experimental whey drink is in accordance with the observations reported by Fernandez and Samaniego (1986). They have reported the high consumer acceptance of coconut milk whey beverage.

Appearance, odour, flavour and body textures of control and experimental whey drinks when compared were found to have no significant difference between them. This indicates that the pineapple flavoured control and experimental drinks were equally acceptable.

Overall mean scores obtained for lemon flavoured control whey drink on the first, second and third day of storage at refrigeration temperature (5±1°C) are 95.60±0.54, 95.60±0.50 and 92.75±0.68, respectively. The corresponding scores obtained for experimental whey drink are 94.38±0.54, 93.63±0.73 and 92.38±0.78. As in the case of pineapple flavoured whey drinks lemon flavoured control and experimental whey drinks were graded as excellent quality.

5.4. Conclusion

From the results it may be concluded that good quality paneer, rasogolla and whey drinks could be prepared from coconut fat-filled skim milk thus utilizing skim milk efficiently, which would have been otherwise wasted.

Addition of coconut milk to skim milk decreased the yield slightly but increased the total protein content of experimental paneer than that of control paneer. No significant difference was observed in fat percentage, mositure content and acidity between control and experimental paneer. Experimental paneer scored less for flavour, body and texture, than control paneer but colour and appearance resembled that of control paneer.

Springiness of control and experimental rasogolla was found to be similar. Control rasogolla obtained higher score for flavour, colour and appearance, but obtained similar scores for body and texture on the first day of storage at room temperature. But on the second and third day of storage, quality of experimental paneer resembled that of control paneer in flavour, body and texture and colour and appearance. Both control and experimental rasogolla samples was found to be of good quality on all the

three days of storage. Control and experimental whey drinks when compared, were found to have apparently similar pH. Pineapple and lemon flavoured experimental whey drinks were found to resemble control whey drinks in appearance, odour, flavour and body characters on all the three days of storage at refrigeration temperature.

SUMMARY

A detailed study was carried out to determine the quality of vegetable fat (coconut fat) filled milk for the preparation of indigenous milk products such as paneer, rasogolla and whey drinks. A modified version of Precision penetrometer to measure the textural quality (springiness) of rasogolla was designed, fabricated and used in the present study. The chemical, textural and organoleptic quality of paneer, rasogolla and whey drinks prepared using filled milk were compared to those prepared from whole cow milk.

The control samples of paneer, rasogolla and whey drinks were prepared using cows' milk standardized to four per cent fat. Filled milk prepared by mixing skim milk with coconut milk and standardized to four per cent fat was used for the preparation of experimental samples of paneer, rasogolla and whey drinks.

The yield, moisture, acidity, fat and total protein of paneer were estimated. Springiness of rasogolla and pH of whey drink were also estimated. The prepared products were subjected to organoleptic evaluation and compared with the control sample.

The overall mean percentage yield of the control paneer obtained in the present investigation was 15.79±0.25 and that of experimental paneer was 14.73±0.34. The yield of control paneer was found to be significantly higher ($P<0.05$) than the yield of experimental paneer.

The mean percentage values of fat in control and experimental paneer was 23.10±0.35 and 23.75±0.46, respectively. No significant differences were noticed between treatments as expected since fat in cow milk and filled milk used for paneer preparation was standardized to four per cent. The control and experimental paneer were found to have a milk fat content of not less than 50 per cent of the dry matter and thus meeting the PFA standards.

No significant differences were noticed between control and experimental paneer with regard to the moisture content.

The overall mean value of acidity of control and experimental paneer were found to be similar, the value being 0.253±0.02 per cent of lactic acid.

The mean protein content of control paneer was 16.08±0.06 per cent and that of experimental paneer was 18.05±0.45 per cent. On statistical analysis, the protein

content of experimental paneer was found to be significantly higher ($P < 0.01$) than control paneer.

On sensory evaluation, control paneer was graded as of 'excellent' quality with a mean total score of 96.10±1.09, while experimental paneer was graded as of 'good' quality with a mean total score of 88.40±0.92. Experimental paneer scored less for flavour and body and texture than control paneer, but colour and appearance resembled that of control paneer.

The mean value of springiness of control rasogolla was 66.98±1.41 and that of experimental rasogolla was 63.53±1.24. Statistical analysis showed no significant difference in springiness between the samples.

Rasogolla prepared using whole milk standardized to four per cent fat was graded as 'excellent' with mean total score of 96.00±1.63 on the first day of storage, when subjected to sensory evaluation. Experimental rasogolla got a total score of 89.30±2.05 and was graded as 'good' quality. No significant difference was observed between the scores obtained for body and texture of control and experimental rasogolla.

Control samples of rasogolla maintained their 'excellent' quality, while experimental samples of rasogolla maintained their 'good' quality on the second and third day of storage at room temperature, indicating a good shelf life of three days.

Whey drinks were prepared using pineapple and lemon flavour both from control and experimental whey. The mean pH of control whey drinks was 4.142±0.03 whereas the mean pH of experimental whey drinks was 4.136±0.03. No significant difference was observed between the treatments.

Pineapple flavoured control whey drink obtained a mean total score of 96.00±0.85, 95.60±1.34 and 93.63±0.73 and pineapple flavoured experimental whey drink obtained a total score with a mean value of 95.60±0.57, 94.40±1.20 and 92.60±0.64 respectively, on the first, second and third day of storage. Both the control and experimental whey drinks were graded as 'excellent' on the first, second and third day of storage. Appearance, odour, flavour and body characters of control and experimental whey drinks, when compared, were found to have no significant difference ~~between~~ among them, indicating that they were equally acceptable.

Lemon flavoured whey drinks even though scored less as compared with pineapple flavoured whey drink, were also excellent in quality during storage and showed no significant difference between control and experimental samples.

The analysis carried out on the various parameters used for the comparison of paneer, rasogolla and whey drinks prepared from cows' milk and coconut fat filled milk revealed no difference in quality ~~between~~ among them.

References

REFERENCES

Agrawal, K.K., Choudhary, P.L. and Sharma, V.S. (1991). Preparation of coconut milk. J. Fd. Sci. Technol. 28(4): 255-256.

*Ahmed, A.R., Vyas, S.H., Upadhyay, K.G. and Thakar, P.N. (1981). Study on manufacture of chhana from buffalo milk. Gujarat Agric. Univ. Res. J. 7(1): 32-36. (Fd. Sci. Technol. Abstr. (1983) 15(1): 170).

Arora, V.K. (1979). Storage study on paneer at subzero temperature. M.Sc. thesis submitted to Kurukshethra University.

Arora, V.K. and Gupta, S.K. (1980). Effect of low temperature storage of paneer. Indian J. Dairy Sci. 33(3): 374-380.

Arora, S. and Mital, B.K. (1991). Preparation and evaluation of soypaneer. J. Fd. Sci. Technol. 28(1): 15-17.

Babje, J.S., Rathi, S.D., Ingle, U.M. and Syed, H.M. (1992). Effect of blending soymilk with buffalo milk on qualities of paneer. J. Fd. Sci. Technol. 29(2): 119-120.

*Backman, C., Lilleberg, L. and Uusi-Rauva, E. (1989). The fatty acid composition of ice cream sold in Finland. Meijeritiet. Aikakausk 47(1): 58-62. (Dairy Sci. Abstr. (1990) 52(5): 3685).

Bambha, P.P., Setty, P.A.S. and Nambudiripad, V.K.N. (1972). Whevit - a nourishing soft drink. Indian Dairym. 24(7): 153-157.

Bandyopadhyay, A.K. and Mathur, B.N. (1987). Dairy India, 3rd Annual Edition.

Bandyopadhyay, A.K., Soni, K. and Ganguli, N.C. (1981). Production and properties of chhana and rasogolla - a review. Dairy Guide 3(3): 43-48.

*Banzon, J.A. (1978). Reconstitution of milk using coconut milk and non fat dry milk. Philippine J. Coconut Stud. 3(2): 1-8.

Bhandari, V., Ladkani, B.G. and Mulay, C.A. (1976). Utilization of filled milk in flavoured milk preparation. J. Fd. Sci. Technol. 13(4): 199-200.

Bhattacharya, D.C., Mathur, O.N., Srinivasan, M.R. and Samlik, O. (1971). J. Fd. Sci. Technol. 8(3): 117-120.

Bhattacharya, D.C. and Raj, D. (1980 a). Studies on the production of rasogolla - Traditional method. Indian J. Dairy Sci. 33(2): 237-243.

Bhattacharya, D.C. and Raj, D. (1980 b). Studies on the production of rasogolla - Part II - Pressure cooker Method. Indian J. Dairy Sci. 33(4): 479-483.

*Birosel, D.M. and Ferro, O.V. (1977). Properties and composition of coconut milk emulsion. Anais Farm. Quim. S. Paulo 17(2): 9-19. (Fd. Sci. Technol. Abstr. (1981) 13:(7): 1172).

*Blazek, Z. and Sule, J. (1961). Method for the manufacture of dietetic whey beverage. Czech. Pat. 101: 689. (Dairy Sci. Abstr. (1961) 26(2): 390).

*Blesa, O., Ellenrieder, G., Geranazzo, H. and Macoritto, A. (1980). Cowmilk and soyamilk mixtures - Studies on their acceptability and elimination of antinutritive factors. An. Bromatol 32(4): 327-36. (Fd. Technol. Abstr. (1983): 183 : 25).

*Blohorn, S.H. (1977). Method for producing a fat similar to the fat in natural milk. Br. Pat. 1: 495. (Fd. Sci. Technol. Abstr. (1978), 10(4): 147).

*Brink, M.F., Balsley, M. and Speckman, E.W. (1969). Nutritional value of milk compared with filled and imitation milks. Am. J. clin. Nutr. 22(2): 168-180. (Dairy Sci. Abstr. (1969) 31(8): 2993).

Chakrabarti, S.R. and Gangopadhyay (1990). Innovation of technology for preparation of rasogolla analogue from soymilk. J. Fd. Sci. Technol. 27(4): 242-243.

Chawla, A.K., Singh, S. and Kanawjia, S.K. (1985). Development of low fat paneer. Indian J. Dairy Sci. 38(4): 280-283.

*Chawla, A.K., Singh, S. and Kanawjia, S.K. (1987). Effect of fat levels, additives and process modifications on composition and quality of paneer and whey. Asian J. Dairy Res 6(2): 87-92. (Dairy Sci. Abstr. (1987) 51: 4856).

Dairy India (1992). Traditional milk specialities - a survey. 4th annual edition.

*Davide, C.L., Peralta, C.N. and Sarmago, I.G. (1987). Utilization of skimmilk powder and water extracted coconut milk in low fat filled milk processing. Philippine J. Coconut Stud. 10(1): 48-59.

De, S. and Ray, S.C. (1954). Preparation of chhana. Indian J. Dairy Sci. 7: 113.

De, S., Bhattacharya, D.C., Mathur, O.N. and Srinivasan, M.R. (1971). Production of paneer from high acid milk. Indian Dairym. 23(11): 224-225.

De, S. (1976). Chhana and chhana-based sweets. Indian Dairym. 28(3): 105-109.

De, S. (1980). Outlines of dairy technology. Oxford University Press, New Delhi.

*Dordevic, L. and Kolev, V. (1967). Refreshing beverages from whey. Dairy Sci. Abstr. 29(8): 439.

*Dordevic, J., Niketic, G., Karic, A., Bubanja, N. and Markovic, D. (1982). Use of sweet and sour whey in the production of fermented beverages. Mljekarstvo 32(7): 214-218. (Fd. Sci. Technol. Abstr. (1983), 15(8): 1263).

*Escueta, E.E. (1980). Stability studies on coconut milk and plant protein isolates based products. I. Physical properties. Philippine J. Coconut Stud. 5(1):63-65. (Fd. Sci. Technol. Abstr. (1981), 13(8): 1162).

*Fernandez, W.L. and Samaniego, L.A. (1984). Lactobacillus-fermented beverage from coconut milk whey. Phillipine. J. Coconut. Stud. 9(1/2): 36-41.

Forsum, E. and Hambracus (1977). Nutritional and biochemical studies of whey products. J. Dairy Sci. 60(3): 370-377.

Gagrani, R.L., Rathi, S.D. and Ingle, U.M. (1987). Preparation of fruit flavoured beverage from whey. J. Fd. Sci. Technol. 24(2): 93-94.

Gandhi, D.N. (1984). Development of soft whey drink - Acidowhey. Dairy Guide. 6(8): 41-43.

Gandhi, D.N. (1989). Whey utilization for beverages production. Indian Dairym. 31(1): 35-36.

Ganguli, N.C. (1971). Imitation milk - Can it be a substitute for milk. Indian Dairym. 23(12):249-251.

Ganguli, N.C. and Kuchroo, C.N. (1979). Humanized milk for infants - a success story. Indian Dairym. 31(10): 692-694.

Gera, V.K. and Rajorhia, G.S. (1979). An instrument for measuring the springiness of chhana. Indian J. Dairy Sci. 32(4): 465-466.

Ghodekar, D.R. (1989). Factors affecting quality of paneer. Indian Dairym. 41(3): 161-164.

*Gonc, S., Oktar, F. and Enfiyeci, A.S. (1988). Use of vegetable fat instead of milk fat in ice cream. Ege Universitesi Ziraat Fakultesi Dergisi 25(1): 10-22. (Dairy Sci. Abstr. (1990), 52(10): 7669).

*Grinene, E.K. and Prantskyarichyus, A.V. (1977). Method for obtaining a soured milk beverage from whey. USSR Pat. 581: 923. (Fd. Sci. Technol. Abstr. (1978), 10(6): 152).

Grover, M., Tyagi, S.M. and Bajwa, U. (1989). Studies on Soy paneer. J. Fd. Sci. Technol. 26(4): 194-197.

Gupta, S.K., Patil, G.R. and Patel, A.R. (1987). Fabricated dairy products. Indian Dairym. 39(5): 199-208.

Gupta, V.K. and Mathur, B.N. (1989). Current trends in whey utilization. Indian Dairym. 31(3): 165-167.

I.S: 1224, Part I. (1977). Indian standard determination of fat by the Gerber method. Bureau of Indian Standards, New Delhi.

I.S: 2785 (1964). Specification for hard cheese, processed cheese spread. Bureau of Indian Standards, New Delhi.

I.S: 7768 (1975). Method for sensory evaluation of milk. Bureau of Indian Standards, New Delhi.

I.S: 10484 (1983). Specification of paneer. Bureau of Indian Standards, New Delhi.

*Jagtiani, J.K., Iyengar, J.R. and Kapur, N.S. (1960). Studies on the preparation and preservation of rasogollas. Fd. Sci. 9(2): 46-47. (Dairy Sci. Abstr. (1960), 22(9): 2461).

Jailkhani, V.K. and De, S. (1980). Utilization of goat milk for chhana making. Indian J. Dairy Sci. 33(1): 29-33.

Jensen, G.K. and Nielsen, P. (1982). Reviews of the progress of dairy science:milk powder and recombination of milk and milk products. J. Dairy Res. 49(3): 515-544.

Joshi, S.V., Majgaonkar, S.V. and Toro, V.A. (1991). Effect of different coagulants on yield and sensory quality of chhana prepared from milk of cow, buffalo and goat. Indian J. Dairy Sci. 44(6): 380-383.

Kanawjia, S.K., Roy, S.K. and Singh, S. (1990). Paneer technology and its diversification. Indian Dairym. 42(9): 390-393.

Kosikowski, F.V. (1978). Cheese and Fermented milk foods, Brooktondale, New York.

Krishnaiah, N., Reddy, C.R. and Rao, M.R. (1991). Development of beverage from acid whey. Indian J. Dairy Sci. 44(4): 300-301.

Kulkarni, S., Rajorhia, G.S. and Chakraborthy, B.K. (1984). Studies on shelf life of chhana. Indian J. Dairy Sci. 37(4): 392-395.

*Kumar, R., Singh, C. and Khan, B.L. (1988). Suitability of Bhadawari buffalo milk for cereal based rasogolla making. Fm. Sci. J. 3(1): 44-50. (Dairy Sci. Abstr. (1991), 53(5): 2932).

Kundu, S.S. and De, S. (1972). Chhana production from buffalo milk. Indian J. Dairy Sci.25(3): 159-163.

*Lupke, J. (1979). A versatile new material for the milk industry. Dt. Milchwirt. 30(21): 796.(Fd. Sci. Technol. Abstr. (1979), 11(11): 118).

Mahadevan, A.P. (1991). Nutritional value of traditional milk products of India. Indian Dairym. 43(2): 95-101.

Mann, E.J. (1982). Soyabean - Dairyblends. Dairy ind. int. 47(1): 11-13.

*Marhounova, E. and Mergl, M. (1980). Flavoured whey beverages. Prum. Potravin. 31(10): 578-579.(Fd. Sci. Technol. Abstr. (1981), 13(8): 1324).

*Mathur, B., Hashizume, K., Musimi, S., Nakazawa, Y. and Watanabe, T. (1986). Traditional cheese-paneer, in India and soyabean food 'tofu' in Japan. Japanese J. Dairy Fd. Sci.35(4): 137-141. (Dairy Sci. Abstr. (1986), 49: 1489).

Medora, P.S. (1971). Role of filled milk in the dairy development of the Philippines. Indian Dairym. 23(4): 82-85.

Miller, D.E. (1968). Role of Dairy substitutes. J. Dairy Sci. 51(8): 1330-1334.

Moorthy, P.R.S. and Rao, B.V.R. (1982). Studies on proudction and quality of chhana from goat milk. J. Fd. Sci. Technol. 19(2): 69-71.

Nair, N.N. and Geevarghese, P.I. (1988). A dairy analogue Keta cream. Paper presented at 22nd Dairy conference held at Trivandrum.

Nasim, M., Mital, B.K. and Tyagi, S.M. (1986). Development of a process for preparation of soypaneer. J. Fd. Sci. Technol. 23(2): 69-72.

Pal, D. and Garg, F.C. (1989 a). Utilization of sour butter milk in the manufacture of paner. Indian J. Dairy Sci. 42(3): 589-594.

Pal, D. and Garg, F.C. (1989 b). Studies on utilization of sweet cream butter milk in the manufacture of paneer. J. Fd. Sci. Technol. 26(5): 259-264.

Pal, D. and Gupta, S.K. (1985). Sensory evaluation of Indian milk products. Indian Dairym. 37(9):465-474.

Pal, M.A. and Yadav, P.L. (1991). Effect of blending buffalo and cowmilk on the physico-chemical and sensory quality of paneer. Indian J. Dairy Sci. 44(5): 327-332.

Pal, M.A., Yadav, P.L. and Sanyal, M.K. (1991). Physico-chemical and sensory characteristics of low fat paneer from high heated milk. Indian J. Dairy Sci. 44(7): 437-441.

Patil, G.R. and Gupta, S.K. (1979). Dairy analogs - A challenge or menace to dairy industry. Indian Dairym. 31(1): 51-53.

Patil, G.R. and Gupta, S.K. (1986). Some aspects of sensory evaluation of paneer. Indian Dairym. 38(3):135-140.

Paul, S.C. (1990). Nutritive beverages for product diversification in dairy industry. Indian Dairym. 42(6): 282-287.

PFA (1982). Prevention of Food Adulteration Rules, Amended upto 1982, New Delhi.

Prajapathi, P.S., Patel, A.A. and Gupta, S.K. (1987). Ingredients for low fat dairy spreads. Indian Dairym. 39(4): 181-185.

Prakash, M.S. and Iya, K.K. (1986). Preparation of paneer from blended soymilk and mixed milk. Indian Dairym. 38(9): 433.

Prendergast, K. (1985). Whey drinks - Technology, processing and marketing. J. Soc. Dairy Technol. 38(4): 103-105.

Pruthi, T.D. (1984). A rapid method for estimation of moisture in paneer. Indian J. Dairy Sci. 37(3): 277-279.

Pruthi, T.D. and Koul, J.L. (1989). Paneer from crossbred cows' milk. Indian J. Dairy Sci. 42(2): 403-404.

Rajani, S.G. and Sharada, D. (1983). Protein quality of sweet meats prepared with sweet curdled milk. Indian J. Dairy Sci. 36(3): 239-243.

Rajor, R.B. and Patil, G.R. (1983). Low cost frozen dessert - an overview. Indian Dairym. 35(1): 39-42.

Rajor, R.B. and Vani, B. (1991). A new approach for the manufacture of kulfi. Indian Dairym. 43(6):256-259.

Rajorhia, G.S. and Sen, D.C. (1988). Technology of chhana - a review. Indian J. Dairy Sci. 41(2): 141-148.

Rao, M.N., Rao, B.V.R. and Rao, J.J. (1984). Paneer from buffalo milk. Indian J. Dairy Sci. 37(1): 50-53.

Rao, M.S., Rao, M.R., Ranganadham, M. and Rao, B.V.R. (1989). Studies on preparation of chhana on buffalo milk and its suitability for rasogolla manufacture. Indian J. Dairy Sci. 42(4): 810-816.

Sachdeva, S. and Singh, S. (1987). Use of nonconventional coagulants in the manufacture of paneer. J. Fd. Sci. Technol. 24(6): 317-318.

Sachdeva, S. and Singh, S. (1988 a). Incorporation of hydrocolloids to improve the yield, solids recovery and quality of paneer. Indian J. Dairy Sci. 41(2): 189-193.

Sachdeva, S. and Singh, S. (1988 b). Optimisation of processing parameters in the manufacture of paneer. J. Fd. Sci. Technol. 25(3): 142-145.

Sen, D.C. (1989). Rasogolla - a classicial Indian milk sweatmeat. Indian Dairym. 41(3): 145-150.

Shukla, F.C. and Gill, G.S. (1986). Technological and physico-chemical studies on paneer and chhana - a review. Dairy Guide 8(9): 48-52.

Singh, G.P. and Mathur, M.L. (1973). Chhana whey - its composition. Indian J. Dairy Sci. 26(3): 201-203.

Singh, G.P. and Ray, T.K. (1977 a). Effect of milk coagulants on the quality of rasogolla and sandhesh. J. Fd. Sci. Technol. 14(4): 149-152.

Singh, G.P. and Ray, T.K. (1977b). Effect of milk coagulants on the quality of chhana and chhana whey. J. Fd. Sci. Technol. 14(5): 205-207.

Singh, U. and Ganesh (1988). Preparation of filled rasogolla utilizing sweet cream butter milk solids. Indian Dairym. 30(8): 445-447.

Snedecor, G.W. and Cochran, W.G. (1968). Statistical Methods. Oxford and IBH Publishing Co., New Delhi.

Soni, K., Bandyopadhyay, A.K. and Ganguli (1980). Manufacture of rasogolla from buffalo milk. Indian J. Dairy Sci. 33(3): 357-365.

Srivastva, D.N. and Singh, M.P. (1976). Utilization of substandard milk for chhana and sweetmaking. Haryana Agric. Univ. J. Res. 6(3/4): 248-250.(Fd. Sci. Technol. Abstr.(1976), 10(10): 168).

Srivastava, M.K. and Lohani, P.P. (1986). Utilization of byproducts by dairies - whey and butter milk. Indian Dairym. 38(8): 389-390.

*Szakaly, S., Schaffer, B. and Obert, G. (1978). Developing beverages and longkeeping desserts from whey and permeate. Int. Dairy Congr. E. 941.(Dairy Sci. Abstr. (1978), 40(9): 4545).

Thampan, P.K. (1975). Handbook on Coconut Palm. Oxford and IBH Publishing Co., New Delhi.

Umesh, A.R., Atmaram, K. and Jayaprakasha, H.M. (1989). Utilization of vanaspathi in the preparation of filled soft serve ice cream. Cheiron 18(3):118-123.

*Upadhayaya, U. and Khan, A.Q. (1981). Studies on utilization of whey for the preparation of soft drink. Allahabad Fmr. 50(4): 429-430.(Fd. Sci. Technol. Abstr. (1981), 13(8): 1324).

Verma, B.B. (1989). Technological studies on production of rasogolla from buffalo milk. M.Sc. thesis submitted to Kurukshetra University.

Vishweshwaraiah, L. and Anantakrishnan, C.P. (1986). Production of paneer from cows milk. Indian J. Dairy Sci. 39(4): 484-485.

Vishweshwaraiah, L. and Anantakrishnan, C.P. (1987). A study on technological aspects of preparing paneer from cow's milk. Asian J. Dairy Res 4(3): 171-176.

* Originals not seen

UTILISATION OF SKIM MILK FILLED WITH COCONUT MILK FOR PREPARATION OF INDIGENOUS DAIRY PRODUCTS

By

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ABSTRACT OF A THESIS

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ABSTRACT

A detailed study was carried out to determine the quality of coconut fat filled milk for the preparation of indigenous milk products such as paneer, rasogolla and whey drinks. A modified version of Precision Penetrometer to measure the springiness of rasegolla was designed, fabricated and used in the present study.

An exhaustive review of literature has been presented on the use of vegetable fat for substitution of milk fat for preparation of various dairy products apart from preparation and other related aspects of paneer, rasogolla and whey drinks.

The methods of chemical analysis and sensory evaluation of these products have been detailed.

The control samples of paneer, rasogolla and whey drinks were prepared using cows' milk while experimental samples were prepared using skim milk filled with coconut fat. The milks were standardized to four per cent fat.

The moisture, fat and acidity were found to be similar in control paneer and experimental paneer. The control paneer was found to have higher yield but low protein

content when compared to experimental paneer. On sensory evaluation, control paneer was graded as of 'excellent quality' while experimental paneer was graded as of 'good quality'.

The control and experimental samples of rasogolla were found to have same springiness. Control samples of rasogolla obtained 'excellent' grade on sensory evaluation but the experimental rasogolla was graded as of 'good' quality. The difference in the quality of paneer and rasogolla was due to the natural flavour of coconut milk carried over to the products. Both control and experimental samples of rasogolla were found to have good shelf life of three days, at room temperature.

Pineapple and lemon flavoured control and experimental whey drinks were found to be equally acceptable with no difference in appearance, odour, flavour and body characteristics.

The chemical and sensory evaluation of paneer, rasogolla and whey drinks prepared from cows' milk and coconut fat filled milk revealed no significant difference between them.