Preparation of *Kulfi* from admixtures of partially de-oiled Groundnut meal and milk/milk powders

Lata Ramachandran¹, Sukhminder Singh¹ and Ashwani Kr. Rathour²*

¹Dept. of Dairy Chemistry, S. M. C. College of Dairy Science, Anand Campus, Anand – 388 110, Gujarat, India
²Mahaan Proteins Ltd., Kosi Kalan 281 403, Distt. – Mathura, Uttar Pradesh, India
*Correspondent author, E-mail: ashwanikumar@mahaanfoods.com

Abstract

Three types of dry *Kulfi* (frozen dessert) blends were prepared from partially de-oiled groundnut meal (PDGM), stabilizers and salts (B₁); PDGM, whole milk powder, stabilizers and salts (B₂); and PDGM, skim milk powder, stabilizers and salts (B₃). The kulifs, designated as K₁, K₂ and K₃, made from B₁; B₂ and B₃, respectively were compared with the control kulif (Kc) for their average chemical composition, physico-chemical properties and microbiological quality. Comparative appraisal of the sensory scores showed significantly higher scores of Kc than K₁, K₂ and K₃ for colour and appearance, flavour and overall acceptability but K₁ had the highest body and texture scores.

Keywords: Groundnut meal, Milk, *Kulfi*, Frozen dessert, Chemical composition, Physico-chemical properties, Microbiological quality, Sensory score.

IPC code; Int.cl.⁷ — A23G9/00, A23G9/02

Introduction

*Kulfi* is a popular Indian frozen dessert made from concentrated sweetened milk with or without added nuts and flavour and is known for its refreshingly cool and delightfully sweet characteristics. Manufacturing practices of kulfi reported in the literature are scanty (Warner, 1951; Itzerott, 1960; Rao & Ghodeker, 1978; Salooja, 1979; Ghodeker & Rao, 1982; Ashokraju et al., 1989). There is no significant improvement in the traditional method of kulfi making which is produced mainly by the unorganized sector. However, with certain dairies taking up the manufacture of kulfi (Ghodeker & Rao, 1982; Aneja, 1992), the scenario is likely to change.

The rising cost of dairy ingredients and nutritional awareness amongst the consumers regarding cholesterol and lactose levels necessitates modifications in the traditional dairy products. Solids from plant sources as cheaper and healthy ingredients have been tried as replacers. As a result non-dairy ice creams using groundnut protein isolates (Ramanna, 1975; Gabriel *et al.*, 1986) and soya proteins (Rothwell, 1976; Rajor & Gupta, 1982) have been developed. Rajor and Vani (1991) have made an attempt of preparing non-dairy kulfi using soya solids.

Keeping the above aspects in view, kulifs were prepared from admixtures of PDGM and milk solids from different sources and an easy to make product was developed wherein preconcentration of milk was eliminated.

Materials and Methods

Preparation of partially de-oiled groundnut meal: Whole groundnuts (*Arachis hypogaea* Linn. cv. 'ANDG-4') were procured in bulk from the Plant Breeding Department,
Gujarat Agricultural University, Anand Campus. Shells were manually separated from the kernels and PDGM was prepared as outlined in Flow sheet 1.

**Preparation of blends and kulfi**: Three types of dry kulfi blends were prepared from the ingredients as described below:
1. Blend-B, was an admixture of PDGM 50g, sugar 120g, gum acacia 2.25g, alginate \( S_1 \) (0.75g), arrowroot powder (1.0g), and salt mixture (0.60g).
2. Blend-B, contained PDGM 60g, whole milk powder 60g, sugar 100g and stabilizers and salts as in B,.
3. Blend-B, had the same ingredients as in B, except that the skimmed milk powder was used in place of whole milk powder.

**Flow sheet 1**: Preparation of PDGM from raw groundnut kernels

Whole milk powder (Amul), skimmed milk powder (Sagar), sugar and arrowroot powder (edible grade) was purchased from local market. Gum acacia (LR, SD Fine Chem. Ltd., Baroda) and alginate \( S_2 \) (S. Square & Co., Gwalior) were used as stabilizers. The salt mixture consisted of sodium chloride, citric acid and sodium phosphate dibasic in the ratio of 10:1:1 (w/w).

Kulfi (K, K, and K,) from the dry blends were prepared according to the Flow sheet 2. Standardized buffalo milk (5% fat) was pasteurized at 80°C with no holding and cooled to room temperature before reconstitution of blend B,. Control kulfi was prepared from buffalo milk according to Flow sheet 3.

**Chemical analysis of the kulfi mixes**: Freshly prepared kulfi mixes were analyzed for their total solids and protein content by the AOAC (1970) method and for fat, sucrose and ash content by ISI (1964) method.

**Physico-chemical properties of the kulfi mixes**: Acidity of mixes was determined by ISI (1964) method. The viscosity of the mixes was determined at 20°C using Hoppler’s falling ball viscometer (type BH,), with ball no. 3. Melt down time of kulfi samples was the time taken for complete melting at
30 ± 1°C of 35g of sample placed on a glass plate resting on a funnel.

Microbiological analysis of different types of kulfi: All the kulfi samples were analyzed for standard plate count (SPC), coliform count and yeast and mould count by the ISI (1964) method.

Sensory evaluation of different types of kulfi: The sensory attributes of the freshly prepared kulfi samples were judged by a panel of 5 judges and evaluated on a 9-point hedonic scale (Nelson & Trout, 1964).

Statistical design: The data obtained from five replicates were analyzed by completely randomized design (Steel & Torrie, 1980).

Results and Discussion

Chemical composition of kulfi mixes: The average chemical compositions of the four types of kulfi mixes are presented in Table 1. The total solids showed an increasing order as Kc<K1<K2<K3, all of which differed significantly (P<0.05), except the difference between K2 and K3. The protein content in the samples was in the order as K2<K3<Kc<K1 and statistical analysis of data indicated significant difference between Kc and K1 and 20% level in each K2 and K3 samples. The level of fat in kulfi mixes was in the increasing order Kc<K1<K2<K3, all of which differed significantly (P<0.05); lactose content in the kulfi mixes was in the increasing order of samples Kc<K1<K2<K3 in which Kc had significantly (P<0.05) higher lactose than the other kulfi mixes; sucrose content in the mixes was in the increasing order of samples K2<K1<Kc<K3, the differences being non-significant between Kc and K1 and between K2 and K3. The ash content was in the increasing order of samples as Kc<K1<K2<K3, but statistically K1 and K2 differed significantly (P<0.05) from each other.

From these results it can be seen that the total solids of Kc, K1 and K2 varied within a narrow range as the wet mixes were prepared to a fixed level of total solids concentration (~ 45 %). The higher total solids levels in groundnut kulfi samples as compared to Kc can be attributed to moisture losses during steaming in pressure cooker and subsequent cooling to room temperature. The protein content of K1, K2 and K3 showed an increase with increasing total solids level, but Kc showed the highest protein content, though its total solids was lower than K1, K2 and K3. The differences in fat content could be due to the differences in levels of fat in the milk solids used. Kc lacks in lactose, its use as an ingredient to partly replace milk solids lowered the lactose content in K1, K2 and K3 than in Kc. The differences in sucrose content in the different types of mix is due to the different rates of addition of sucrose in the mixes, that is, 24% level in each Kc and K1 and 20% level in each K2 and K3. However, the estimated sucrose content was lower as compared to the actual additions probably due to protein-carbohydrate interactions during mix processing. The variations in the ash content of the different samples depend upon the ash content of the raw materials used and their relative proportion in the mix. The PDGM prepared has 3.45% ash on an average while the average ash content of whole milk powder and skim milk powder are 5.9 and 8.0%, respectively (Hall & Hedrick, 1971).

Physico-chemical properties of kulfi: The average value of acidity, viscosity and melt down times of the kulfs are given in Table 2. The value of lactic acid in the kulfs were in the increasing order Kc<K1<K2<K3. The control had significantly higher acidity than the test samples due to an increase in the levels of citrates, phosphates, lactates and protein as a result of open-pan heat desiccation of milk. Ashokraju et al (1989) have also observed a decrease in pH of kulfi mixes with increasing concentration of milk. On the other hand, non-significant variations in the acidity values of test samples could be due to the source of milk solids used.

The mean values of total solids and the viscosities (cP, 20 C) of kulfi mixes showed a parallel trend, and were in the increasing order Kc<K1<K2<K3, indicating profound effect of total solids on viscosity of mix. Replacement of milk solids with PDGM may also have contributed to the significant increase in the viscosities of test samples compared to the control. Gabriel et al (1986) have also observed an increase in the viscosity of ice cream mix due to groundnut protein addition. Further addition of stabilizers (alginate, gum acacia, arrowroot starch) and salt mixture due to the test samples may also have contributed to viscosity increase over the control. Ashokraju et al (1989) have also reported an increase in viscosity on addition of alginates and starch to kulfi mixes. The type of milk solids in the mixes also influenced the viscosity and were in the decreasing order of viscosity, skim milk powder > whole milk powder > standardized buffalo milk.
Melt down times (minutes) of kulfis were in the increasing order, \( K_c < K_1 < K_2 = K_3 \). The lowest value of melt down in the control is due to the fact that it is made from standardized buffalo milk and without added stabilizers and salt mixture. The differences between the control and test samples were significant and attributed partly to the addition of stabilizers and salt mixture to the test samples. Improvements in the melting resistance on addition of sodium alginate have also been reported in kulfi and ice cream (Ashokraju et al., 1989; Glickman, 1983). Dried milk powders showed greater increase in the melt down time than standardized buffalo milk. The total soluble constituents (lactose, sucrose and ash) may also have influenced melting resistance of kulfis. An increase in the amount of total soluble constituents depresses the freezing point of milk (Jenness & Patton, 1969), therefore, it is inferred that kulfi having higher soluble constituents would show faster melting than those containing lower soluble constituents.

**Microbiological quality of kulfi:** The average SPC, coliform count and yeast and mould count of the kulfi samples is given in Table 3. The low SPC indicates that additives and water may have provided survivor types of contaminants while majority of the general types of organisms may not have survived the

**Flow sheet 2: Flow sheet for preparation of Kulfi from different types of dry blends**

*Blend-1: PDGM (50 g), Sugar (120 g), Stabilizer mixture (4 g) and Salt mixture (0.6 g).*

*Blend-2: PDGM (60 g), Sugar (100 g), Whole milk powder (60 g), Stabilizer mixture (4 g) and Salt mixture (0.6 g).*

*Blend-3: PDGM (60 g), Sugar (100 g), Skimmed milk powder (60 g), Stabilizer mixture (4 g), and Salt mixture (0.6 g).*
rigorous heat processing of the wet mixes. Similarly, the coliform contamination also appears to have been arrested. The high yeast and mould counts are indicative of post-processing or aerial contamination of the products.

**Sensory qualities of kulfis:** Results of the sensory scores on a 9-point hedonic scale are presented in Table 4. The mean scores of kulfis samples for colour and appearance were in the decreasing order of Kc>K1>K2>K3. The source of milk solids and the subtle changes in proteins during heating are the factors affecting the colour and appearance of the product. The significantly higher score of Kc was due to more uniform light brown colour and homogeneous appearance than the others as the proteins were wholly milk proteins in the former. Whey protein denaturation, casein-whey protein and lactose-protein interactions during slow heat desiccation are responsible for the higher score of Kc. Partial substitution of milk proteins with PDGM lowered the sensory score in K1 compared to Kc. Again the source of milk proteins in the form of milk powder further lowered the sensory scores in K2 and K3 due to the differences in the extent of denaturation and their interaction with plant proteins.

The flavour scores of the kulfis samples showed a slightly different trend and were in the decreasing order of Kc>K1>K2>K3. The control sample had significantly higher average score than the test samples. Obviously the higher levels of lactose and sucrose, the open-pan heat desiccation and the presence of milk fat as the only kind of fat in Kc have attributed to the high flavour score. It is known fact that milk fat plays an important role in the flavour of ice cream (Arbuckle, 1977). On the other hand the presence of groundnut oil in free state could have caused a lower score of the test samples.

However, the mean scores of body and texture of the different kulfis samples indicate that K1 scored the highest followed by K3, Kc and K2. The significantly (P<0.05) higher scores for K1 over Kc could be due to the presence of a combination of stabilizers and salt mixture in K1. Ashokraju et al (1989) found that use of stabilizers imparted better body and textural properties to kulfis. The salt might have stabilized the proteins by changing the ionic strength of the medium thereby...
preventing dehydration and precipitation of the colloidal system. Use of buffered salts and double salts have been suggested to improve the body and texture of ice cream (Arbuckle, 1977; Anonymous, 1991a, b). These could also be the reasons for K3 scoring over Kc. However, K2 scored lower than Kc, which could be due to differences in the state of fat in the dried milk and fluid milk.

The overall acceptability of Kc over the test samples is evident as it had the highest flavour and colour and appearance scores. Similarly, among the test samples K1 had better acceptability due to its higher scores for body and texture and colour and appearance. Thus, it is clear that the kulfi prepared from fluid milk was more acceptable than those prepared from dried milks. The differences in the state of milk proteins and fat in liquid milk and dried milks could be mainly responsible for better overall acceptability of Kc and K1 than K2 and K3.

### Conclusion

From the findings of this study it can be concluded that addition of PDGM reduces fat content of the kulfi and is likely to ward off health hazards such as obesity, atherosclerosis and heart failure common in the affluent society. PDGM addition as such also increases the viscosity and improves the melt down characteristic of kulfi in addition to a source of desirable unsaturated fatty acids. These studies indicated that an acceptable quality of kulfi could be prepared by replacing up to 50% of milk solids with groundnut solids. Of the three test samples K1 was the most acceptable followed by K3 and K2.

### Table 3 : Microbiological quality (c.f.u./g) of fresh kulfi samples

| Count* (c.f.u./g) | Type of Kulfi |
|------------------|--|------------------|
|                  | Kc | K1 | K2 | K3 |
| SPC**            | 1297 | 4408 | 2426 | 3059 |
| Coliform         | 3 | 5 | 3 | 3 |
| Yeast & Mould*** | 14 | 13 | 29 | 33 |

* Mean value of 5 replicates  
** Retransformed log (x) means  
*** Retransformed x+1 means

### Table 4 : Average* Sensory scores** of different types of fresh kulfi

| Parameter          | Type of Kulfi |
|--------------------|--|------------------|
|                    | Kc | K1 | K2 | K3 |
| Colour & Appearance | 7.9 | 7.3 | 7.0 | 7.1 |
| Flavour            | 8.3 | 6.6 | 6.0 | 6.8 |
| Body & Texture     | 6.7 | 6.9 | 6.6 | 6.8 |
| Overall acceptability | 7.7 | 7.0 | 6.5 | 6.8 |

* Mean value of 5 replicates  
** Maximum score 9

### Acknowledgement

Authors express their sincere thanks to Dr. R.S. Sharma, Principal, Seth M.C. College of Dairy Science, GAU, Anand Campus for providing necessary facilities for the above research project.

### References

4. AOAC, Methods of analysis of the association of official agricultural chemists. Association of official...
Low-dose irradiation as a measure to improve microbial quality of ice cream

The scientists at Food Technology Division, Bhabha Atomic Research Centre, Mumbai and Foods & Fermentation Technology Division, University Department of Chemical Technology, University of Bombay, Matunga, Mumbai investigated the efficacy of low-dose irradiation to improve the microbial safety of ice cream. Initially three different flavours (Vanilla, Strawberry and Chocolate) of ice cream were exposed, at −72°C, to doses of 1, 2, 5, 10 and 30 kGy to γ-radiation. Irradiation at 1 kGy resulted in reduction of microbial population by one log cycle, thus meeting the requirement limits prescribed by Bureau of Indian Standards. Pathogens such as *Listeria monocytogenes* 036, *Yersinia enterocolitica* 5692 and *Escherichia coli* O157:H19, respectively, showed the $D_{10}$ values 0.38, 0.15 and 0.2 kGy in ice cream at −72°C suggesting the efficacy of low doses (1 kGy) in eliminating them. Sensory evaluation studies of ice cream irradiated at 1, 2, 3 and 5 kGy by a 15 member panel demonstrated that doses higher than 2 kGy irradiation induced off-odour and an aftertaste was evident in Vanilla ice cream. A radiation dose of 1 kGy was sufficient to eliminate the natural number of pathogens present in the ice cream. No statistically significant differences were observed in the sensory attributes of all the three flavours of ice cream either unirradiated or exposed to 1 kGy (P<0.05) [Kamat et al, *Int J Food Microbiol*, 2000, 62(1-2), 27-35].