

Development of Fibre Enriched Kulfi

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ABSTRACT: The present study aims to develop the fibre enriched kulfi with inulin. Frozen dessert (kulfi) was prepared from milk, sugar, khoa and inulin at the levels of (2 per cent, 4 per cent and 6 per cent). The inclusion level of inulin was standardized based on sensory evaluation. The developed fibre enriched kulfi was analyzed for physico-chemical properties and proximate composition such as moisture, fat, carbohydrates, protein, fibre and ash. Sensory evaluation revealed that sample T₂ contain 4 per cent inulin sample was superior among all the samples. From the present investigation, it was concluded that frozen dessert (kulfi) prepared with inulin at the level of 4% having good sensory quality attributes and nutritional quality.

Keywords: Kulfi, Fibre, Inulin, Fibre enriched kulfi, Organoleptic qualities, Proximate composition.

INTRODUCTION

Milk is a complete food, which is rich in all essential nutrients such as fat, protein, vitamins and minerals. It is directly consumed as liquid milk or converted into many dairy products like khoa, ice cream, kulfi, paneer, cheese, ghee, butter and fermented dairy products such as curd and yoghurt etc., Kulfi, often referred to as malai Kulfi, is a native frozen dairy product with a consistency that is quite similar to ice cream. Kulfi is traditionally made by slowly heating sweetened and flavoured milk while stirring quite constantly to prevent the milk from adhering to the bottom of the vessels until the volume is decreased by half, concentrating the milk. Customers prefer kulfi because it is a relatively inexpensive, delectable, and healthy frozen dairy delicacy. In comparison to ice cream, it is widely accepted and its demand is rising daily. Kulfi contains no air; ice cream is either overrun or whipped with air. It comes in a variety of flavours, including apple, orange, strawberry, and peanut in addition to the more classic strawberry, rose, mango, saffron (Keshar), and pistachio. It is a common frozen treat sold in various regions of our country, particularly during the summer, by tiny milk vendors, halwais, sweet manufacturers, etc. So the Kulfi can be considered the poor man's ice cream (Ubale *et al.*, 2014). About 0.7% of the total milk in India is used to make kulfi, ice cream, and other frozen desserts. India has a per capita consumption of

these frozen desserts of roughly 300 ml/year, which is significantly less than the global average of 2.3 l/year, with the USA having the highest amount at 22 l/year (Naik and Londhe 2011). Halder *et al.* (2018) suggested that the concentration of milk was reduced to half of its original volume or in the ratio of 2:1. Concentrated milk is cooled, sugar is added and the blend is thoroughly stirred. In some cases, small quantity of khoa or non-fat dried milk is added during boiling of milk. Milk or the majority of milk products are deficient in dietary fibre. The successful creation of several dietary fibre fortified dairy products was facilitated by consumers' increasing awareness of the physiological advantages of dietary fibre and the easy accessibility to commercial dietary fibre preparations (Raju and Pal 2014).

Higher intakes of dietary fibre are also associated with lower body weights and a decreased risk of conditions including cardiovascular disease, diabetes, obesity, intestinal cancer and constipation, all of which have major negative impacts on human health. Therefore, a high-fibre diet improvement that is taken in the necessary amounts will aid in keeping excellent health (Divyashree *et al.*, 2017).

Processing, preservation, and value addition are becoming more popular in Indian food processing. Value addition includes the process of creating premium goods by fortifying and enriching them with useful components. Hence, the need for fibre enriched

kulfi with the required functional properties has been developed. The proportion of the various bacterial groups in the human colon has reportedly changed as a result of inulin consumption. It has been demonstrated that adding prebiotics (fructooligosaccharides) to diets increased the proportion of bifidobacteria by 3.67 times and decreased the proportion of harmful bacteria (bacteroides, clostridia, and frusobacteria) by 5–10 times (Teferra, 2021). Chicory roots are the most abundant source of inulin and have the GRAS (Generally Regarded As Safe) classification in the USA. Inulin is widely distributed in 36,000 species of plants. Due to its advantageous effects on gastric health, inulin is utilised as a prebiotic, fat replacer, sugar replacer, texture adjuster and for the development of functional meals in order to promote health (Shoaib *et al.*, 2016). New dairy products with therapeutic and nutritional value have been developed in recent years as a result of increased health consciousness. With this in perspective, adding inulin to Indian kulfi, the most popular frozen dairy product in India, could boost the product's appeal, value addition, and therapeutic benefits.

MATERIALS AND METHODS

The present investigation was carried out in Department of Food Safety and Quality Assurance in College of Food and Dairy Technology, TANUVAS, Chennai-52.

Materials. The raw materials such as milk and sugar were purchased from local market at Thiruvallur. Stabilizer (Sodium alginate), Inulin (Brand Urban platter, Istore Direct Trading Pvt. Ltd, Mumbai) food grade was used in the preparation of the fibre enriched kulfi.

Chemicals and glassware. The chemicals of analytical grade and glass wares required during investigation were used in the department of food safety and quality assurance.

Methods. The kulfi was prepared with varying the proportion of inulin. The formulation was presented in Table 1. Flow chart for the preparation of kulfi incorporated with inulin was shown in Fig. 1. The proportion of milk, khoa and sugar in each sample was kept constant.

Table 1: Formulation of kulfi with addition of inulin.

Sample	Milk (ml)	Khoa (gm)	Sugar (%)	Stabilizer (%)	Inulin (%)
T ₀	1000	10	13%	0.5	0
T ₁	1000	10	13%	0.5	2
T ₂	1000	10	13%	0.5	4
T ₃	1000	10	13%	0.5	6

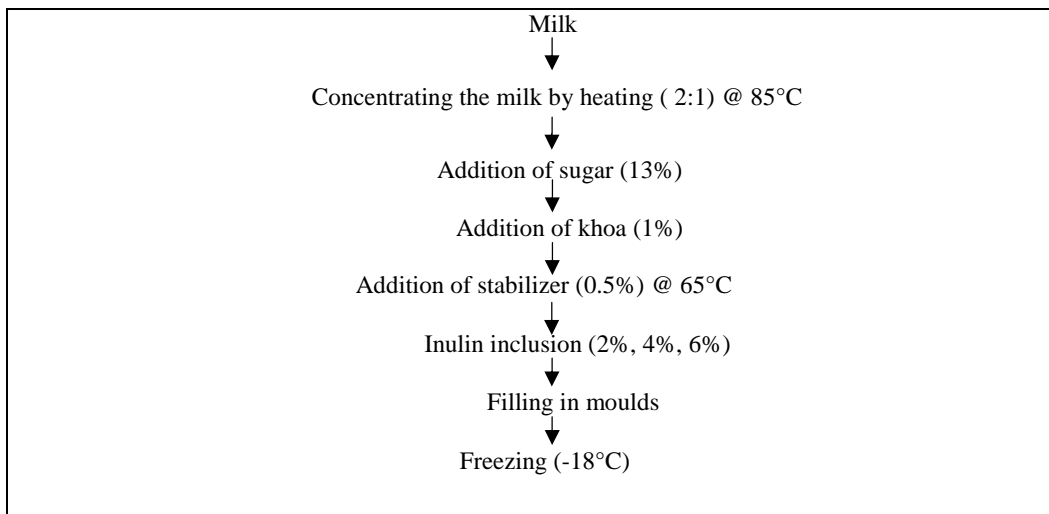


Fig. 1. Preparation of frozen dessert (kulfi) incorporated with inulin (Nalkar, 2012).

Production of inulin kulfi. Milk was condensed in open pan up to half of its original volume. As given in Table 1, the ingredients Milk, Inulin (2%, 4%, 6%), khoa, sugar and stabilizer (0.2%) were added at 65 °C and mixed thoroughly. The mix was cooled at room temperature then filled in moulds and hardened at -18 °C. Then the inclusion level of inulin was standardized based on sensory evaluation. The developed fibre enriched kulfi were subjected to proximate and physico-chemical analysis.

Proximate analysis. All samples were analyzed for moisture, protein, fat, total ash and total carbohydrate

according to their respective standard methods as described in (A.O.A.C., 2000) and Total dietary fiber content was analyzed by using the method of IS-11062 (1984).

Physico-chemical analysis. The pH was determined using a pH meter (AOAC, 2005). Titratable acidity of kulfi was determined according to the method described in IS: 1166-1973.

Sensory evaluation of frozen dessert (Kulfi). The sensory evaluation was carried out to assess the overall acceptability of the frozen dessert (kulfi) incorporated with inulin. The quality attributes (colour, flavour, taste

and texture) of prepared frozen dessert (kulfi) were evaluated against the control samples by 15 members using a Nine-point Hedonic Scale. The Score card for sensory evaluation is made as per (IS: 6273 (Part –II), 1971).

Statistical analysis. The data generated from the present study was subjected to analysis of variance (ANOVA) as per the guidelines of Snedecor and Cochran (1989) using Statistical Analytical System (SPSS version 16.0).

RESULTS AND DISCUSSION

Effect of inulin level on sensory attributes of kulfi.

The average sensory scores for inulin incorporated kulfi were presented in Table 2, which revealed that the incorporation of three different levels of inulin in the kulfi significantly altered the overall sensory scores compared to the control kulfi. The average values of color and appearance, mouthfeel, body and texture,

flavor, and overall acceptability of inulin incorporated kulfi higher than the control. The neutral flavor of the inulin offers no aftertaste (Valluru and Van den Ende 2008).

Technical and dietetic benefits of inulin make it a good choice to be used as an essential ingredient in diet and mostly it is used to offer dual benefits: a better organoleptic character and a sound nutritional make-up (Roberfroid, 2007). Among the samples, T₂ had the highest scores for overall acceptability and hence, it was taken for the further studies. They developed the technology to standardize the process for preparation of frozen dessert (kulfi) incorporated with fibre at the level of (3%, 5% and 7%). Frozen dessert (kulfi) prepared with 5% partially hydrolyzed guar gum achieved highest score for overall acceptability and good textural property when compare to control sample.

Table 2: Effect of inulin level on sensory attributes of kulfi.

Sr. No.	Treatments	Control	T ₁	T ₂	T ₃	F value
1.	Colour and appearance	8.67±0.126 ^c	8.40±0.131 ^b	8.87±0.091 ^c	7.80±0.223 ^a	9.464**
2.	Mouthfeel	8.33±0.211 ^b	8.00±0.169 ^a	8.73±0.118 ^b	7.87±0.215 ^a	4.489**
3.	Flavor	8.00±0.169 ^c	7.33±0.159 ^b	8.67±0.126 ^d	6.73±0.118 ^a	33.285**
4.	Body and texture	8.27±0.153 ^c	6.80±0.107 ^b	8.53±0.192 ^c	5.80±0.145 ^a	71.135**
5.	Overall acceptability	8.33±0.211 ^c	7.20±0.145 ^b	8.73±0.118 ^c	5.93±0.067 ^a	75.568**

@- Average of fifteen trials (Different superscripts in a same row differs significantly; same superscripts in row does not differ significantly)

** highly significant difference (p 0.01)

Control – Plain kulfi

T₁, T₂ and T₃ – Kulfi with 2, 4 and 6 percent of inulin concentration respectively

Proximate analysis of optimized inulin kulfi. In this study, the proximate composition such as moisture, fat, protein, carbohydrate and total solids, energy, fibre and ash were estimated for control and fibre enriched functional kulfi, presented in Table 3. The average values of proximate composition such as moisture, fat, protein, carbohydrate and total solids, energy, fibre, and ash of fibre enriched kulfi with inulin was 56.51, 10.12, 3.91, 28.346, 43.49, 220.104, 3.92, 1.113 and the corresponding values for control 60.55, 10.68, 3.58, 24.052, 39.44, 206.640 and 0, 1.129 respectively.

Statistical analysis showed that a highly significant (p 0.01) difference was observed between the control and treatments. Similar effect was reported by Giri *et al.* (2014).

They observed that in inulin incorporated processed cheese spread, due to inulin addition as compared to the control sample, moisture, fat proportionately reduced with increased levels of inulin. Reduction in moisture content might be due to the water binding capacity of inulin. As a result of decreased moisture, the total solid content of kulfi increased.

Table 3: Proximate composition of optimized Inulin kulfi.

Treatment	Control	T ₁	T Value
Moisture	60.55±0.211	56.51±0.023	46.568**
Fat	10.68±0.223	10.12±0.023	6.067**
Protein	3.58±0.238	3.91±0.021	-3.323**
Carbohydrate	24.052 ±0.529	28.346±0.035	-19.807**
Total solids	39.44±0.211	43.49±0.023	-46.568**
Energy	206.640 ±0.946	220.104±0.151	-24.491**
Fibre	0±0.000	3.92±0.023	-405.759**
Ash	1.129±0.002	1.113±0.001	10.480**

@ average six trials (Different superscripts in a same row differs significantly; same superscripts in row does not differ significantly)

** highly significant difference (p 0.01)

Control – Plain kulfi

T₁ – Fibre enriched kulfi with 4 percent inulin respectively

Inulin incorporated kulfi found to be having decreased amount of fat compared to the control. It is mainly because of proportionate increase in total solids. Similar findings was observed by Alaei *et al.* (2018). They discovered that increasing the levels of inulin in chicken sausage reduced the fat content (p 0.05). It was mainly because of inulin can be easily used as a fat substitute due to its gel-forming ability with water present in food.

The protein content of fibre enriched functional kulfi was observed higher than the control kulfi. Moreover, in the study conducted by Menegas *et al.* (2013), the increased level of inulin enhanced the protein content of the sausage samples. In this sense, it was consistent with our findings.

The fibre percentage of developed kulfi was observed higher than control. It is mainly because of incorporation of inulin. Similar effect was observed by Giri *et al.* (2014). They studied that the effect of textural and melting properties of the processed cheese spread have been studied at different levels (0, 4, 6 and 8 %) of inulin addition and they found that the fibre percentage of processed cheese spread increased as the

levels of incorporation of inulin increased ranged from 0.0% to 6.4%.

Physico-chemical analysis of optimized inulin kulfi. In the Table 4, the results of physico-chemical characteristics of control and fibre enriched kulfi *viz.* pH, titratable acidity are presented. The mean values of pH, acidity of the control were 6.72, 0.17 and the corresponding average values of fibre enriched kulfi with inulin were 6.69, 0.18. Statistical analysis revealed that there was a no significant (p>0.5) difference observed in the pH and acidity of control and fibre enriched kulfi respectively.

Because addition of inulin has no significant effect on pH. Similar effect was observed by Guggisbert *et al.* (2009), who reported no significant differences in pH values by the addition of inulin in yoghurts and Guven *et al.* (2005) studied the impact of various inulin concentrations on the production of high-quality fat-free yoghurt. Inulin doses of 1, 2, and 3% were added to milk that already contained 0.1% milk fat. The pH readings were not significantly impacted by using inulin as a fat substitute (P > 0.05).

Table 4: Physico-chemical characteristics of optimized inulin kulfi.

Treatment	Control	T ₁	T Value
pH	6.72±0.023	6.69±0.023	2.096 ^{NS}
Titratable acidity	0.17±.021	0.18±0.003	-1.218 ^{NS}

@ average six trials (Different superscripts in a same row differs significantly; same superscripts in row does not differ significantly)

NS- non significant (p > 0.05)

Control – Plain kulfi

T₁ – Fibre enriched kulfi with 4% percent inulin respectively

CONCLUSION

Since inulin has been made available as an ingredient for use in the food business, it has been employed in a wide range of food products for both its technological and nutritional advantages, incorporation of these into frozen dessert (kulfi) will add health benefits. As consumption of kulfi is becoming popular worldwide, this kind of kulfi will supply essential nutrition as well as health benefits. Fibre content of developed fibre enriched kulfi were significantly higher than control kulfi.

FUTURE SCOPE

Inulin has a variety of intriguing health advantages that are helpful in creating foods for the present and the future. Inulin can be incorporated into a variety of items, notably popular dairy products, to provide consumers with a quick answer in today's fast-paced world. The use of inulin has a lot of potential still, and additional research and study on the subject may be fruitful.

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Conflict of Interest. None.

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