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Shiv B Singh
M.Tech (DT) Scholar WCDT, SHUATS Allahabad, India

Anamika Das
Assistant Professor WCDT, SHUATS Allahabad, India

Prafull Kumar
M.Tech (DT) Scholar WCDT, SHUATS Allahabad, India

Correspondence
Shiv B Singh
M.Tech (DT) Scholar WCDT, SHUATS Allahabad, India

Effect of incorporation of wood apple pulp on physico-chemical, sensory and microbiological properties of Kulfi

Shiv B Singh, Anamika Das and Prafull Kumar

Abstract
The present investigation was carried out to develop a wood apple pulp supplemented kulfi by addition of different levels of wood apple pulp, and thereafter evaluate the effect of addition of wood apple pulp on nutritional quality of kulfi. In treatment T_3, T_2 and T_1 wood apple pulp was added @ 15 %, 10% and 5 % respectively. In the kulfi samples of different treatments and control, the physic-chemical analysis as well as organoleptic characteristic were assessed. The highest values for organoleptic parameters was observed in case of treatment T_3 and therefore kulfi prepared in this treatment was carried as the optimised product. The pH and titratable acidity of kulfi samples of T_3 treatment was found to be 6.11 and 0.19 respectively. Total solid, fat, protein, carbohydrate and ash of kulfi samples of T3 treatment was found to be 33.41, 6.31, 5.18, 21.12 and 0.97 per cent respectively.

Keywords: Wood apple pulp, Standardized milk, kulfi, physico-chemical properties, organoleptic evaluation.

Introduction
Kulfi is a frozen dairy product made by suitable blending and processing of SMP and other milk products, together with sugar and flavour, with or without stabilizer or colour A typical compositional range for the components used in kulfi mix is milk fat 10-16%, milk solids not fat 9-12%, sucrose 9-12%, corn syrup solids 4-6%, stabilizers/ emulsifiers 0-0.5%, total solids 36-45%, and water 55-64%. Kulfi was prepared regularly for the grandest of all mughals to bring relief during the scorching summer. Kulfi also known as Malai kulfi /Malai-ka-burf is an indigenous frozen dairy product, which closely resembles ice cream in composition. Traditionally Kulfi is prepared by evaporating sweetened and flavoured milk by slow heating with almost continuous stirring to keep milk from sticking to the bottom of the vessel until its volume is reduced by a half thus concentrating the milk. It has a distinctive taste due to caramelization of lactose and sugar during the lengthy heating process. Ice cream is whipped with air or overrun, kulfi contains no air. It comes in various flavours, including strawberry, rose, mango, cardamom, saffron (kesar or saffron), and pistachio, the more traditional flavours, as well as supplemented with fruit pulp like apple, orange, strawberry, peanut, and avocado. *Aegle marmelos* has been used as a herbal medicine for the management of diabetes mellitus in Ayurvedic, Unani and Siddha systems of medicine in India, Bangladesh and Sri Lanka. The unripe dried fruit is stringy, heals stomach ache and is used to cure diarrhea and dysentery. Sweet drinks prepared from the pulp of bael produces a soothing effect on the patients who have just recovered from bacillary dysentery. Physico-chemical analysis of bael fruit indicates that it is rich in carbohydrates, fibers, protein, vitamins and minerals (Ramulu and Rao, 2003 [1] Parichha, 2004 [2], Rathore, 2009 [3], Purohit & Vyas, 2005 [4], Parmar & Kaushal, 1982(5), Roy & Khurdiya, 1995 [6], Shankar and Garg, 1967 [7], Sharma *et al*., 2007) [8]. Kamalakkannan and Prince (2003) [9] have reported that the aqueous extract of the bael fruit pulp exerts antioxidant property and daily oral administration of the aqueous extract of bael fruit (125 and 250 mg/kg) twice to diabetic rats for a period of 30 days decreased the levels of fasting blood glucose and glycosylated hemoglobin levels. Bael fruit pulp is rich in carotenoids, phenolics, alkaloids, pectins, tannins, coumarins, flavonoids, terpenoids, coumarins like aegeline, aegelenine, marmelin, o-mtheyl halfordinol, alloimperatorin, furocoumarins, psoralen, o-isopentenyl halfordinol, marmelosin, linoleic acid, tannins, phlobatannins, flavon-3-ols, leucoanthocyanins, anthocyanins, and flavonoid glycosides (Parmar and Kaushal, 1982 [5], Roy and Khurdiya, 1995 [6], Suvimol and Pranee, 2008 [10], Maity *et al*., 2009 [11], Rastogi and Mehrotra, 1990 [12]. In India, bael sherbet is prepared from the ripe fruit of bael by scooping the soft pulp, deseeding it and then blending it with milk, sugar and cardamom and is

consumed as drink. The semi ripe fruits has been used for making jam, marmalade, murabba and may even be used as an ingredient for preparing cakes (Parmar and Kaushal, 1982, Roy and Khurdiya, 1995) [5, 6].

The present investigation involves manufacturing of wood apple pulp supplemented kulfi with different levels of Wood Apple pulp and thereafter assess the sensory, physico chemical properties of developed Kulfi.

Materials and Methods

Preparation of kulfi samples

Kulfi samples were prepared as per the method of Giri *et al*., 2012 [13] with some modifications. For preparation of control kulfi samples milk was standardized to 4.5% fat and 35% TS. It was taken in a double jacketed vat and condensed to half of the initial amount. Wood apple pulp was prepared by removing the shell, seeds and fibre from the fruit and mashing the 100 gm pulp along with addition of 200 ml of water. It was filtered through strainer and then subjected to heat treatment at 68 ^{0}C for 10 min. It was cooled to 40^{o}C and then calculated quantity of the pulp was added to prepare kulfi samples of treatment T3, T2 and T1. For treatment T3, T2 and T1 wood apple pulp was added @ 15 %, 10% and 5 % of concentrated milk. Also 14% sugar was added after condensing. The mix was cooled to 5 ^{o}C and was frozen in moulds at -20 ^{o}C for overnight.

Physico chemical, organoleptic and sensory evaluation

Titratable acidity of kulfi was determined according to the method as described in IS: 1166-1973 [14]. pH was estimated by pH meter. Total solids was determined by gravimetrically as per the procedure for milk laid down in IS 2802, 1964 [15]. The fat percentage of kulfi was determined as per procedure laid down in IS: 1166-1973 [14]. Determination of protein was done as per the procedure suggested by Maneffee and Overman (1940) [16]. Determination of carbohydrate was done according to SP: 18, Part XI, 1981[17]. Determination of ash content was done as per the procedure laid down in IS: 5962, 1970 [18]. Antioxidant properties was determinrd by DPPH method. Melting resistance was determined by (Giri *et al.*, 2012) [13].

Kulfi was subjected to organoleptic evaluation to trained panelists who evaluated the product for colour & appearance, body & texture, flavor and taste, melting resistance and overall acceptability using 9 point hedonic scale as described by (Amerine *et al*., 1965) [19].

Kulfi was analyzed for different microbial parameters such as standard plate count, yeast and mould count and coliform count by adopting standard procedure as per manual of Dairy Bacteriology ICAR (1972) [20].

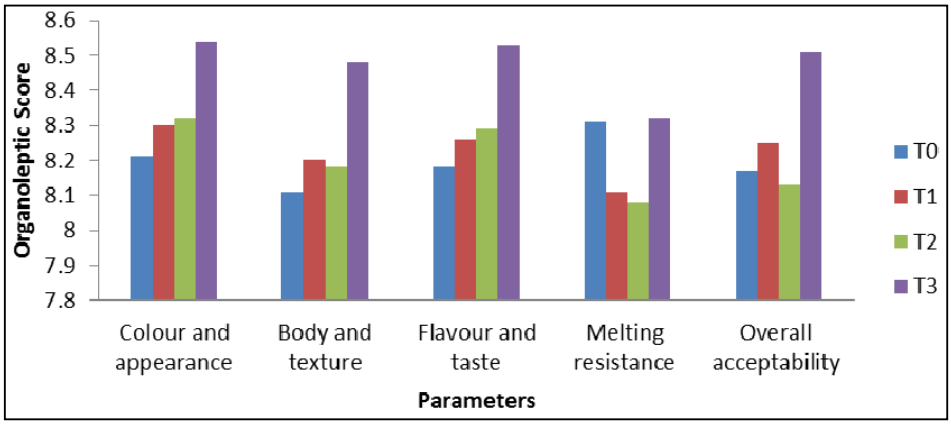
Statistical analysis

The data obtained were statistically analyzed for ANOVA using MS Excel software, 2007.

Results and Discussion

Effect of addition of wood apple pulp on organoleptic score of Kulfi samples.

The kulfi samples were subjected to organoleptic evaluation before a panel of trained judges using a 9 point hedonic scale. The samples were evaluated for colour & appearance, body & texture, flavor and taste, melting resistance and overall acceptability. The organoleptic scores are presented graphically in Fig 1. From the figure, it can be observed that treatment T_3 scored significantly higher values for colour & appearance, body & texture, flavour and taste, melting resistance and overall acceptability as compared to other treatments including control. Therefore kulfi samples of T_3 treatment was taken as the optimized product.



Effect of addition of wood apple pulp on physico chemical, microbiological quality of Kulfi samples.

The kulfi samples were evaluated for pH by melting them and collecting 50 ml of the melt which was then placed beneath the electrode to assess the pH reading. The pH of T0, T1, T2 and T3 was found to be 6.22, 6.15, 6.12 and 6.11 respectively. The titratable acidity of kulfi samples of different treatments were analyzed and it was found that kulfi samples of T0 treatment was found to be 0.19 % lactic acid. Kulfi samples of T1, T2 and T3 tratments exhibited a titratable acidity of 0.20%, 0.21% and 0.22% lactic acid respectively. There was significant differences (P>0.05) between the titratable acidity values of different treatments. The melting resistance for kulfi samples of T0, T1, T2 and T3 treatments was found to be 16.60, 19.20, 21.600 and 24.00 minutes respectively. The melting resistance increased significantly with the increased quantity of wood apple pulp. The increase in melting resistance values may be due to the presence of soluble dietary fiber or carbohydrate which forms a complex metrix which binds and holds the water resulting in slow melting.

The total solid percentage of different treatments decreased significantly with increase in the level of wood apple pulp which may be due to higher water content in the wood apple pulp-water mixture. The total solid of T0, T1, T2 and T3 was found to be 34.66%, 34.29%, 33.74% and 33.41% respectively. The fat percentage of kulfi samples of different treatments viz., T0, T1, T2 and T3 was found to be 7.34%, 7.09%, 6.40% and 6.13% respectively. It can be seen that

with the increase in addition of wood apple pulp, the fat percentage in different treatment decreased which can be attributed to the fact that the wood apple pulp contributed minimal quantity of fat to the kulfi mix. The protein percentage of kulfi samples of different treatments viz., T0, T1, T2 and T3 was found to be 6.02%, 5.75%, 5.45% and 5.18% respectively. It can be seen that with the increase in addition of wood apple pulp, the protein percentage in different treatment decreased which can be attributed to the fact that the wood apple pulp contributed minimal quantity of protein to the kulfi mix. The carbohydrate percentage for kulfi samples of T0, T1, T2 and T3 treatments was found to be 20.17%, 20.38%, 20.78% and 21.12% respectively. The carbohydrate percentage increased significantly with the increased quantity of wood apple pulp. The ash percentage for kulfi samples of T0, T1, T2 and T3 treatments was found to be 1.12%, 1.04%, 1.00% and 0.97% respectively. The ash percentage increased significantly with the increased addition of wood apple pulp. Paricha, 2004 [2] reported that bael fruit is rich in water, carbohydrates, fibers and minerals. The antioxidant value (expressed as mg gallic acid equivalent per 100ml mix) for kulfi samples of T0, T1, T2 and T3 treatments was found to be 0.23, 11.34, 18.70 and 32.30 respectively. The antioxidant value increased significantly with the increased quantity of wood apple pulp. Kamalakkannan and Prince (2003) [9] have reported that the aqueous extractof the bael fruit pulp possess potent antioxidant effects.

Standard plate count of kulfi samples of different treatments viz., T0, T1, T2 and T3 was found to be 1480 cfu/g, 1508 cfu/g, 1520 cfu/g and 1540 cfu/g respectively. There were no significant difference among the SPC. The coliform count of different samples were found to be absent. The yeast and mold count of different samples were also found to be nil. The lower microbial load may be due to the antimicrobial effect of bael pulp as reported by Raja, Murali, Malathi, Anbarasu, and Devaraj (2009) [21].

Conclusion

It may be concluded that the Wood Apple Pulp supplemented kulfi can be successfully prepared by supplementing Wood Apple Pulp @15% of concentrated milk. Kulfi made with Wood Apple Pulp in treatment T3 was best in organoleptic characteristics and received highest score in organoleptic evaluation (colour & appearance, body & texture, Flavour & taste, overall acceptability). Based on its value in traditional medicine and promise from preclinical studies, bael fruit has plethora of health benefits and kulfi being a widely accepted product, it can act as a vehicle to deliver the bioactive components of bael pulp to the wide range of urban customers who may find it difficult to procure and consume bael fruit.

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