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Development of Basundi from admixture of whole milk and aegle marmelos (wood apple) pulp

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Abstract
The present investigation was undertaken with studying of the standard procedure of preparation of basundi by using whole milk and Aegle Marmelos (Wood Apple) Pulp. In the present study T_0, T_1, T_2 and T_3 were formulated in which basundi was prepared by using whole milk, bael fruit pulp and sugar was in the ratio of (100:00:00, 85:10:05, 75:15:10 and 65:20:15) respectively. Various analysis parameters were analyzed by two way ANOVA to obtained a predicted optimum result prepared basundi was subjected to chemical, microbial, and sensory analysis to evaluate the highest mean value of basundi were moisture T_0(48.84%), fat T_0(15.40%), protein T_3(8.48%), Total Sugar T_3 (26.09%), Total Sugar T_3 (51.91%), ash T_3(2.07%) and acidity T_0(0.37% LA) and SPC (10^3 x cfu/g) Count T_0(16.20), Yeast and Mould (10^2 x cfu/g) Count T_1(4.40) and coliform nil. The sensory score for overall acceptability of basundi of by using whole milk and bael fruit pulp, highest mean score of overall acceptability was recorded in T_2 (8.40) followed by T_1 (8.10), T_0 (7.90) and T_3(7.50). It was found that among all treatments T_2 (8.40) higher score in sensory evaluation and considered as optimized product of basundi.

Keywords: Whole milk, bael fruit, basundi, sensory, chemical, microbiological analysis

Introduction
The traditional milk products are masses being made in India since time immemorial. The traditional milk product provides the preserving precious milk solids for a comparatively longer time than the fluid milk whose shelf life is being higher under Indian tropical conditions is only 5-6 hrs at ambient temperature. The Indian dairy products refers to those milk products which originated in India in different locality. It is estimated that about 50 to 55% of milk is converted by the traditional sector (halwais) into variety of Indian milk products by using processes such as heat and acid coagulation, heat desiccation and fermentation. In India, about 50% of the total milk produced is converted into different traditional milk products (Rao & Raju, 2003; Bhasin, 2010; NDDB, 2014) [10, 2, 5].

Basundi is a heat desiccated traditional milk products. Basundi is one of the heat desiccated indigenous milk products popular in western part of India, mostly Maharashtra and Gujarat. Basundi possesses highly nutritive and therapeutic values. Basundi is a traditional heat desiccated whole milk product prepared by partial dehydration of the milk with sugar and other ingredients. Basundi can be classified in the condensed milk group along with Rabri, Khoa-Mithai, and Kheer and also can be considered similar to sweetened condensed whole milk (Raghavan, 1960) [9]. Pal (1998) [6] reported the method of basundi preparation from cow or buffalo milk is concentrated to about two-fold by slow boiling in an open kettle. It is often made on Hindu festivals such as Kali Chaudas and Bhai Dooj. Different types of basundi are also prepared like *sitaphal* (custard apple) *basundi* and *angoor basundi* (basundi with smaller kinds of *rasgullas*). It is served during special occasions like birthday, wedding ceremony, marriage anniversary etc. Its production is mainly confined to the halwais who adopt small scale batch method. Basundi contains 18-22% fat, 20-22% sucrose and 28-32% TS (Aneja, 1992) [1]. Basundi is popular dairy product having sweetish caramel and pleasant aroma, light to medium brown colour, thick body and creamy consistency with or without soft textured flakes and are uniformly suspended throughout the product. It contains all the solids of milk in an appropriate concentration with sugar and dry fruits (Pagote 2003) [7]. Some of the milk product with vegetable and fruit based delicacies are very popular such as Amrakhand,

Santra Barfi, Anjeer Burfi etc. Fruits are rich source of various phyto-nutrients namely vitamins, minerals, antioxidants and dietary fiber.

Aegle marmelos is commonly called as bael, or bel or wood apple. It is found in tropical and sub-tropical regions. The Aegle marmelos tree belongs to the *Rutaceae* family. The trees are of great importance to the environment as they act as climatic purifier, they release greater percentage of oxygen in comparison to other trees. This fruit has a hard, woody outer shell and inside is present a sweet and aromatic pulp. In the pulp, the seeds are present in ridges and each seed is surrounded by thick slimy and transparent mucilage. The fruit is eaten as a highly delicacy when it's ripe, either by cutting into pieces. The fruit pulp is mixed with milk, water and sugar and make into a sweet sherbet. Aegle marmelos tree is known for its medicinal values. There are various parts of the tree such as leaves, fruit, bark and seeds are a constituent of many ayurvedic medicines. Different parts of the plants contain hypoglycemic, hypolipidemic and blood pressure lowering factors (Lmbole *et al.*, 2010) [3]. The bael pulp contains laxative properties and is even considered as the best laxatives known so far. This plant are used in case of gastrointestinal related problems such as diarrhea, dysentery and diabetes (Maity *et al.*, 2009) [4]. It has antibacterial and anti-fungal properties. Bael is known to have anti-cancer activity, pyretic and analgesic activities and also provides relief in constipation (Patel *et al*., 2012) [8]. The pulp of the Aegle fruit is a natural source of natural antioxidants and also bioactive compounds.

Materials and methods

Experimental site

The experiment Entitled **"**Development of Basundi from Admixture of Whole Milk and Aegle Marmelos (Wood Apple) Pulp**"** was carried out in research lab, Warner College of Dairy Technology, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj-211007, U.P. (India).

Procurement and collection of ingredients

Whole Milk

Whole milk was purchased from Aggies Dairy, SHUATS, Prayagraj.

Bael fruit

Bael fruit was purchased from local market of Prayagraj.

Sugar

Sugar required as sweetening agent was purchased from local market of Prayagraj.

Cardamom

Cardamom was purchased from local market of Prayagraj.

Chemicals

The entire chemicals required for the analytical purpose used were of analytical reagent (AR) or guaranteed reagent (GR) grade by Merck, India Ltd/Glaxo India Ltd. throughout study.

Treatment combination

T0: Whole Milk (100:00:00)

T1: Whole Milk: Aegle Marmelos (Wood Apple) pulp: Sugar (85:10:5)

T2: Whole Milk: Aegle Marmelos (Wood Apple) pulp: Sugar (75:15:10)

T3: Whole Milk: Aegle Marmelos (Wood Apple) pulp: Sugar (65:20:15)

Plan of work

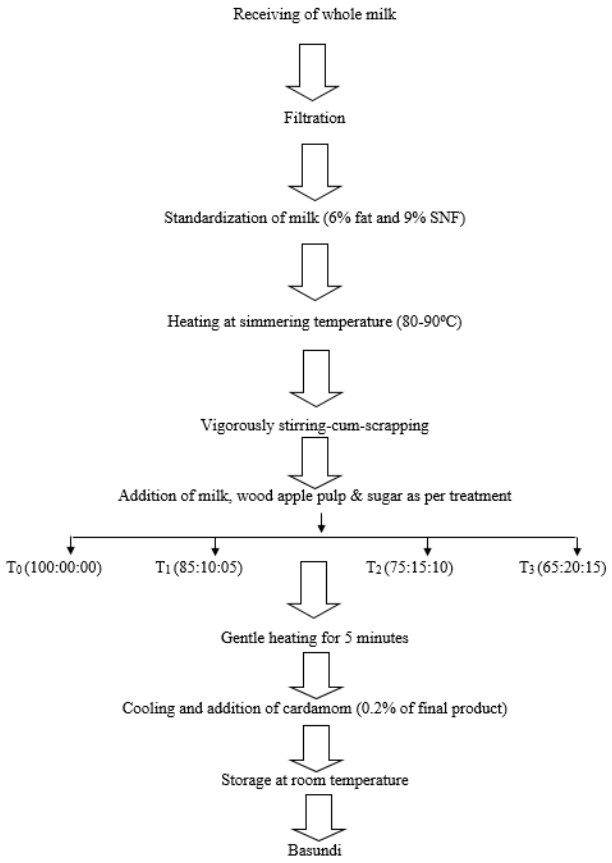

Fig. 1: Flow diagram for manufacturing of whole milk basundi

Technical programme

Physico-chemical analysis

The following analysis was conducted during the investigation

1. Determination of Fat: by Gerber method as described in IS: 1224, Part I.
2. Determination of Protein: by Kjeldahl method (IS: 1479, Part-II, 1961).
3. Determination of Total sugar: by as per procedure of Lane - Eynon in BIS (1981).
4. Determination of Total Solids (TS): by IS: 1479, Part II (1961).
5. Determination of Lactic Acidity (%LA): by as per procedure given in BIS (1981).
6. Determination of Ash: by as per the procedure given in BIS (1981).

Microbiological analysis

1. Standard Plate Counts (SPC): By using Standard Plate Count Agar (SPCA) media as mentioned by Amin.
2. Yeast and Mould Counts (YMC): Determined as per the procedure described in IS: 5403 (1999) using Potato Dextrose Agar (PDA).
3. Coliform Counts: Determined as per the procedure described in IS: 5550 (1970) using McConkey's Agar.

Sensory analysis

By using the method described in the IS: 6273, Part-I and Part- II (1971) adopting 9 point Hedonic scale.

1. Colour & Appearance
2. Body & Texture
3. Flavour & Taste
4. Overall acceptability

Statistical analysis

The data will be analyzed statistically by completely randomized design (CRD) and Analysis of variance at 5%.

Result and discussion

The data collected on the different aspects were tabulated and analyzed statistically using the method of analysis of variance and critical difference technique. The significant and non-significant differences observed have been analyzed critically within and between the treatment combinations.

Table 1: Average data for different parameters of basundi from admixture of Whole Milk and aegle marmelos (wood apple) pulp

Parameters	Treatments				
	T_0	T_1	T_2	T_3	C.D. at 5%
Physico-chemical analysis					
Moisture (%)	48.84	48.23	48.21	48.09	0.03
Fat (%)	15.40	15.39	15.31	15.27	0.05
Protein (%)	8.42	8.44	8.47	8.48	0.04
Total Sugar (%)	25.44	25.97	26.02	26.09	0.18
Ash (%)	1.90	1.97	1.99	2.07	0.09
Acidity (%LA)	0.37	0.34	0.33	0.32	
Total Solid (%)	51.16	51.77	51.79	51.91	0.03
Microbiological analysis					
SPC ($\times 10^3$ cfu/g)	16.20	15.00	13.00	12.60	2.41
Yeast and mold ($\times 10^2$cfu/g)	3.80	4.40	4.20	4.00	1.19
Coliform ($\times 10^1$ cfu/g)	NIL	NIL	NIL	NIL	
Organoleptic analysis (9 point hedonic)					
Colour and Appearance	7.80	7.90	8.60	7.60	0.42
Body and Texture	7.90	8.00	8.30	7.30	0.65
Flavour and Taste	7.90	8.10	8.40	7.60	0.50
Overall Acceptability	7.90	8.10	8.40	7.50	0.53

Physico-chemical characteristics

Moisture percentage

From the Table 1, moisture percentage in samples of different treatments and control, the highest mean moisture percentage was recorded in the sample of T0 (48.84) followed by T1 (48.23), T2 (48.21) and T3 (48.09).

As evident from the result of ANOVA, the F (Cal) value (4.88) was higher than the table value of F (3.49) at 5% level of significance. Therefore, the differences was significant, indicating significant effect of treatments on moisture. The Significant difference was further analyzed statistically to find out the C. D. between and within the different treatment combination. The difference between the mean values of T0-T1 (0.604), T0-T2 (0.624), T0-T3 (0.75), T1-T3 (0.146) and T2-T3 (0.126) was greater than the C.D. value, (0.03). Therefore, the difference was significant. The difference between the mean values of T1-T2 (0.02) was less than the C.D. value, (0.03). Therefore, the difference was non-significant.

Fat percentage

Fat percentage in samples of different treatments and control of basundi, the highest mean fat percentage was recorded in the sample of T0 (15.40) followed by T1 (15.39), T2 (15.31) and T3 (15.27). As evident from the result of ANOVA, the F (Cal) value (18.72) was higher than the table value of F Tab (3.49) at 5% level of significance. Therefore, the differences was significant, indicating significant effect of treatments on fat. The significant difference was further analyzed statistically to find out the C. D. between and within the different treatment combination. The difference between the mean value of T0-T2 (0.09), T0-T3 (0.135), T1-T2 (0.08) and T_1-T_3 (0.12) was greater than the C.D. value (0.05). Therefore, the difference was significant and the difference between the mean value of T0-T1 (0.014) and T2-T3 (0.04) was less than the C.D. value (0.05). Therefore, the difference was non-significant.

Protein percentage

From the above data on protein percentage in samples of different treatments and control the highest mean protein percentage was recorded in the sample of T3 (8.48) followed by T2 (8.47), T1 (8.44) and T0 (8.42). The result of ANOVA, the F (Cal) value (3.86) was higher than the table value of F (3.49) at 5% level of significance. Therefore, the differences was significant, indicating significant effect of treatments on protein. The significant difference thus obtained was further analyzed statistically to find out the C. D. between and within the different treatment combination. The difference between the mean value of T0-T2 (0.05) and T2-T3 (0.08) was greater than the C.D. value (0.04). Therefore, the difference was significant. The difference between the mean value of T0-T1 (0.022), T0-T3 (0.058), T1-T2 (0.028) and T_1-T_3 (0.036) was less than the C.D. value (0.04). Therefore, the difference was non-significant.

Total sugar percentage

From the above table 1, Total Sugar percentage in samples of different treatments and control of basundi, the highest mean Total Sugar percentage was recorded in the sample of T3 (26.09) followed by T2(26.02), T1 (25.97) and T1 (25.44). As evident from the result of ANOVA, the F (Cal) value (25.05) was higher than the table value of F (3.49) at 5% level of significance. Therefore, the differences was significant, indicating significant effect of treatments on total sugar.

Ash percentage

Ash percentage in samples of different treatments and control the highest mean Ash percentage was recorded in the sample of T3 (2.07) followed by T2 (1.99), T1 (1.97) and T0 (1.90). As evident from the result of ANOVA, the F (Cal) value (6.4) was higher than the table value of F (3.49) at 5% level of significance. Therefore, the differences was significant, indicating significant effect of treatments on ash.

Acidity percentage

From the above data, Acidity percentage in samples of different treatments and control, the highest mean Acidity percentage was recorded in the sample of T0 (0.37) followed by T1 (0.34), T2 (0.33) and T3 (0.32). C.D. value at 5% 0.02. It indicates significant difference between the treatments.

Total Solid percentage

Total Solid percentage in samples of different treatments and control the highest mean Total Solid percentage was recorded in the sample of T3 (51.91) followed by T2(51.79), T1 (51.77) and T0 (51.16). Increase the concentration of Aegle Marmelos (Wood Apple) pulp in whole milk, decrease the mean value of basundi, indicates significance difference between the treatments. The significant difference was further analyzed statistically to find out the C. D. between and within the different treatment combination. The difference between the mean value of T0-T1 (0.60), T0-T2 (0.63), T0-T3 (0.75), T1-T2 (0.22) and T_1-T_3 (0.14) was greater than the C.D. value (0.03). Therefore, the difference was significant. The difference between the mean values of T2-T3 (0.12) was less than the C.D. value (0.03). Therefore, the difference was non-significant.

Microbiological characteristics

Standard plate count (×10^3 cfu/g)

SPC count in samples of different treatments and control of Basundi, the highest mean SPC count was recorded in the sample of T0 (16.20) followed by T1 (15.00), T2 (13.00) and T3 (12.60). Decrease the mean value of SPC count after the addition of Aegle marmelos pulp in Basundi.

Yeast and mould count (×10^2cfu/g)

From the above data on table 1, Yeast and Mould count in samples of different treatments and control, the highest mean ash percentage was recorded in the sample of T1 (4.40) followed by T2 (4.20), T3 (4.00) and T0 (3.80).

Coliform (x10^1 CFU/gm)

The coliform test for control and experimental sample was 100% negative. It shows the absence of gram negative bacteria which means the strict hygienic practice was maintained during the procedure preparation.

Organoleptic characteristics

Colour and appearance score

From the above data on colour and appearance score in samples of different treatments and control, the highest mean colour and appearance was recorded in the sample of T2 (8.60) followed by T1 (7.90), T0 (7.80) and T3 (7.60). From the result of ANOVA, the F (Cal) value (10.32) was greater than the table value of F (3.49) at 5% level of non-significance. Therefore, the differences was significant, indicating significant effect of treatments on colour and appearance.

Body and texture score

Body and Texture score in samples of different treatments and control of Basundi, the highest mean Body and Texture score was recorded in the sample of T2 (8.30) followed by T1 (8.00), T0 (7.90), T3 (7.30). Increase the concentration of Aegle Marmelos (Wood Apple) pulp, decrease the mean value of body and texture of Basundi as compared to control.

Flavour and taste score

Flavour and Taste score in samples of different treatments and control, the highest mean Flavour and Taste score was recorded in the sample of T2 (8.40) followed by T1 (8.10), T0 (7.90) and T3 (7.60). From the result of ANOVA, the F (Cal) value (4.59) was higher than the table value of F (3.49) at 5% level of significance. Therefore, the differences was significant, indicating significant effect of treatments on flavour and taste.

Overall acceptability score

From the above data on Table 1, Overall acceptability score in samples of different treatments and control, the highest mean Overall acceptability score was recorded in the sample of T2 (8.40) followed by T1 (8.10), T0 (7.90) and T3 (7.50). C.D. value at 5% 0.53.

Conclusion

The moisture percentage in samples of different treatments and control, the highest mean moisture percentage was recorded in the sample of T0 and lowest in T3. The highest mean of fat and acidity percentage was recorded in the sample of T0 and also lowest in T3. But in Protein, Total Sugar, ash and Total Solid percentage in samples of different treatments and control the highest mean percentage was recorded in the sample of T3 and lowest in T0. The highest mean SPC (10^3 x cfu/g) count was recorded in the sample of T0. Yeast and Mould (10^2 x cfu/g) Count in samples of different treatments and control, the highest mean ash percentage was recorded in the sample of T1 and lowest in T0. Coliform test for control and experimental sample was 100% negative. It means the strict hygienic practice was maintained during the procedure preparation. Colour and appearance body and texture, flavour and taste and overall acceptability score in samples of different treatments and control, the highest mean score was recorded in the sample of T2 sample.

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