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Preparation of kulfi blended with guava (*Psidium guajava*) powder

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Abstract
The present study entitled "Preparation of kulfi Blended with Guava (*Psidium guajava*) powder" was carried out using different levels of guava powder with a view to optimize the process for its manufacture and to study its chemical, sensory and microbiological qualities. Initially the preliminary trials were conducted by blending of different levels of guava powder @ 0, 5, 10 and 15% in the guava kulfi with 15% sugar to finalize the experimental treatments. Experimental guava kulfi samples were analyzed for sensory, chemical and microbiological qualities. It was observed that guava kulfi samples under different treatments showed significant differences for total solid, fat, protein, ash, acidity and moisture content. The values were ranged from 42.25 to 31.29, 12.34 to 10.64, 4.23 to 3.98, 1.29 to 1.09%, 0.211 to 0.100% L.G., and 68.70 to 57.75 respectively. Total solids, Fat, Protein, Ash, Acidity and Moisture contents differed significantly among the different types of kulfi with guava flavour. Significant difference was observed within the smell and taste score and the body and texture score of different types of kulfi. In case of sensory evaluation, colour and appearance and overall acceptability found to be significant over the other treatments. The microbial results indicate the SPC and coliform was within the permissible limit upto 15th day while yeast and mould count found to acceptable upto 7th days. The yeast and mould count may be due to inadequate cleaning or aseptic condition. Hence, it is recommended that the aseptic condition should be maintained during product preparation. The production cost of most acceptable quality kulfi (T_1) was Rs-156.51/kg.

Keywords: Guava, Kulfi, production cost, physicochemical, sensory and microbial quality

Introduction
The Indian version of ice-cream "kulfi" is an indigenous frozen milk product, with good palatability, nutritious and provides pleasure of eating. Kulfi is defined as frozen mixture of milk, cream, dried milk and condensed milk with addition of non-milk products for sweetening, stabilizing and flavouring (Yerriswamy *et al.* 1983**)** [8]**.** Kulfi is 500-year-old a popular frozen dessert (Aneja, 1992) [1] of Indian origin and it occupies a privileged position amongst the traditional Indian dairy products.

Guava (*Psidium guajava*) is popular around the world, particularly as guava juice. India is the number one guava producing country in the world. Guava contains strong antioxidant powers, these compounds help to neutralize free radicals, which can causes damage skin cells and premature aging. Guava tea every day will reduce your chances of wrinkles, dry skin, and leave you with a healthy complexion and glow.

Guava has a high vitamins A content which is known to be a booster for vision health. This vitamin helps to slow the appearance of macular degeneration, and can improve the overall health of our eyes.

Guava also possesses anti-inflammatory properties that help to inhibit any inflammatory molecules such as prostaglandins helping prevalent disease. Regulator guava consumption can help to reduce the risk of breast, mouth, skin, lung, and stomach and colon cancer. The oil from a guava leaf acts as an anti-proliferative, which has been shown to have some effect in reducing cancer cell growth.

According to PFA (1955), kulfi is a frozen product obtained from cow or buffalo milk or combination thereof or from cream or other milk products, with or without addition of cane sugar, dextrose, liquid glucose, egg, fruits, fruit juice, edible flavours and permit. In recent years, growing health consciousness has led to development of novel dairy products, having therapeutic and nutritive value.

In view of this, Indian kulfi, the most commonly consumed Indian frozen dairy product, if enriched with guava fruit powder, could result in increased acceptability, value addition and therapeutic value of the product.

Material and Methods

The study was carried out at the Department of Animal Biotechnology, College of Agricultural Biotechnology, Loni. The fresh milk was obtained from the Prabhat dairy, Tal-Shrirampur Dist- Ahmednagar (MS).

Ingredients like buffalo milk, cream, skim milk powder, sugar, stabilizers and emulsifier and guava powder were purchased from the local market.

Physico-Chemical Analysis

The total solid content of buffalo milk, cream, skim milk powder, sugar, stabilizers and emulsifier and guava powder were determined by gravimetric method as per IS: 1479 (part II), 1961 [11]. The fat content was determined by using standard Gerber method as described in IS: 1224 (part II), 1977 [9]. The protein content was determined by estimating the per cent nitrogen by Micro-kjeldhal method as recommended in IS: 1479 (part II), 1961 [11].

The per cent nitrogen was multiplied by 6.38 to find out protein percentage in Kulfi. Per cent ash content was determined by the method described in A.O.A.C., 1975 [2]. Per cent moisture content was determined by gravimetric method as per IS: 1479 (part II) 1961 [11].

The acidity of Kulfi expressed as per cent lactic acid was determined by the method described in IS: 1479 (part I), 1960 [10].

Sensory Evaluation

The fresh sample of guava Kulfi were evaluated organoleptically by nine point hedonic scale for various quality attributes such as general appearance, body, texture and flavour by panel of 8-10 judges. The experimental samples were served to the judges at 7°C. The panelists were instructed to rate each sample on 9 point hedonic scale.They were provided hedonic scale score cards for evaluating the quality of product as described in IS: 6273 (part-II) 1971 [8].

Microbiological Analysis

All the treatment samples of guava Kulfi along with control sample were stored at 4^0C and analysed for different microbial parameters such as standard plate count, coliform count, yeast and mould count by adopting standard procedure as given by (Dubey and Maheshwari, 2004) throughout the storage period.

Statistical Analysis

For the present investigation Randomized Block Design was employed using four treatments and four replications. The data were tabulated and analyzed according to the statistical methods prescribed by Snedecor and Cochran (1994) [14].

Treatments

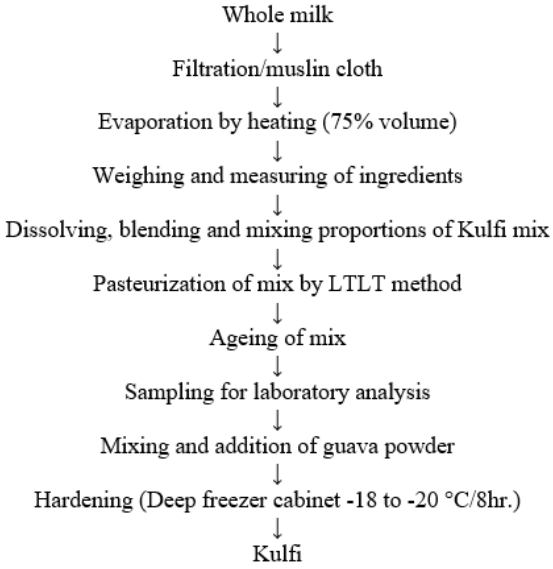
Preliminary trials were conducted to find out the blending of kulfi mix and guava powder to have proper aroma and consistency. After trying different levels of kulfi mix and guava powder the following proportion were finalized for study.

T_0- Without addition of Guava powder in Kulfi mix
T_1 - Addition of 5% Guava powder in Kulfi mix
T_2 - Addition of 10% Guava powder in Kulfi mix
T_3 - Addition of 15% Guava powder in Kulfi mix

The mixture of buffalo milk, cream, skim milk powder, sugar, stabilizers and emulsifier and guava powder were used to prepare Kulfi in the following proportions.

Sr. No.	Ingredients	Per cent composition			
		T_0	T_1	T_2	T_3
1	Milk with 6.0% fat & 9.0% SNF (ml)	39.75	37.25	34.75	32.25
2	Cream with 25% fat & 5.5% SNF (ml)	39.75	37.25	34.75	32.25
3	Milk powder with 0.36% fat & 99% SNF(ml)	5	5	5	5
4	Sugar (g)	15	15	15	15
5	Stabilizer (g)	0.5	0.5	0.5	0.5
6	Guava powder (ml)	---	5	10	15
Total		**100**	**100**	**100**	**100**

Flow diagram for preparation of guava Kulfi



Results and Discussion

Table 1: Chemical analysis of buffalo milk, cream and guava powder

Sr. No.	Constituents	Buffalo milk	Cream	Guava powder
1	Total Solid	16.32	31.82	96.98
2	Fat	6.00	25.10	3.96
3	Protein	4.51	2.12	4.94
4	Acidity	0.15	0.08	0.80
5	Ash	0.80	1.06	5.04

These observations indicate that the buffalo milk used in the present investigation was of good quality. It is clear from the figures of total solid, fat, protein, acidity, ash that they lie within the limits of legal standards for buffalo milk in Maharashtra state as prescribed by PFA rules, 1976, cited by De (2008) [6]. Values for cream are within the range of legal standards for cream as prescribed by PFA act, 1976 (Fat–25%, T.S.–40%).

Table 2: Effect of different levels of guava powder on total solids of Kulfi (percent)

Particulars	R_1	R_2	R_3	R_4	Average	S.D.
T_0	31.20	31.34	31.24	31.38	31.29^d	0.072801
T_1	34.92	34.90	35.00	34.98	34.95^c	0.041231
T_2	38.90	38.51	38.30	38.69	38.60^b	0.221472
T_3	42.10	42.16	42.40	42.34	42.25^a	0.123693

It was observed that the total solid content showed gradual increase with the increase in level of guava powder. This simultaneous increase from T_0 to T_3 may be due to higher amount of total solid content of guava powder (96.98) than buffalo milk (16.32), cream (31.82) and skim milk powder (90.14). The highest total solid content was noticed at T_3 i.e. kulfi blended with 15% guava powder, while the lowest total

solid content was observed at T_0 i.e. kulfi without guava powder. Treatment T_3 found significantly different than the T_0, T_1, &T_2.

Table 3: Effect of different levels of guava powder on fat content of Kulfi (Per cent)

Particulars	R_1	R_2	R_3	R_4	Average	S.D.
T_0	12.19	12.33	12.59	12.25	12.34^a	0.152643
T_1	11.70	11.72	11.88	11.98	11.82^b	0.115758
T_2	11.33	11.13	11.18	11.28	11.23^c	0.079057
T_3	10.74	10.60	10.68	10.54	10.64^d	0.076158

Blending with guava powder had significantly affected the fat content of kulfi. It was observed that blending of guava powder decrease the fat content of kulfi. The declining trend of fat content of kulfi can be attributed to the fact that the fat content of guava powder is much lower (3.96 per cent) than that of milk, cream and skim milk powder.

Besides, obvious reason is that as the level of guava powder increased, there was reduction in amount of milk, cream and skim milk powder on added percentage basis.

Treatment T_0 was found to be significantly superior over the treatments T_1, T_2 and T_3, respectively. The highest fat content in kulfi (12.34) was observed in (T_0) i.e. kulfi without guava powder and the lowest (10.64 per cent) at 15 per cent level of guava powder (T_3).

Table 4: Effect of different levels of guava powder on protein content of Kulfi (per cent)

Particulars	R_1	R_2	R_3	R_4	Average	S.D.
T_0	3.99	3.92	4.04	3.97	3.98^c	0.043012
T_1	4.00	4.01	4.13	4.14	4.07^{bc}	0.065192
T_2	4.24	4.09	4.23	4.08	4.16^{ab}	0.075166
T_3	4.20	4.26	4.20	4.26	4.23^a	0.030000

Variation in protein content was significant. The average protein content of kulfi was 3.98, 4.07, 4.16 and 4.23 per cent for T_0, T_1, T_2& T_3, respectively. The highest level of protein 4.23 content was noticed at treatment T_3 i.e. 15% guava powder, lowest (3.98 percent) at T_0 i.e. without guava powder.

It was observed that the protein content showed gradual increase in kulfi with the increase in level of guava powder. The simultaneous increase from T_1 to T_3 may be due to high amount of protein content of guava powder (4.94 per cent). Treatment T_3 found significantly different than the T_0, $T_1$and T_2.

Table 5: Effect of different levels of guava powder on ash content of Kulfi (per cent)

Particulars	R_1	R_1	R_2	R_3	Average	S.D.
T_0	1.05	1.06	1.12	1.13	1.09^d	0.035355
T_1	1.34	1.26	1.32	1.24	1.29^c	0.041231
T_2	1.45	1.41	1.59	1.55	1.50^{ab}	0.072801
T_3	1.60	1.64	1.76	1.80	1.70^{ca}	0.082462

Ash content showed gradual increase with increase in level of guava powder. The simultaneous increase from T_1 to T_3 may be due to total amount of ash content of guava powder (5.04). The lowest ash content was observed at T_0 i.e. kulfi without guava powder (1.09), while the highest ash content was observed at T_3 i.e. kulfi with 15% guava powder (1.70). Treatment T_4 found significantly different than the treatment T_0, T_1 and T_2.

Table 6: Effect of different levels of guava powder on acidity content of Kulfi (per cent)

Particulars	R_1	R_2	R_3	R_4	Average	S.D.
T_0	0.111	0.101	0.07	0.121	0.10075^c	0.01911
T_1	0.135	0.181	0.101	0.147	0.141^{bc}	0.028601
T_2	0.175	0.151	0.167	0.191	0.171^{ab}	0.014422
T_3	0.211	0.181	0.241	0.211	0.211^a	0.021213

Acidity showed gradual increase with the increase in level of guava powder. This simultaneous increase from T_0 to T_3 may be due to high amount of acidity of guava powder (0.80) than buffalo milk (0.15), cream (0.08) and skim milk powder (0.10).The lowest acidity was noticed at T_0 i.e. kulfi blended without guava powder, while the highest acidity was observed at T_3 i.e. kulfi blended with 15% guava powder. Treatment T_1 was found at par with treatment T_0, T_2. Treatment T_3 found significantly different over the treatments T_2, T_1 and T_0

Table 7: Effect of different levels of guava powder on moisture content of guava Kulfi (per cent)

Particulars	R_1	R_2	R_3	R_4	Average	S.D.
T_0	68.68	68.66	68.76	68.71	68.7025^a	0.037666
T_1	65.05	65.10	65.00	65.05	65.05^b	0.035355
T_2	60.97	61.49	61.40	61.31	61.2925^c	0.196771
T_3	57.75	57.84	57.75	57.66	57.75^d	0.06364

Variation in moisture content was significant. The highest level of moisture content was noticed at treatment T_0 i.e. without guava powder, lowest (57.75 percent) at T_3 i.e. 15% guava powder. It was observed that the moisture content showed gradual decrease in kulfi with the increase in level of guava powder. The simultaneous decrease from T_0 to T_3 may be due to low amount of moisture content of guava powder (3.02) per cent). Treatment T_0 found significantly different than the other treatments.

Sensory evaluation of guava Kulfi

Table 8: Score for colour and appearance of guava Kulfi (out of nine)

Particulars	R_1	R_2	R_3	R_4	Average	S.D.
T_0	6.70	7.00	6.90	7.20	6.95^c	0.180278
T_1	8.10	8.20	8.90	8.80	8.50^a	0.353553
T_2	7.30	7.60	7.65	7.45	7.50^b	0.136931
T_3	6.90	6.80	6.85	6.95	6.87^c	0.055902

Score for colour and appearance was increased and sometimes decreased due to addition of guava powder. The highest score (8.5) was observed for treatment T_1 i.e. kulfi blended with 5% guava powder and this highest score may be due to its particular slight yellowish appealing colour and appearance which was liked most by the judges. Lowest score (6.95) was observed for treatment T_0 i.e. kulfi blended without guava powder. The lowest score may be due to its white colour which was not accepted by judges. Treatment T_1 was found to be significantly superior over the treatments T_2, T_3 and T_0, respectively.

Table 9: Score for body and texture of guava Kulfi (out of nine)

Particulars	R_1	R_2	R_3	R_4	Average	S.D.
T_0	6.70	6.80	7.00	7.25	6.9375^b	0.210283
T_1	8.60	8.10	8.90	8.60	8.55^a	0.287228
T_2	7.00	7.10	7.15	7.20	7.1125^b	0.073951
T_3	6.80	6.85	7.05	6.60	6.825^b	0.160078

Kulfi prepared from T_1 level recorded highest score for (8.55) followed by T_2 (7.1125). The sensory score increased at T_1 i.e. 5 per cent level of guava powder. Treatment T_1 found significantly different than the T_0, T_2 and T_3, whereas treatment T_0, T_2 and T_3 found at par with each other.

Table 10: Score for flavour of guava Kulfi (out of nine)

Particulars	R_1	R_2	R_3	R_4	Average	S.D.
T_0	6.60	6.80	6.90	7.10	6.85^c	0.180278
T_1	8.50	8.40	8.90	8.40	8.55^a	0.206155
T_2	7.00	7.30	7.20	7.20	7.17^b	0.108972
T_3	6.80	6.87	7.00	6.85	6.88^c	0.073686

Kulfi prepared from T_1 level recorded highest score for flavour (8.55) followed by T_2 (7.17). The sensory score increased upto T_1 i.e. 5 per cent level of guava and decreased simultaneously for T_0. Lowest score was noticed for Kulfi blended without guava powder (6.85).

Table 11: Score for consistency of guava Kulfi (out of nine)

Particulars	R_1	R_2	R_3	R_4	Average	S.D.
T_0	6.80	6.90	7.10	7.05	6.96^d	0.119242
T_1	8.60	8.30	8.80	7.30	8.25^a	0.576628
T_2	6.70	7.30	7.10	6.95	7.01^b	0.219018
T_3	6.90	6.80	7.05	6.50	6.81^c	0.201168

Kulfi prepared from T_1 level recorded highest score for consistency (8.25) followed by T_2 (7.0125), T_3 (6.8125) and T_0 (6.9625). The sensory score increased at T_3 i.e. 3 per cent level of guava powder. Treatment T_3 was found to be significantly superior over the treatments T_2, T_1, and T_0, respectively.

Table 12: Score for overall acceptability of guava Kulfi (out of nine)

Particulars	R_1	R_2	R_3	R_4	Average	S.D.
T_0	6.70	6.875	6.975	7.15	6.925^c	0.16298
T_1	8.45	8.25	8.875	8.52	8.525^a	0.225693
T_2	7.00	7.32	7.275	7.20	7.200^{ab}	0.123744
T_3	6.85	6.83	6.988	6.72	6.848^c	0.093556

From overall acceptability scores, it is clear that kulfi prepared from 5 per cent guava powder scored highest point (8.52), followed by kulfi prepared from 10 per cent guava powder. Amongst different levels of guava powder T_1 (5 per cent guava powder) treatment was found more acceptable for blending. The results of overall acceptability scores thus indicate that kulfi blended with 5 per cent guava powder is superior over rest of treatments. Lowest score was noticed for kulfi blended with 5 per cent guava powder. Treatment T_1 was found to be significantly superior over the treatments T_0, T_2 and T_3, respectively.

Changes in microbial qualities of Guava Kulfi during storage

Standard plate count

It was observed that standard plate counts of guava Kulfi increased with increase in storage period for samples stored at room temperature of 4°C. The microbial results indicate the SPC was varied among the different treatments. Overall, the Kulfi was acceptable upto 15th day because the count was within the acceptable limit.

Yeast and mould count

A yeast and mould count of fresh Kulfi was measured very less and negligible. It was observed that yeast and mould counts of guava Kulfi increased with increase in storage period for samples stored at room temperature of 4 °C.

Coliform count

The *E coli* count was not detected upto 15 days. The microbial load may be due to inadequate cleaning or aseptic condition. Hence, it is recommended that the aseptic condition should be maintained during product preparation.

Production of cost

It is pointed out here that the data indicated the cost of ingredients only and other cost factors remains constant for all treatments and were not accounted for cost estimation.

Cost of ingredients increased with the increase in the level of guava powder. The yield of guava kulfi shows inclining trend, with the increase in the level of guava powder, which resulted in increasing cost of production weight basis.

The highest cost (T_3) was recorded in case of guava kulfi blended 15% guava powder, while lower cost (T_0) recorded in case of guava kulfi without guava powder. It was observed that the cost of guava kulfi was increase with the increase in the level of guava powder flavour. The production cost of most acceptable level (T_1)/was Rs- 156.51/kg.

Conclusion

It may be concluded that guava powder could be successfully utilized for the development of kulfi. The most acceptable level of kulfi can be prepared by using 5 per cent guava powder. The guava powder had a positive effect on flavour acceptability and its consumption. On the basis of microbial analysis it may be concluded that the product is acceptable for up to 15 day after that high growth of microorganisms was observed.

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