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Development and sensory evaluation of apple ber (*Ziziphus mauritiana* L.) enriched Khoa Burfi

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Abstract

Burfi is the most well-liked khoa-based confectionary in India and is probably going to become a worldwide favorite. Nuts, fruits, legumes, and other ingredients are added to burfi to make it more acceptable to both the general public and wealthy groups. Apple ber is important fruit crop of the family Rhamnaceae, it is an excellent source of fiber and carbs. It has been noted that the original plain burfi is likewise deficient in fiber and some nutrients. Taking into account apple ber's nutritional value and health benefits, it was planned to utilize apple ber (*Ziziphus mauritiana* L.) in preparation of burfi. Form and level were first optimized based on sensory assessment. It was discovered that, out of the three varieties, the Burfi made with pulp addition received the highest score. In second phase selection of apple ber pulp levels in this two levels of apple ber selected and use for optimization with sugar. In optimization Apple ber was added in two levels viz., 10 and 15% and sugar was added in two levels viz., 25 and 30 percent of the khoa. From this optimization stage 15% apple ber pulp and 30% sugar of khoa given highest score i.e. treatment T₄. The optimized apple ber burfi received scores of 7.55±0.07 for colour and appearance, 8.60±0.03 for body and texture, 8.50±0.02 for flavor and 8.21±0.04 for overall acceptance.

Keywords: Burfi, Apple ber, Khoa, sensory evaluation

Introduction

India is the leading country in the world in terms of milk production and consumption since 1998 and likely to be the "Dairy to the World" in near future. At present, India produces 24% of the total world milk production amounting to 230.6 million tons in 2023-24, showing 5% increase over last year. Out of the total milk produced, only 25-30% is handled by organized sector and hence there is a tremendous scope for the dairy industry to grow and serve the nation by providing safe and secure milk and milk products (Prajapati, 2024) ^[10].

One of the most significant heat-desiccated products is khoa, which serves as the foundation for a wide range of delectable treats. Due to their widespread appeal and extended shelf life, khoa and khoa-based products have significant economic value. Khoa maintains higher levels of vitamin A (581.721 U/100 g), B₂ (622.85 µg/100 g), B₆ (85 µg/100 g), folic acid (0.68 µg/100 g) and vitamin C (5.42 µg/100 g). The typical composition of khoa made from whole buffalo milk is 78.4 percent total solid, 30.5 percent fat, 17.70 percent protein, 30.90 percent lactose and 5.90 percent ash (Aneja *et al.*, 2002) ^[2].

Burfi a traditional khoa-based milk product, is highly nutritious as it contains nearly all milk solids in a concentrated form, along with easily digestible carbohydrates and various additives. It is made from cow and buffalo milk and is popular throughout India. The product includes a range of additives such as cane sugar and it comes in several varieties, including plain mawa, pista, nut, chocolate, coconut and raw burfi, depending on the specific ingredients used (Kumar *et al.*, 2016) ^[7].

Apple ber (*Ziziphus mauritiana* Lamk.) is a significant fruit crop in arid regions, belonging to the Rhamnaceae family. It is primarily grown in states such as Rajasthan, Madhya Pradesh, Uttar Pradesh, Haryana, Punjab, Gujarat, Bihar, Maharashtra, Andhra Pradesh and Tamil Nadu. This fruit is not only nutritious and delicious but also rich in ascorbic acid, vitamin B-complex and minerals. In Ayurveda, various parts of the plant including the root, stem bark, flower and seed are used to treat conditions like indigestion, headaches and coughs.

The leaves serve as good fodder for animals, particularly goats and sheep (Bisen, 2022) [3].

Apple ber offers significant nutritional value that changes with its developmental stage and is rich in vitamins A, C, B-complex and K, as well as calcium. With a caloric content of 104 J/100 g, the whole fruit of *Ziziphus mauritiana* has around 17.0% carbs, 0.03% calcium and phosphorus, 81-83% moisture, 0.8% protein, 0.02% carotene, 0.07% fat, 0.03% phosphorus, 0.038% riboflavin, 0.09% thiamine and 1.3% fiber. Additionally, the fruit includes trace amounts of magnesium, copper, iron, zinc and sodium (Naz *et al.*, 2023) [8].

Materials and Methods

The Division of Animal Husbandry and Dairy Science at Rajarshree Chhatrapati Shahu Maharaj College of Agriculture in Kolhapur conducted the current study. The dairy farm at RCSM College of Agriculture in Kolhapur provided the whole fresh, pure buffalo milk. We purchased a single batch of high-quality cane sugar from the Kolhapur city local market. The apple ber was purchased at the Kolhapur city local market and kept at room temperature.

Methodology

Preparation of forms of Apple ber

Powder form

The powder of apple ber was prepared as per procedure described by Pandey and Poonia (2020) [9] with slight modification. Initially the apple ber was washed and cleaned and fruit was cut into small pieces. Drying at 52 °C in hot air oven to reduce the moisture.

Pulp form

The pulp of apple ber was prepared as per procedure described by Kuchi *et al.*, (2017) [6]. Healthy fruits were chosen to make burfi. Fruits were washed and cleaned and the pulp was extracted manually. To produce fine pulp, it had been homogenized in a mixer.

Juice form

The juice of apple ber was prepared as per procedure described by Khomane (2020) [5] with slight modification. Initially clean juicy fruits were selected and cut into small pieces and grind in a mixer with help of water and sieve. Apple ber juice was obtained.

Shredded form

First, wash the fruit, then trim off the tips and greens. Next, set the ber against a box grater and shred it by sliding it down against the big holes.

Preparation of apple ber Burfi

The Apple ber Burfi was made using a modified version of the Kamble *et al.* (2019) [4]. Buffalo milk was first filtered via muslin cloth before being standardized to contain 6% fat. After that, the standardized milk was placed over a hot fire in an open pan or karahi. To prevent any burning or charring of the milk solids at the bottom of the karahi, the milk was constantly swirled and the side of the karahi was scratched. The result was vigorously stirred with the aid of a stirrer until it attained a pasty consistency, at which point the temperature was reduced. When the product reached the stage of pat creation, it left the karahi's sides, Various forms of apple ber was added @ 15% and sugar @ 30% of khoa,

respectively. To get the appropriate consistency, the ingredients were well combined and cooked on low heat for 5 to 8 minutes. After being removed from the flame, the product was placed in a 30 x 30 x 1.5 cm tray and allowed to cool and set at ambient temperature in a sanitary environment until it started to solidify somewhat.

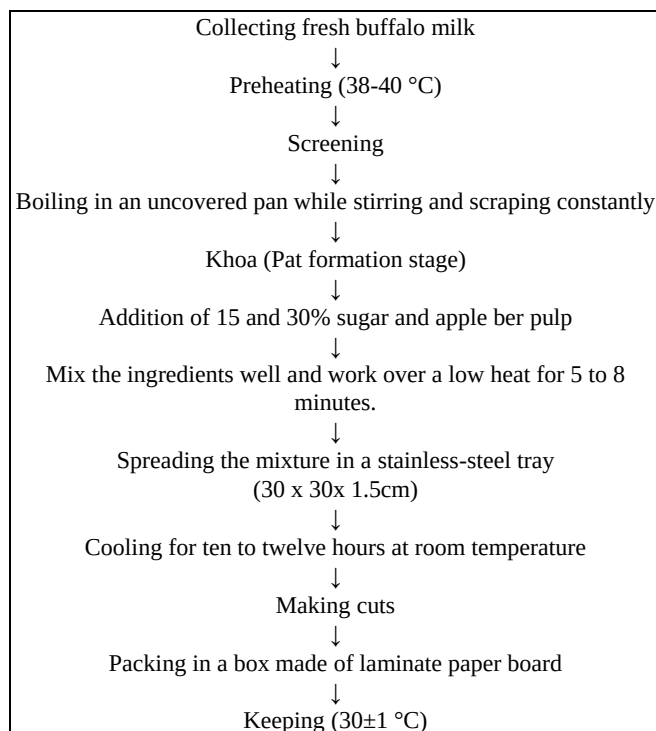


Fig 1: Flow diagram for preparation of Apple ber Burfi.

The best of these four treatment combinations was chosen after their sensory qualities were analyzed.

Sensory Evaluation of Apple ber Burfi

A semi-trained panel of five judges from the Division of Animal Husbandry and Dairy Science and the Division of Horticulture evaluated the sensory qualities of fresh and preserved Apple ber Burfi samples. The 9-point Hedonic scale was used to evaluate the flavor, colour and appearance, body and texture and overall acceptability (Amerine *et al.*, 1965) [1].

Statistical Analysis

The data of storage samples were analyzed using (CRD) Completely Randomized Design and (FCRD) Factorial Completely Randomized Design in order to provide significant conclusions (Snedecor and Cochran, 1994) [11].

Results and Discussion

Effect of level of apple ber and sugar on colour and appearance of burfi

The first sign of how a thing is perceived may be its colour and appearance. During the cooking process, the natural colour of the apple ber and the sugar blended to create the colour of apple ber burfi. Table 1 and Fig. 2 show the colour and appearance scores of apple ber burfi as influenced by the amount of apple ber and sugar. The treatment T₁ received the highest mean score for colour and appearance (8.42), followed by T₂ (7.95), T₃ (7.77) and T₄ (7.55). Treatment T₁ had given better colour and appearance than other treatment.

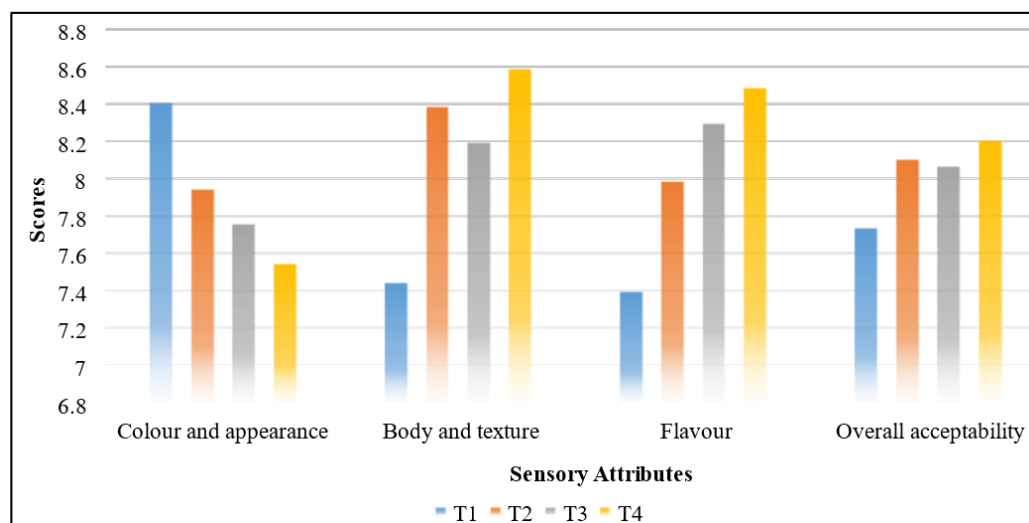
Table 1: Combined effect of level of apple ber and sugar on sensory attributes (score*) of Burfi

Level of apple ber and sugar	Sensory attributes			
	Colour and appearance	Body and texture	Flavour	Overall acceptability
T ₁	8.42±0.07	7.45±0.02	7.40±0.02	7.75±0.01
T ₂	7.95±0.09	8.40±0.03	8.00±0.04	8.11±0.03
T ₃	7.77±0.07	8.20±0.02	8.30±0.01	8.08±0.02
T ₄	7.55±0.07	8.60±0.03	8.50±0.02	8.21±0.04

*Means ± SE of three replications

Table 2: ANOVA Combined effect of level of apple ber and sugar on sensory attributes (score*) of Burfi

Sensory Property	Sources of variation	d.f.	MSS	F value	CD
Colour and Appearance	Between apple ber level (B)	1	1.10	10.71	0.35*
	Between Sugar level (S)	1	0.49	4.76	0.35*
	Interaction (B×S)	1	0.06	0.61	NS
	Error	12	0.10		
Body and Texture	Between apple ber level (B)	1	0.90	83.31	0.11*
	Between Sugar level (S)	1	1.82	168.23	0.11*
	Interaction (B×S)	1	0.30	27.92	0.16*
	Error	12	0.01		
Flavour	Between apple ber level (B)	1	1.96	188.16	0.11*
	Between Sugar level (S)	1	0.64	61.44	0.11*
	Interaction (B×S)	1	0.16	15.36	0.16*
	Error	12	0.01		
Overall Acceptability	Between apple ber level (B)	1	0.18	13.46	0.13*
	Between Sugar level (S)	1	0.23	17.10	0.13*
	Interaction (B×S)	1	0.05	3.89	NS
	Error	12	0.01		

* $p < 0.05$ NS = Non-significant**Fig 2:** Effect of Apple ber form on sensory qualities of Burfi

Finished product become dark which was not liked by the judges and also with increased level of sugar the colour of level of apple ber and sugar level individually was significant but their interaction was non-significant. From the data it is seen that with increased level of apple ber and the colour of finished product become dark. According to Kamble *et al.* (2019) [4], a lower amount of green chickpea results in a dull overall look and a dark, undesirable colour, which lowers the acceptance of burfi. Inversely Kuchi *et al.* (2017) [6] reported that with addition banana pulp initially score of burfi increases then decreases.

Effect of level of apple ber and sugar on body and texture of burfi

Additionally, it was discovered that Table 1 and Figure 2 show the impact of apple ber and sugar level on body and texture. The effect of apple ber, sugar level and their

interaction were significant ($P < 0.05$). The overall acceptability scores for T₁, T₂, T₃ and T₄ were 7.45±0.02, 8.40±0.03, 8.20±0.02 and 8.60±0.03. The average scores for body and texture attribute of apple ber burfi prepared under each treatment were lowest in T₁ (7.45) and highest in T₄ (8.60). Score of Apple ber burfi increased with increase in sugar and apple ber level. The judge's preference for Burfi's soft appearance might account for the treatment behaviour that was seen. With addition of apple ber in burfi becomes soft and sugar also gives structure to burfi. Similar finding reported by Kuchi *et al.* (2017) [6] increasing sugar level in banana pulp burfi score of burfi increases and with addition banana pulp initially score of burfi increases then decreases and Kamble *et al.* (2019) [4] reported that with increasing green chickpea level and sugar level score of burfi decreases.

Effect of level of apple ber and sugar on flavour of burfi

Score for flavour of burfi was presented in Table 1 and fig.2. The burfi samples made under T₁, T₂, T₃ and T₄ had mean flavor scores of 7.40±0.02, 8.00±0.04, 8.30±0.01 and 8.50±0.02, respectively. Apple ber, sugar level and their combination had a substantial ($p<0.05$) impact on the flavor score. With addition of apple ber and sugar level in burfi score increases. Based on the data above, it appears that the product made with 15% apple ber pulp and 30% sugar was significantly superior over other treatment combination. Judges commented the 10% apple ber level burfi had less flavour and 25% sugar given less sweetness. 15% apple ber had given flavour to burfi and use of 30% sugar gives sweetness to burfi. Similar finding reported by Kamble *et al.* (2019) ^[4] that initially addition of green chickpea score of burfi increases then decreases. Inversely Kuchi *et al.* (2017) ^[6] reported that score of banana pulp burfi decreased with increasing banana pulp and increased with addition of sugar.

Effect of level of apple ber and sugar on overall acceptability of burfi

The formulation with 10% apple ber and 25% sugar had the lowest score, whereas the formulation with 15% apple ber and 30% sugar received the highest grade. The effect of apple ber and sugar individually were significant but interaction was non-significant. The natural apple ber flavor, sweetness of the sugar and richness of the milk solids were all well-balanced in sample T₄.

The fact that the overall acceptability was a total of the product's colour and appearance, body and texture, and flavor might help to explain the unique behaviour of the treatment combinations with regard to this specific feature. Each of the four apple ber burfi treatment combinations appeared to have significantly improved, which may have increased the judge's preference for overall acceptance. Furthermore, it should be emphasized that the T₄ therapy seems to be a good fit for controlling the sensory qualities to the highest possible degree.

Therefore, it could be concluded that the ideal way to make apple ber burfi was to add 15% apple ber and 30% sugar to khoa.

Conclusions

According to the study's findings, the final product was examined for sensory aspects such as colour and appearance, body and texture, flavor and general acceptability. According to this study, the best burfi was made by adding 15% apple pulp and 30% sugar. Score for optimized selected apple ber burfi for colour and appearance, body and texture, flavour and overall acceptability were 7.55±0.07, 8.60±0.03, 8.50±0.02 and 8.21±0.04 respectively.

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