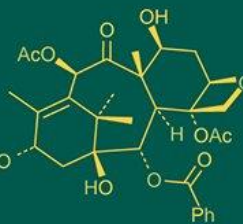
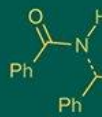


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Effect on physico-chemical properties of burfi blended with moringa leaves powder

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Abstract

The present study was undertaken to develop and evaluate the physicochemical properties of Moringa Leaves Powder (MLP) burfi prepared using jaggery as a sweetening agent. Moringa leaves powder was incorporated into burfi at five different levels, namely 0% (control), 0.5%, 1.0%, 1.5%, and 2.0%, while jaggery was used at a constant level of 35%. The prepared burfi samples were evaluated for important physicochemical parameters, including protein, fat, total solids, moisture, ash, acidity, and Solids-Not-Fat (SNF). Thus, Moringa leaves powder can be utilized as a functional ingredient in jaggery-sweetened burfi, with incorporation levels ranging from 0.5 to 2.0%, to develop a value-added traditional dairy product with enhanced nutritional characteristics. The study demonstrates the potential of combining Moringa leaves powder and jaggery for the development of a nutritious and acceptable functional burfi.

Keywords: Moringa leaves powder, burfi, jaggery, physicochemical properties, protein, fat, moisture, ash, total solids, acidity, solids-not-fat

Introduction

India is currently the world's leading milk-producing country, with an estimated annual milk production of 248 million tonnes during 2024-2025. This information is reported by the National Dairy Development Board (NDDB), based on data from the Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India. During the same period, the per capita availability of milk in India reached approximately 448 grams per day.

Burfi is a widely consumed traditional Indian dairy sweet that is primarily prepared using khoa and milk. It generally has a white to pale-cream appearance and is characterized by a firm consistency with a smooth yet slightly granular texture. The quantity of sugar used may vary depending on the desired taste, while additional ingredients are incorporated according to consumer preferences and regional traditions. Consequently, numerous varieties of burfi are available, including plain, mava, pista, nut, chocolate, coconut, and rava burfi, with each variety distinguished by its specific added ingredients.

Moringa, traditionally considered an underutilized plant, has gained considerable attention in recent years because of its nutritional and nutraceutical properties. It is often referred to as the "Miracle Tree" due to its wide range of potential health benefits. According to the APEDA Market Intelligence Report (2019), the global market for moringa-based products was projected to increase from approximately USD 5.5 billion in 2018 to USD 10 billion by 2025, representing a Compound Annual Growth Rate (CAGR) of around 8.9%. Growing consumer awareness regarding the nutritional and medicinal properties of moringa is expected to further support the expansion of this market. India is particularly significant in the global moringa industry and is estimated to account for nearly 80% of the world's moringa demand. Owing to its rich nutritional profile and potential health-promoting properties, moringa is increasingly recognized as a superfood. Divya *et al.* (2024)^[2] reported that moringa leaves are highly nutritious, containing approximately 20-35% protein, dietary fiber, carbohydrates, essential amino acids, and vitamins A, B-complex, C, and E. They also provide essential minerals, including calcium, potassium, iron, magnesium, phosphorus, and zinc. The researchers highlighted that moringa leaves have a greater nutrient density compared with many commonly consumed vegetables.

Material and Methods

Moringa leaves powder was prepared by sundrying method and jaggery was used as sweetening agent for preparation of burfi. For preparation of burfi the level of jaggery is finalized first by sensory evaluation by using 9 point hedonic scale and finalized the levels of moringa leaves powder for preparation of burfi.

The treatment were khoa and moringa leaves powder was (99.5:0.5)%T₂, (99:1)%T₃, (98.5:1.5%)T₄ and (98:2)% (T₄) were compared with (100:0)% control (T₁). The burfi was prepared by the standard method with certain modifications. The finished product is then analysed for sensory, physico chemical properties of burfi.

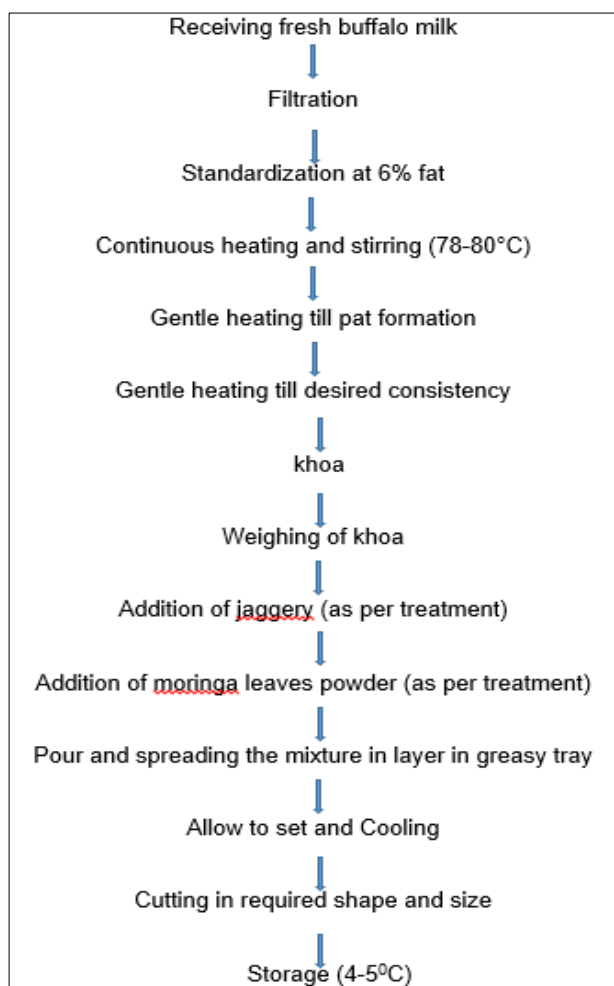


Fig 1: Flow chart for preparation moringa leaves powder burfi

Statistical analysis

The data obtained during different phases of this study was analyzed by using CRD (Completely Randomized Design) with five treatments and four replications.

Analytical methods

The prepared Burfi samples were analyzed for fat, protein,

total solids, moisture, ash, SNF, and acidity as per standard methods.

Result and Discussion

The burfi prepared with blending of moringa leaves powder and jaggery were analysed for the fat, protein, total solids, moisture, ash, SNF, and acidity as per standard and the optimum level were finalised by using sensory evaluation.

Table 1: Overall sensory evaluation of burfi

Treatment	Parameters			Overall Acceptability (9)
	Flavour	Body and texture (9)	Colour and Appearance (9)	
T ₁	7.58	7.57	7.59	7.6
T ₂	7.80	7.81	7.81	7.8
T ₃	7.93	7.99	8.01	8.0
T ₄	8.45	8.46	8.47	8.4
T ₅	7.54	7.53	7.54	7.4
S.E (m) ±	0.0543	0.0503	0.0580	0.06
C.D	0.1136	0.1054	0.1214	0.12
Result	sig	sig	sig	sig

The sensory characteristics of the five treatments (T₁-T₅) were assessed in terms of flavour, body and texture, colour and appearance, and overall acceptability. Among the treatments, T₄ obtained the highest sensory scores across all evaluated attributes, with an overall acceptability score of 8.4, demonstrating the greatest preference among the treatments. T₃ showed the next highest acceptability score (8.0), followed by T₂ (7.8) and T₁ (7.6). In comparison, T₅

received the lowest overall acceptability score of 7.4.

Statistical analysis indicated that the differences among treatments were significant for all the sensory attributes evaluated, suggesting that the treatments had a meaningful influence on the sensory quality of the product. Based on the overall sensory performance and acceptability scores, T₄ was identified as the most suitable and preferred treatment.

Table 2: Overall average chemical composition of burfi prepared with different levels of moringa leaves powder

Treatments	Parameters						Solid not fat
	Fat	Protein	Total Solids	Moisture	Acidity	Ash	
T ₁	22.4	15.16	83.60	16.4	0.36	3.17	61.20
T ₂	22.3	15.21	84.50	15.5	0.39	3.67	62.10
T ₃	22.3	15.27	85.00	15.0	0.41	4.17	62.70
T ₄	22.2	15.34	85.70	14.3	0.43	4.60	63.50
T ₅	22.1	15.37	86.52	13.475	0.44	5.10	64.42
S.E(m)	0.0186	0.0191	0.1789	0.1769	0.0041	0.1417	0.1759
C.D	0.0389	0.0401	0.3745	0.3681	0.0124	0.2966	0.3681
Result	Sig	Sig	Sig	Sig	Sig	Sig	sig

1. Fat

The data presented in Table 2 indicate that the incorporation of moringa leaves powder had a significant effect on the fat content of burfi. The burfi samples prepared using khoa and moringa leaves powder at ratios of 100:0 (T₁), 99.5:0.5 (T₂), 99:1 (T₃), 98.5:1.5 (T₄), and 98:2 (T₅) showed fat contents of 22.43, 22.34, 22.25, 22.18, and 22.10 per cent, respectively. The control treatment, T₁, which did not contain moringa leaves powder, exhibited the highest fat content, whereas T₅, containing the maximum level of moringa leaves powder, showed the lowest value of 22.10 per cent. Overall, a gradual decline in fat content was observed as the proportion of moringa leaves powder increased. This reduction may be attributed to the comparatively lower fat content of moringa leaves powder than that of khoa. The present findings are supported by Suchita Bhosale *et al.* (2018) [12], who reported a progressive reduction in the fat content of burfi with increasing incorporation of ash gourd pulp. Similarly, Deshmukh (2020) [1] observed a decrease in the fat content of orange burfi following the addition of orange pulp.

2. Protein

The results in Table 2 demonstrate that the incorporation of moringa leaves powder influenced the protein content of burfi. The average protein content of burfi formulated with khoa and moringa leaves powder in the proportions of 100:0 (T₁), 99.5:0.5 (T₂), 99:1 (T₃), 98.5:1.5 (T₄), and 98:2 (T₅) was found to be 15.16, 15.21, 15.27, 15.34, and 15.37 per cent, respectively. The results show a gradual increase in protein content with an increasing proportion of moringa leaves powder. This improvement may be associated with the contribution of protein from the moringa leaves powder. The findings are in agreement with K. V. Jadhav (2021) [13], who reported significant differences in protein content among different burfi treatments. In that study, the protein content ranged from 13.16 per cent in T₁ to 19.07 per cent in T₅, with the highest level observed in the treatment containing the greater proportion of the incorporated ingredient. The present results therefore follow a similar trend.

3. Total solid

As shown in Table 2, the addition of moringa leaves powder had a noticeable effect on the total solids content of burfi. The average total solids content recorded for treatments containing khoa and moringa leaves powder at ratios of 100:0 (T₁), 99.5:0.5 (T₂), 99:1 (T₃), 98.5:1.5 (T₄), and 98:2 (T₅) was 83.60, 84.50, 85.00, 85.70, and 86.52 per cent, respectively. The highest total solids value was obtained in T₅ (86.52%), while the lowest was observed in T₁. These results clearly indicate that the total solids content increased progressively as the level of moringa leaves powder was increased.

The present observations are comparable with the findings of Kapare (2017) [6], who reported total solids values ranging from 83.16 to 84.20 per cent in finger millet burfi. A relatively high total solids content can contribute to desirable characteristics such as improved body, consistency, and storage quality of burfi.

Mohod (2020) [7] also reported the highest total solids content of 82.02 per cent in T₅ and noted that increasing the proportion of finger millet flour resulted in a corresponding rise in the total solids content of burfi.

4. Solid not fat

The results presented in Table 2 reveal that the incorporation of moringa leaves powder significantly affected the Solids-Not-Fat (SNF) content of burfi. The SNF content of burfi prepared with khoa and moringa leaves powder at ratios of 100:0 (T₁), 99.5:0.5 (T₂), 99:1 (T₃), 98.5:1.5 (T₄), and 98:2 (T₅) was 61.20, 62.10, 62.70, 63.50, and 64.42 per cent, respectively. The maximum SNF content was observed in T₅ (64.42%), which contained the highest proportion of moringa leaves powder. In contrast, the minimum value of 61.20 per cent was recorded in the control treatment, T₁, where moringa leaves powder was not incorporated.

The progressive increase in SNF content with increasing levels of moringa leaves powder suggests that its incorporation contributed to the non-fat solid fraction of the product. Similar observations were reported by Suchita Bhosale *et al.* (2017) [11], who found that increasing the level

of bottle gourd pulp in burfi resulted in a gradual enhancement of SNF content, with values increasing from 65.95 to 67.35 per cent. This supports the trend observed in the present study.

Mohod (2020) [7] reported that the SNF content of burfi increased significantly as the level of finger millet flour was increased in the formulation. The maximum SNF value of 60.29 per cent was observed in treatment T₅. The increase in SNF was mainly associated with the comparatively higher solids-not-fat contribution of finger millet flour.

5. Moisture

The findings presented in Table 2 show that the incorporation of moringa leaves powder at different levels had a significant effect on the moisture content of burfi. The mean moisture content of burfi prepared using khoa and moringa leaves powder in the ratios of 100:0 (T₁), 99.5:0.5 (T₂), 99:1.0 (T₃), 98.5:1.5 (T₄), and 98:2.0 (T₅) was 16.40, 15.50, 15.00, 14.30, and 13.47 per cent, respectively. The control treatment, T₁, exhibited the highest moisture content (16.40%), whereas the lowest value was observed in T₅ (13.47%). These results demonstrate a continuous decrease in moisture content as the amount of moringa leaves powder increased. This trend may be explained by the relatively lower moisture content of moringa leaves powder compared with the other ingredients used in the formulation.

The present findings are consistent with Kapare (2017) [6], who observed a gradual reduction in moisture content in finger millet burfi with increasing levels of finger millet flour. The moisture content decreased from 16.84 per cent in T₀ to 15.87 per cent in T₄, indicating that increased incorporation of finger millet flour contributed to lower moisture levels in the finished product.

Similarly, Suchita Bhosale *et al.* (2017) [11] reported significant differences in the moisture content of burfi prepared with varying quantities of bottle gourd pulp. The highest moisture content (17.77%) was recorded in T₁, whereas T₄ had the lowest value (16.50%). The researchers attributed these differences to the varying quantities of bottle gourd pulp incorporated into the different treatments.

6. Ash

According to the results presented in Table 2, the ash content of burfi was significantly affected by the addition of moringa leaves powder. The ash content obtained for burfi prepared with khoa and moringa leaves powder at ratios of 100:0 (T₁), 99.5:0.5 (T₂), 99:1 (T₃), 98.5:1.5 (T₄), and 98:2 (T₅) was 3.17, 3.67, 4.17, 4.60, and 5.10 per cent, respectively. Among the treatments, T₅, containing 2 per cent moringa leaves powder, recorded the maximum ash content (5.10%). The minimum value (3.17%) was observed in the control treatment T₁, which did not contain moringa leaves powder. The progressive increase in ash content may be due to the greater contribution of mineral-rich moringa leaves powder as its level in the formulation increased.

The present results are comparable with the findings of K. V. Jadhav *et al.* (2021) [13], who observed an increase in ash content from 2.66 per cent in T₁ to 4.16 per cent in T₅ with an increase in skim milk powder (SMP) from 0 to 50 per cent. The higher ash values were attributed to the greater contribution of mineral components from SMP. The highest ash content (4.16%) was found in T₅, while the control

treatment T₁ recorded the lowest value (2.66%).

Likewise, G. S. Dhakhne reported a gradual increase in ash content with increasing levels of Nagpur mandarin powder. The ash content increased from 2.44 per cent in T₁ (control) to 2.50 per cent in T₂, 2.58 per cent in T₃, and 2.62 per cent in T₄. The maximum ash content (2.62%) was recorded in T₄, whereas the minimum (2.44%) was observed in the control treatment. This trend indicates that increasing the level of Nagpur mandarin powder contributed to an increase in the mineral fraction of the product.

7. Acidity

The results in Table 2 indicate that the acidity of burfi increased progressively with the incorporation of moringa leaves powder. The acidity values obtained for the formulations containing khoa and moringa leaves powder in the ratios of 100:0 (T₁), 99.5:0.5 (T₂), 99:1 (T₃), 98.5:1.5 (T₄), and 98:2 (T₅) were 0.36, 0.39, 0.41, 0.43, and 0.44 per cent, respectively.

The lowest acidity value (0.36%) was recorded in T₁, the control treatment without moringa leaves powder. In contrast, T₅, containing 2 per cent moringa leaves powder, exhibited the highest acidity (0.44%). Overall, the results show a gradual rise in acidity with an increase in the proportion of moringa leaves powder incorporated into burfi.

The present findings are in agreement with Patil *et al.* (2015) [10], who observed a gradual increase in the titratable acidity of date burfi with increasing incorporation of dates. The study suggested that the addition of dates at higher levels contributed to an elevation in the overall acidity of the finished burfi.

Similarly, Gadekar (2018) [4] reported that the acidity of burfi increased progressively with the incorporation of wood apple pulp. Treatments T₂, T₃, and T₄ exhibited comparatively higher acidity values, which were associated with the naturally acidic nature of wood apple pulp, having an acidity range of 0.72-1.25 per cent. The study further indicated that increasing the quantity of wood apple pulp resulted in a corresponding rise in the acidity of the prepared burfi.

Conclusion

The present investigation was undertaken to assess the physicochemical characteristics of Moringa leaf powder (MLP) burfi developed using jaggery as the sweetening ingredient. Moringa leaf powder was added at five different concentrations 0% (control), 0.5%, 1.0%, 1.5%, and 2.0% whereas the level of jaggery was kept constant at 35%. Among the treatments, the formulation containing 1.5% Moringa leaf powder and 35% jaggery was found to be the most acceptable based on its physicochemical composition. This formulation recorded 15.34% protein, 22.20% fat, 85.70% total solids, 14.30% moisture, 4.60% ash, 0.43% acidity, and 63.50% Solids-Not-Fat (SNF).

The control treatment, prepared without Moringa leaf powder, was used as a reference for comparison. Incorporation of Moringa leaf powder at levels ranging from 0.5% to 2.0% improved the nutritional and functional attributes of the burfi. The use of 35% jaggery provided natural sweetness while also contributing to the total solids and overall nutritional composition of the product.

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