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Effect of Indian gooseberry (*Phyllanthus emblica* L.) shreds on physico-chemical properties of kalakand

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ABSTRACT

The present investigation was undertaken to study the effect of Indian gooseberry (*Phyllanthus emblica* L.) shreds, used as a natural coagulant, on the physico-chemical properties of kalakand. The study was conducted during 2024–25 at the Department of Animal Husbandry and Dairy Science, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra. Six treatments were evaluated, viz., T_1 (control; 100 parts cow milk + 0.02 per cent citric acid), T_2 (100 parts cow milk + 2 per cent Indian gooseberry shreds), T_3 (100 parts cow milk + 4 per cent Indian gooseberry shreds), T_4 (100 parts cow milk + 6 per cent Indian gooseberry shreds), T_5 (100 parts cow milk + 8 per cent Indian gooseberry shreds) and T_6 (100 parts cow milk + 10 per cent Indian gooseberry shreds), with sugar held constant at 7 per cent in all treatments. The experiment was laid out in a Completely Randomized Design (CRD) with five replications.

Physico-chemical analysis revealed that moisture content increased progressively from 29.60 per cent in T_1 to 34.84 per cent in T_6 , whereas total solids decreased from 70.40 to 65.16 per cent over the same range. Fat declined from 20.50 to 16.80 per cent and protein from 14.20 to 12.50 per cent with increasing levels of Indian gooseberry shreds. Total sugar decreased from 31.27 to 29.58 per cent, while total ash increased from 2.29 to 2.50 per cent. Vitamin C content increased markedly from 0.00 mg/100 g in T_1 to 85.19 mg/100 g in T_6 , reflecting the naturally high ascorbic acid content of Indian gooseberry. Titratable acidity increased from 0.50 to 0.79 per cent, whereas pH decreased from 5.85 to 4.69 with increasing incorporation of Indian gooseberry shreds. On the basis of physico-chemical and sensory evaluation, kalakand prepared with 4 per cent Indian gooseberry shreds (T_3) was found to be the most acceptable, at a production cost of Rs. 368.75 per kg. It is concluded that Indian gooseberry shreds can be effectively utilized as a natural coagulant for the preparation of a nutritionally enriched, vitamin C-fortified value-added kalakand.

Keywords: Indian gooseberry, *Phyllanthus emblica*, Natural coagulant, Kalakand, Physico-chemical properties, Value-added dairy product

Introduction

Milk and milk products form an integral part of the human diet, and India, being the largest milk-producing country in the world, utilizes a substantial share of its milk for the manufacture of traditional and value-added dairy products (DAHD, 2025). Among the numerous indigenous milk sweets, kalakand occupies a distinct position owing to its characteristic caramelized flavour, soft granular texture and wide consumer acceptance. Kalakand is a partially desiccated and sweetened milk product prepared by heat concentration of milk followed by coagulation using a suitable acidulant (Gawande *et al.*, 2015).

Indian gooseberry (*Phyllanthus emblica* L.), commonly known as aonla or amla, is one of the richest natural sources of vitamin C and is valued for its potent antioxidant, antimicrobial and health-promoting properties (Patel *et al.*, 2024). The fruit possesses a characteristic acidic and astringent taste owing to the presence of organic acids and tannins, which makes it a potential natural coagulant for milk proteins during the manufacture of traditional dairy products (Muzaffar *et al.*, 2022) [1]. Utilization of aonla shreds as a natural coagulant offers an attractive alternative to conventional food acids and synthetic additives, while simultaneously enriching the finished product with vitamin C and other bioactive compounds.

Despite its immense nutritional and therapeutic value, a considerable quantity of amla remains underutilized owing to its highly acidic and astringent taste, limited shelf life and seasonal availability. Incorporation of amla shreds into kalakand therefore provides an opportunity for value addition, reduction of post-harvest losses and development of a functional dairy product. However, scientific information on the effect of Indian gooseberry shreds, used as a natural coagulant, on the physico-chemical properties of kalakand is limited.

Therefore, the present investigation was undertaken to study the effect of different levels of Indian gooseberry shreds on the physico-chemical properties of kalakand.

Materials and methods

Materials

Fresh, clean whole cow milk was procured from the Livestock Instructional Farm, Department of Animal Husbandry and Dairy Science, Dr. PDKV, Akola, and strained through a clean muslin cloth prior to use. Fresh, mature and healthy fruits of Indian gooseberry (*Phyllanthus emblica* L.) were procured from the Department of Horticulture, Dr. PDKV, Akola, washed with clean tap water and ground into fine shreds using a mixer. Good quality commercial cane sugar was used at 7 per cent by weight of milk in all treatments.

Treatment details

The treatments were laid out as follows:

Treatment	Cow milk (%)	Indian gooseberry shreds
T ₁ (Control)	100	0.02% citric acid
T ₂	100	2%
T ₃	100	4%
T ₄	100	6%
T ₅	100	8%
T ₆	100	10%

Preparation of kalakand

Fresh cow milk was filtered and heated in a stainless-steel pan at 90–95 °C with continuous stirring until the volume was reduced to approximately one-third of the original. Coagulation was induced by ad-

dition of treatment-wise Indian gooseberry shreds (except the control, in which 0.02 per cent citric acid was used) with continuous stirring. The coagulated mass was desiccated to a characteristic granular texture, after which sugar (7%) was incorporated and heating continued until the product attained a semi-solid consistency with approximately 30–35 per cent moisture. The hot mass was spread in stainless-steel trays to a thickness of 2–3 cm and cooled at room temperature (27 ± 2 °C) for setting.

Physico-chemical analysis

The kalakand samples were analysed for moisture and total solids by the gravimetric method as per IS: 1479 (Part-II) 1961; fat by the Gerber method as per IS: 1224 (Part-II) 1977; protein by the micro-Kjeldahl method ($N \times 6.38$) as per IS: 1479 (Part-II) 1961; total sugar by the Lane and Eynon volumetric method after acid inversion, as per IS: SP 18 (Part XI)–1981; total ash by the muffle furnace method as per IS: 1479 (Part-II) 1961; vitamin C (ascorbic acid) by the 2,6-dichlorophenol-indophenol (DCPIP) titration method; titratable acidity by titration against 0.1 N NaOH using phenolphthalein indicator as per IS: 1479 (Part-I) 1960; and pH using a digital pH meter standardized with buffer solutions at 25 °C.

Statistical analysis

The data obtained were analysed statistically in a Completely Randomized Design (CRD) with five replications, as suggested by Amble (1984) [2].

Results and discussion

The physico-chemical properties of kalakand prepared with different levels of Indian gooseberry shreds, viz., moisture, total solids, fat, protein, total sugar, total ash, vitamin C, acidity and pH, were determined and the mean values are presented in Table 1.

Table 1. Mean values of physico-chemical properties of kalakand prepared with different levels of Indian gooseberry shreds

Treatment	Moisture (%)	Total Solids (%)	Fat (%)	Protein (%)	Total Sugar (%)	Total Ash (%)	Vitamin C (mg/100g)	Acidity (%)	pH
T ₁ (Control, 0.02% citric acid)	29.60	70.40	20.50	14.20	31.27	2.29	0.00	0.50	5.85
T ₂ (100% milk + 2% Indian gooseberry shreds)	30.66	69.34	19.80	13.84	30.94	2.33	22.10	0.55	5.62
T ₃ (100% milk + 4% Indian gooseberry shreds)	31.70	68.30	19.10	13.50	30.60	2.37	40.97	0.61	5.38
T ₄ (100% milk + 6% Indian gooseberry shreds)	32.80	67.20	18.30	13.17	30.26	2.41	54.91	0.67	5.15
T ₅ (100% milk + 8% Indian gooseberry shreds)	33.80	66.20	17.60	12.84	29.92	2.45	69.29	0.73	4.92
T ₆ (100% milk + 10% Indian gooseberry shreds)	34.84	65.16	16.80	12.50	29.58	2.50	85.19	0.79	4.69
SE(m) ±	0.044	0.044	0.057	0.026	0.025	0.011	0.576	0.007	0.014
CD at 5%	0.128	0.132	0.170	0.077	0.075	0.032	1.682	0.023	0.042

Values with different superscripts within a column differ significantly ($P < 0.05$)

Moisture

The moisture content of kalakand increased progressively from 29.60 per cent (T₁) to 34.84 per cent (T₆) with increasing levels of Indian gooseberry shreds. The lowest moisture content was recorded in the control (T₁), while the highest was observed in T₆. The increase in moisture may be attributed to the higher moisture content contributed by the Indian gooseberry shreds incorporated into the product.

Total solids

Total solids content decreased from 70.40 per cent in T₁ to 65.16 per cent in T₆, showing a trend inverse to that of moisture. The decline in total solids with increasing gooseberry shreds is consistent with the corresponding rise in moisture content of the product.

Fat

Fat content declined from 20.50 per cent (T₁) to 16.80 per cent (T₆) with increasing levels of Indian gooseberry shreds. The reduction in fat percentage may be due to a dilution effect, as the fat contributed by cow milk was proportionately reduced with increasing incorporation of the relatively low-fat gooseberry shreds.

Protein

Protein content decreased from 14.20 per cent in T_1 to 12.50 per cent in T_6 . The decreasing trend in protein content with increasing levels of Indian gooseberry shreds may again be attributed to a dilution effect, since Indian gooseberry contains comparatively lower protein than cow milk.

Total sugar

Total sugar content decreased from 31.27 per cent (T_1) to 29.58 per cent (T_6) with increasing incorporation of Indian gooseberry shreds, which contain a comparatively low sugar content relative to the concentrated milk solids of kalakand.

Total ash

Total ash content increased from 2.29 per cent in T_1 to 2.50 per cent in T_6 , indicating a progressive rise in mineral content with increasing levels of Indian gooseberry shreds, owing to the mineral-rich composition of the fruit.

Vitamin C

Vitamin C content increased markedly from 0.00 mg/100 g in T_1 to 85.19 mg/100 g in T_6 . This substantial increase reflects the naturally high ascorbic acid content of Indian gooseberry, confirming its potential as a functional, vitamin C-fortifying ingredient in kalakand, despite partial loss of vitamin C during heat processing.

Acidity

Titrate acidity increased from 0.50 per cent (T_1) to 0.79 per cent (T_6) with increasing levels of Indian gooseberry shreds, attributable to the natural organic acids present in the fruit.

pH

The pH of kalakand decreased progressively from 5.85 in T_1 to 4.69 in T_6 with increasing incorporation of Indian gooseberry shreds, corresponding to the observed increase in titrate acidity, and confirming the coagulating and acidifying effect of the gooseberry shreds.

Conclusion

The incorporation of Indian gooseberry (*Phyllanthus emblica* L.) shreds as a natural coagulant significantly influenced the physico-chemical properties of kalakand. Total solids, fat, protein, total sugar and pH decreased, while moisture, total ash, vitamin C and titrate acidity increased with increasing levels of Indian gooseberry shreds. The marked increase in vitamin C content confirms the potential of Indian gooseberry shreds as a functional, nutritionally enriching natural coagulant. On the basis of the physico-chemical characteristics along with sensory evaluation, kalakand prepared with 4 per cent Indian gooseberry shreds (T_3) was found to be the most suitable, offering a favourable balance between nutritional enrichment and product quality, at an economical production cost of Rs. 368.75 per kg.

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