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Proximate Composition and Sensory Evaluation of Ambika Mango (Mangifera indica) Pulp Fortified Yoghurt

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Abstract

Yoghurt was formulated and flavored with ambika mango pulp (AMP) at substitution levels of 0, 10, 20, 30, 40 and 50 % of the total yoghurt content. Proximate composition and sensory attributes of the yoghurts were evaluated using standard analytical methods, with plain yoghurt (PY) serving as the control. Results showed a decrease in protein, ash, fat, and fiber content as the proportion of ambika mango pulp increased, while moisture content exhibited a proportional increase. Sensory evaluation revealed that the plain yoghurt (control) achieved the highest mean scores (7.95) for all evaluated attributes, including color, flavor, taste, consistency, and mouthfeel, making it the most preferred sample with an overall acceptability score of 7.95. Among the fortified variants, the 90:10 sample received the highest overall acceptability score (7.35) and ranked second in preference. Samples containing 10 and 20 % ambika mango pulp were generally well-accepted, whereas samples with 30, 40 and 50 % pulp were deemed unacceptable due to lower sensory scores. No significant difference ($p > 0.05$) was observed between the plain yoghurt and the 10 % ambika mango pulp-fortified yoghurt in terms of sensory attributes. These findings suggest that yoghurt fortified with 10% ambika mango pulp is comparable to plain yoghurt in acceptability and could be suitable for commercial production.

Keywords: Dairy product, Fortification, Natural flavour, Optimization and Sensory analysis

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Introduction

Yoghurt is one of the most widely consumed fermented dairy products globally, prized for its nutritional benefits, probiotic content, and appealing sensory properties. It is an excellent source of high-quality protein, calcium, vitamins, and live beneficial microorganisms that promote gut health and boost immunity. Over the years, there has been growing interest in enhancing the nutritional profile of yogurt through the incorporation of natural fruit-based additives, which can enrich it with vitamins, minerals, dietary fiber, and bioactive compounds. This innovation aligns with consumers' increasing preference for functional foods that combine health benefits with sensory satisfaction. Among tropical fruits, mango (*Mangifera indica*) stands out for its rich flavor, vibrant color, and exceptional nutritional profile. Mango pulp contains significant amounts of vitamins A and C, dietary fiber, potassium, and natural sugars, alongside phytochemicals like carotenoids and polyphenols that exhibit antioxidant properties. The ambika mango variety, known for its distinctive sweetness and aromatic profile, holds great potential as a functional ingredient in yogurt production. Fortifying yogurt with mango pulp can enhance its taste, texture, and nutritional value while addressing the demand for innovative dairy products with a natural and wholesome appeal [1].

This study focuses on evaluating the proximate composition and sensory attributes of yogurt fortified with varying levels of ambika mango pulp. The proximate composition analysis aims to quantify the macronutrient content—such as moisture, protein, fat, ash, fibre and carbohydrate levels—in the fortified yogurt, providing insights into its nutritional profile. Concurrently, sensory evaluation is conducted to assess consumer acceptance, focusing on attributes such as taste, color, texture, and overall appeal. The findings from this research can have implications for both academic and industrial domains [1]. Academically, the study contributes to the growing body of literature on functional dairy products, emphasizing the role of tropical fruits like mango in enhancing their nutritional and sensory qualities. From an industrial perspective, the outcomes can guide the development of novel dairy formulations that cater to the health-conscious consumer market. Additionally, promoting the utilization of ambika mango pulp in yogurt production can

encourage the value-added use of indigenous fruit varieties, supporting local agriculture and reducing post-harvest losses.

Materials and Methods

Source of Raw Materials

The ambika mango (*Mangifera indica*) was obtained from koyembedu market while skimmed milk, starter culture, sugar and stabilizer were purchased from Chennai, Tamil Nadu.

Ambika mango Fruit pulp Production

The ambika mango fruit was processed according to [2] procedure. The Ambika mango fruits were sorted to remove the bad ones after which they were washed and peeled. Fruit pulp was extracted using a Pulping machine and pasteurized for 85 ºC for 3 minutes. The pulp was then cooled.

Production of ambika mango flavoured yoghurt

The raw materials were appropriately weighed and mixed with water. The mixed product was then homogenized to obtain a creamy and uniform product. Pasteurization was then carried out at 85ºC for 30 minutes to destroy the undesirable microorganism in the raw materials to provide a favour environment free from competition for the growth of the starter culture. The product was then cooled to a temperature of 43-46 ºC which is the ideal growth temperature of the starter culture. The ambika mango fruit pulp was added. The starter inoculated. Fermentation was then carried out for 18 hours after which the yoghurt was set.

Proximate analysis

Moisture content

The moisture content of the fortified yoghurt was determined by AOAC (2006) method. The weight loss percentage after oven-drying at 105° C until a constant weight was obtained and moisture content (%) was calculated.

Crude protein content

The protein content of the fortified fortified yoghurt was estimated by Kjeldahl method (AOAC, 2006).

Fat content

The fat content of fortified yoghurt was determined by solvent extraction method using Soxhlet apparatus with hexane as solvent (AOAC, 2006).

Total carbohydrates

Total carbohydrates were determined by the method of Lane and Eynon as reported by Ranganna (1986).

Total ash content

Ash content of the fortified yoghurt represents the inorganic residue remaining after destruction of organic matter. The total ash content of the samples was estimated according to AOAC, (2006).

Sensory evaluation

Organoleptic evaluation of fruit yoghurt was carried out by a panel of judges for flavour and body texture, according to method approved by American Dairy Association [2].

Statistical analysis

The statistical techniques were followed namely, the analysis of variance (one-way ANOVA) was used for the determination of significance between the control and fortified yoghurt samples during the assessment of quality parameters by IBMSPSS®20.0 [11] for selection the ingredients levels for the development of fortified yoghurt.

Results and Discussion

Table 1 presents the proximate composition (%) of yoghurt fortified with ambika mango pulp. The moisture content of the fortified yoghurt ranged between 86.27 and 85.17% (Table 1). Statistical analysis indicated no significant difference ($p < 0.05$) in moisture content across the samples PY:AMP (100:0, 90:10, 80:20, and 60:40). However, the sample with an 80:20 ratio exhibited the lowest moisture content, while the 70:30 sample had the highest. This trend suggests a reduction in moisture levels with an increasing concentration of ambika mango pulp. The observed decrease in moisture content might be due to the progressive replacement of yoghurt volume by the mango pulp. The moisture content range observed in this study aligns with the previously reported values of 80.45–90.47% for yoghurt flavored with solar-dried bush mango pulp [3].

Table 1 Proximate composition (%) of ambika mango pulp fortified yoghurt.

Sample (PY:AMP)	Moisture	Crude protein	Ash	Crude fat	Crude fibre	Carbohydrate
100:0	85.17b ± 0.02	3.42b ±0.01	0.28c±0.02	0.67e ±0.01	1.31a ±0.02	7.99a± 0.03
90:10	85.18c ±0.03	3.27c ±0.02	0.24b ±0.01	0.51d ±0.01	1.48b ±0.08	8.25b ±0.02
80:20	85.15b ± 0.09	2.22b ±0.00	0.20d ±0.00	0.43c ±0.00	1.44b ±0.01	9.35d ±0.10
70:30	86.13d ± 0.09	2.32b ±0.01	0.18a ±0.00	0.29e ±0.01	1.71a ±0.05	8.84c ±0.20
60:40	85.56d± 0.06	2.33d ±0.08	0.26c ±0.00	0.23b ±0.01	2.22d ±0.01	7.64ab ±0.01
50:50	86.27a ± 0.20	1.31a ±0.01	0.31c ±0.01	0.17a ±0.00	2.87c ±0.04	11.35e ±0.03

Values are mean standard deviation of triplicate readings. Values on the same column with different superscript are significantly different ($p<0.05$);PY- Plain yoghurt, AMP-ambika mango pulp

Crude Protein levels, as shown in Table 1, ranged from 1.31 to 3.42 %, with plain yoghurt exhibiting the highest protein content. Protein levels declined as the concentration of ambika mango pulp increased, likely due to the lower protein content of mango pulp compared to milk. The protein content of plain yoghurt in this study was consistent with the range of 3.4–5.6 % reported for soymilk-based plain yoghurt [4]. Crude fat content, detailed in Table 1, ranged from 0.17 to 0.67%, with the highest value observed in plain yoghurt (100:0). Fat content decreased as mango pulp concentration increased, attributed to the low fat content of ambika mango pulp. Significant differences ($p < 0.05$) were found in fat content between plain yoghurt and the fortified variants, although no significant difference was observed between the 70:30 and 90:10 samples. The fat content range of 0.17–0.67 % classifies the formulated product as non-fat yoghurt, comparable to the range of 0.15–0.80 % reported for tamarind-flavored yoghurt [4].

Ash Content, as shown in Table 1, ranged from 0.18% (in samples 70:30 and 50:50) to 0.28%. The ash content in fortified yoghurt was slightly lower than that of plain yoghurt, with non-significant differences ($p < 0.05$) between samples 80:20 and 70:30, as well as 90:10 and 80:20. This reduction in ash content with increasing mango pulp addition can be attributed to the substitution of milk with mango pulp, which has lower mineral content. The ash content in this study was lower than the range of 1.21–1.38% reported for yoghurt fortified [5]. Ash, representing the mineral residue after organic matter combustion, is abundant in milk but relatively lower in ambika mango pulp [5]. Fibre Content, as presented in Table 1, ranged from 1.31 % in plain yoghurt (100:0) to 2.87 % in the 50:50 sample. Statistical analysis showed no significant difference ($p < 0.05$) in fibre content among samples 70:30, 90:10, and 80:20. The observed increase in fibre content is attributed to the incorporation of ambika mango pulp. Carbohydrate Content ranged from 7.64 to 11.35%, as indicated in Table 1. Carbohydrate levels increased with the addition of ambika mango pulp, with the 50:50 sample exhibiting the highest carbohydrate content. This increase is likely due to the naturally high carbohydrate content of ambika mango pulp [6].

Table 2 Sensory scores of ambika mango pulp fortified yoghurt (9 point Hedonic scale).

Sample (PY:AMP)	Colour	Flavour	Taste	Aftertaste	Consistency	Mouthfeel	Overall Acceptability
100:0	8.20c ±0.15	7.65b ±0.56	7.55d ±0.07	7.35d ±1.12	6.95d ±0.25	7.55c ±0.70	7.95dc ±0.72
90:10	7.31d ±0.26	6.80c ±1.07	6.87c ±1.45	7.11c ±1.04	7.55cd±1.14	7.00cd ±1.21	7.35d ±0.24
80:20	6.84e±1.06	6.15b ±1.04	5.93b ±1.57	6.35c ±1.58	6.70b±0.06	6.80b ±0.85	6.200c ±0.36
70:30	6.15b±1.18	5.65a ±1.05	5.62b ±1.42	5.60bc±1.01	6.65bc±1.55	6.35b ±1.25	5.15b ±1.54
60:40	5.61ab±1.55	5.05a ±1.54	4.72a ±1.31	5.10ab±1.02	5.70a±1.25	5.90ab ±1.14	4.30ab±1.80
50:50	4.94a ±1.25	4.95d±1.55	4.31a ±1.35	4.50a ±1.24	4.30a ±2.86	4.15a ±2.75	3.60a ±1.25

Values are mean ± standard deviation of 20 panelists. Means on the same column with different superscripts are significantly different ($P<0.05$); PY= Plain yoghurt; AMP-ambika mango pulp

Table 2 presents the sensory evaluation scores for yoghurt fortified with ambika mango pulp. The mean scores for overall acceptability ranged from 3.60 in the 50:50 sample to 7.95 in plain yoghurt. Plain yoghurt consistently received the highest mean scores (7.95) across all sensory attributes, including color, flavor, taste, aftertaste, consistency, and mouthfeel, making it the most preferred sample with an overall acceptability score of 7.95.Among the fortified samples, the 90:10 formulation achieved the highest mean score for overall acceptability (7.35) and was ranked second in overall preference. In contrast, samples with higher concentrations of ambika mango pulp (30, 40 and 50%) recorded lower mean scores across all sensory parameters, with overall acceptability scores of 5.15, 4.30, and 3.60, respectively, making them the least preferred variants. The overall acceptability score of 6.70 for yoghurt containing 10% African bush mango pulp was not significantly different ($p < 0.05$) from the 6.75 reported for yoghurt flavored with solar-dried ambika mango pulp [7, 8]. These findings suggest that yoghurt fortified with up to 20% ambika mango pulp can be formulated without adversely affecting consumer acceptability [9].

Conclusion

The incorporation of ambika mango pulp as flavoring agents in yoghurt enhanced the proximate and sensory properties of the formulated product. The utilization of this underutilized natural flavor, ambika mango, not only diversifies yoghurt options but also boosts its nutritional and medicinal value. The study revealed that the addition of ambika mango pulp positively influenced the proximate composition and sensory appeal of the yoghurt. Among the formulations, the yoghurt blended with ambika mango pulp at a 90:10 ratio emerged as the most preferred, achieving a general acceptability score of 7.35. Similarly, the 90:10 pulp blend was highly rated among flavored yoghurt samples. Based on these findings, it is recommended to explore further research on ambika mango pulp to enhance its sensory characteristics and extend the shelf life of its juice and pulp for use as flavoring agents. Consumer awareness campaigns should be initiated to highlight the nutritional and health benefits of ambika mango pulp as part of strategies for food diversification and domestication of this indigenous fruit. Additional studies on the shelf stability of ambika mango pulp-fortified yoghurt are also encouraged to support its commercial viability.

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