International Journal of Chemistry Studies
www.chemistryjournal.in
ISSN: 2581-348X
Received: 13-10-2024, Accepted: 12-11-2024, Published: 27-11-2024
Volume 8, Issue 2, 2024, Page No. 52-54

Physico-chemial analysis and sensory evaluation of ambika mango (*Mangifera indica*) juice fortified yoghurt

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Abstract
Yogurt was developed and enhanced with varying concentrations of ambika mango juice (AMJ) at substitution levels of 0%, 10%, 20%, 30%, 40%, and 50% of the total yogurt composition. The proximate composition and sensory characteristics of the fortified yogurts were analyzed using standardized methodologies, with plain yogurt (PY) serving as the control. The results demonstrated a progressive reduction in protein, ash, fat, and fiber content with increasing proportions of AMJ, while moisture content increased correspondingly. Sensory analysis indicated that the plain yogurt achieved the highest mean scores (7.95) across all evaluated attributes—color, flavor, taste, consistency, and mouthfeel—emerging as the most favored sample with an overall acceptability score of 7.95. Among the fortified variants, the 90:10 yogurt (90% yogurt and 10% AMJ) recorded the highest sensory acceptance score (7.35), ranking second in preference. Yogurts fortified with 10% and 20% AMJ were widely accepted, while formulations containing 30%, 40%, and 50% AMJ scored lower on sensory attributes, rendering them less acceptable. Statistical analysis revealed no significant differences ($p > 0.05$) between the sensory attributes of plain yogurt and the 10% AMJ-fortified sample. These findings indicate that incorporating 10% AMJ into yogurt maintains sensory acceptability comparable to plain yogurt, making it a promising candidate for commercial production.

Keywords: Physico-chemial analysis, ambika mango (*Mangifera indica*), yoghurt

Introduction

Materials and Methods

Source of Raw Materials

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

Ambika mango fruit juice production

The ambika mango fruit was processed according to [10] procedure. The ambika mango fruits were sorted to remove the bad ones after which they were washed and peeled. Fruit juice was extracted using a juice extractor (Juiceing machine) and pasteurized for 85 ºC for 3 minutes. The juice 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 43-46ºC which is the ideal growth temperature of the starter culture. The Ambika mango fruit juice/ juice was added. The starter inoculated. Fermentation was then carried out for 18 hours after which the yoghurt was set.

Determination of physico-chemical parameters

pH

The pH meter was calibrated with commercial buffer solutions at pH 9.1 and 4.0 before measurement. About 10 ml of sample was inserted with a pH electrode and pH was recorded after stabilization (AOAC, 2000)[10].

Titratable acidity

Titratable acidity (as per cent lactic acid) of the fortified beverage was estimated as titratable acidity (TA) of fortified milk beverage samples as determined by titration method (Ranganna, 1986).

Total solids

The total solid content (%) of the fortified milk beverage was calculated by gravimetric method according to AOAC, 2006.

Reducing sugar

Standard invert sugar solution

A 1-litre volumetric flask was accurately filled with 9.5g of AR sucrose before being filled with 100ml of water and 5ml of conc. HCl. The solutions were left for three days between 20 and 25° C in order to allow for inversion and then distilled water was used to make up the solutions.

Preparation of sample

25 ml or 25 g of shrikhand is placed into a 250 ml volumetric flask. 100 ml of water was then added and 1N sodium hydroxide was used to neutralize the mixture. Lead acetate solution (2 ml) was added and the mixture was shaken before being allowed to stand for 10 minutes. To eliminate the surplus lead, the required volume of potassium oxalate solution was added and the volume was made up with water and then filtered.

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 [17].

Statistical analysis

Two kinds of statistical techniques were followed namely, the analysis of variance (two-way ANOVA) was used for thedetermination of significance between the control and treated samples during the assessment of quality parameters by IBMSPSS®20.0 [11].

Results and Discussion

Table 3 shows some selected physico-chemical of yoghurt fortified with ambika mango juice. Table 3 showed that the pH of the fortified yoghurt ranged from 4.67 in (100:0) and 5.11 in (70:30). The fortified yoghurt had slightly higher pH values than plain yoghurt but this difference was not significant ($p < 0.05$). Addition of ambika mango juice slightly lowered the acidity of the yoghurts and this was however in contrast with the report given by [5] whose results indicated that the use of indigenous fruits as flavours resulted in a slight increase in the acidity of yoghurts. It was also observed that addition of ambika mango juice resulted to a more less acidic yoghurt compared to that of the ambika mango juice this, might be attributed to the pH of the ambika mango juice which was observed to be slightly acidic. The pH value of formulated yoghurt with ambika mango juice concentration of 30% agreed with the value (5.49) reported by [6]. The decrease in acidity could probably be attributed to fact that the acidity of fruits decrease as they ripen.

Table 1: Physico-chemical analysis of ambika mango juice fortified yoghurt

Sample (PY:AMJ)	pH	Titrable acidity (%)	Total solids (%)	Reducing sugar(%)
100:0	4.67^{a} ±0.10	0.95^{c}±0.05	13.25^{a}±0.05	8.33^{a} ±0.01
90:10	4.68^{b} ±0.09	0.93^{bc}±0.05	13.35^{ab}±0.08	8.85^{a}±0.02
80:20	4.71^{d} ±0.07	0.90^{b} ±0.01	13.24^{a}±0.10	9.80^{bc}±0.09
70:30	5.11^{a} ±0.08	0.86^{ad} ±0.02	12.87^{a} ±0.09	9.20^{ab}±0.07
60:40	4.72^{c} ±0.09	0.99^{e} ±0.01	13.65^{ab}±0.07	9.90^{c} ±0.17
50:50	4.77^{a} ±0.01	0.92^{de}±0.02	14.26^{b} ±0.08	11.56^{d} ±0.10

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, AMJ-Ambika mango juice

Total solids increased with increase in concentration of the ambika mango juice in yoghurt. The (50:50) had highest total solids content (14.24%). [5] reported total solids values for yoghurts flavoured with tamarind ranging from (13.12 - 21.78%). Similar results ranged from 12.87 to 14.26% were obtained from this study. The total solids value obtained in this study was lower than that reported on yoghurt flavoured with solar-dried bush mango (*Irvingia gabonensis*) juice by [5]. This could be attributed to the nature of the ambika mango used in this study (juice and wet juice).

Table 3 showed that the titrable acidity were decreased with increase in the pH values. Titrable acidity ranged from 0.86% (70:30) to 0.93 % (90:10). [7] reported titrable acid values for soursop juice flavoured yoghurts ranging from 0.69 - 0.83%. Similar results 0.76 - 0.91% were obtained from this study.

Table 2: Sensory scores of ambika mango juice fortified yoghurt (9 point Hedonic scale)

Sample (PY:AMJ)	Colour	Flavour	Taste	Consistency	Mouth feel	Overall Acceptability
100:0	8.12^{d} ±0.55	7.65^{d} ±0.87	7.65^{e} ±0.71	6.85^{c} ±0.73	7.80^{d} ±0.29	7.85^{e} ±0.29
90:10	6.55^{c} ±0.75	6.55^{c} ±0.25	6.35^{e} ±0.35	6.62^{c} ±0.55	6.25^{c} ±0.63	6.72d ±0.27
80:20	6.15^{c} ±1.43	5.27^{c} ±1.29	5.05^{e} ±1.38	5.78^{bc}±1.33	4.80^{b} ±1.44	5.30^{c} ±1.49
70:30	4.25^{b} ±1.56	4.78^{bc}±1.74	4.34^{e} ±1.50	5.25^{ab}±1.87	3.45^{a} ±1.30	4.39^{c} ±1.57
60:40	3.45^{a} ±1.67	4.35^{ab}±1.75	3.53^{e} ±1.33	4.45^{a} ±2.50	3.27^{a} ±1.35	3.45^{ab}±1.70
50:50	3.07^{a} ±2.00	4.17^{a} ±1.99	2.90^{e} ±1.32	4.28^{a} ±2.50	3.25^{a} ±1.92	3.25^{a} ±1.92

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; AMJ-Ambika mango juice

Table 2 presents the sensory evaluation scores for yoghurt fortified with Ambika mango juice. The mean scores for overall acceptability ranged from 3.25 in the 50:50 sample to 7.85 in plain yoghurt. Plain yoghurt consistently received the highest mean scores (7.85) across all sensory attributes, including color, flavor, taste, consistency, and mouthfeel, making it the most preferred sample with an overall acceptability score of 7.85. Among the fortified samples, the 90:10 formulation achieved the highest mean score for overall acceptability (6.72) and was ranked second in overall preference. In contrast, samples with higher concentrations of Ambika mango juice (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 juice was not significantly different ($p < 0.05$) from the 6.75 reported for yoghurt flavored with solar-dried Ambika mango juice [7, 8]. These findings suggest that yoghurt fortified with up to 20% Ambika mango juice can be formulated without adversely affecting consumer acceptability [9].

Conclusion

The inclusion of ambika mango juice as a natural flavoring agent in yogurt improved its physicochemical and sensory properties, enhancing both its nutritional profile and consumer appeal. Utilizing this underexplored tropical fruit not only broadens the spectrum of flavored yogurts but also adds medicinal and nutritional benefits due to its bioactive compounds. The study demonstrated that the incorporation of ambika mango juice positively impacted the yogurt's

proximate composition and sensory evaluation. Notably, the yogurt containing ambika mango juice in a 90:10 ratio was the most preferred formulation, achieving a general acceptability score of 6.72. This ratio also ranked highest among the flavored yogurt samples for its balance of sensory attributes. To leverage these findings, further research should focus on optimizing the sensory qualities of ambika mango juice, as well as extending its shelf life for use as a flavoring agent. Additionally, public awareness campaigns could promote the nutritional and health benefits of ambika mango juice, supporting food diversification and the domestication of this indigenous fruit. Studies on the shelf stability and commercial viability of ambika mango juice-fortified yogurt are essential to foster its acceptance and large-scale production.

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