



## Micro-nutrient composition and microbial evaluation of fruit flavoured yoghurt with papaya pulp

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### Abstract

The vitamins and minerals of the yoghurts were determined using standard procedures. Plain yoghurt (PY) served as the control. The results showed that plain yoghurt sample PY:PP (100:0) were had less vitamins content and increases while incorporating papaya pulp concentrations. This is probably due to the micronutrient content of papaya pulp. Micro-nutrient (vitamin A and C) increased with increased level of papaya pulp in the yoghurt while (phosphorus and calcium) decreased with increased level of papaya pulp in the yoghurt. Microbial quality for total plate count, coliform count and yeast and mold count was analyzed at 0, 3, 5 and 7 days and which were found more in the experimental sample than the control. The coliform and yeast/molds count was zero up to 5 days. Sample containing 30 % of papaya pulp in yoghurt were generally acceptable while samples containing 40 and 50% of the pulp were generally unacceptable due to increase in microbial count.

**Keywords:** fruit flavoured, microbial evaluation

### Introduction

Yoghurt is a widely consumed fermented dairy product known for its nutritional value, sensory appeal, and health benefits. It serves as an excellent source of protein, calcium, vitamins, and probiotics, making it a staple in diets worldwide. In recent years, the food industry has witnessed a growing trend toward incorporating fruit into yoghurt, driven by consumers' increasing preference for functional foods that provide additional health benefits. Among various fruits, papaya (*Carica papaya*) has garnered attention due to its rich nutrient profile and functional properties. This research focuses on the development and evaluation of fruit-flavored yoghurt enriched with papaya pulp, emphasizing its micronutrient composition and microbial quality [1, 4].

Papaya is a tropical fruit renowned for its vibrant flavor, high water content, and impressive nutritional attributes. It is a rich source of essential vitamins, such as vitamin C and vitamin A, and minerals, including potassium and magnesium. Papaya also contains bioactive compounds like papain, an enzyme that aids digestion, and antioxidants such as beta-carotene, which help combat oxidative stress. Incorporating papaya pulp into yoghurt not only enhances its sensory characteristics but also offers potential health benefits, including improved digestion, immune support, and reduced risk of chronic diseases. Furthermore, papaya's natural sweetness can reduce the need for added sugars, aligning with consumer demands for healthier food options. The combination of papaya pulp with yoghurt offers a promising approach to creating a functional food product. However, the success of such formulations depends on their nutrient stability, sensory acceptability, and microbial safety. The microbial quality of yoghurt is a critical factor, as it directly impacts shelf life, safety, and the presence of probiotic bacteria. Probiotic cultures, such as *Lactobacillus bulgaricus* and *Streptococcus thermophilus*, are vital for the fermentation process and provide additional health benefits, including gut health and enhanced immunity. At the same time, ensuring the absence of pathogenic and spoilage

microorganisms is paramount to maintaining product quality and safety [5, 7].

This study investigates the micronutrient composition and microbial evaluation of fruit-flavored yoghurt supplemented with papaya pulp. The primary objectives are to assess the nutritional enhancement imparted by papaya pulp, evaluate its effect on the yoghurt's microbial profile, and determine the product's overall acceptability. A detailed analysis of the micronutrient profile, including vitamins, minerals, and antioxidant content, will shed light on the health benefits of the formulated yoghurt. Additionally, the study examines the microbial load, focusing on probiotic viability and the absence of harmful contaminants, ensuring the product meets safety standards [8].

The incorporation of papaya pulp into yoghurt aligns with the growing consumer interest in functional foods that bridge the gap between nutrition and indulgence. This research contributes to the field by providing insights into the formulation and quality attributes of papaya-enriched yoghurt, offering a sustainable and nutritious product innovation. By addressing both nutritional and microbial aspects, the study aims to enhance understanding of the potential benefits and challenges associated with fruit-flavored yoghurt, paving the way for broader application in the dairy and functional food industries.

### Material and methods

#### Source of raw materials

The papaya 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.

#### Papaya fruit pulp production

The papaya fruit was processed according to [9] procedure. The papaya fruits were sorted to remove the bad ones after which they were washed and peeled. Fruit pulp was extracted using a pulp extractor (Pulping machine) and pasteurized for 85 °C for 3 minutes. The pulp was then cooled.

### Production of papaya 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 85°C 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°C which is the ideal growth temperature of the starter culture. The papaya fruit pulp/pulp was added. The starter inoculated. Fermentation was then carried out for 18 hours after which the yoghurt was set.

### Determination of vitamin A content of the formulated flavoured yoghurt

Vitamin A content was determined according to [8] procedure. Then, 5 ml sample was first saponified using an alcoholic solution of potassium hydroxide in the presence of pyrogallol. This freed the vitamins from the food matrix and converted any retinyl ester to retinol. The unsaponified matter containing vitamin A was extracted using a mixture of diethyl ether and petroleum spirit. The extract was evaporated under nitrogen and the residue was dissolved in methanol. The extract was chromatographed using a reverse phase octadecyl silane (ODS) column with the mobile phase consisting of 95% acetonitrile with 5% water. The separated retinol was then quantified using a UV absorbance detector at 328 nm.

### Determination of vitamin C content of the formulated flavoured yoghurt

The ascorbic acid was determined using the method of [10]. Then, two millilitres (2ml) of the sample was weighed and 100 ml of distilled water was added to it. It was then filtered to get a clear solution. Also, 10 ml of the clear solution was pipette into small flask in which 2.5 ml acetone was added. It was then titrated with indophenols solution (2, 6-dichlorophenolindophenol) to a faint pink colour which persists for 15 seconds.

### Microbial analysis

The microbial quality of yogurt drink samples, including Total Viable Count (TVC), Coliform Count, and Yeast and Mold Count, was assessed using the Standard Methods for the Examination of Dairy Products outlined by the American Public Health Association (APHA, 1989). The following media were employed for microbial enumeration: Total Viable Count (TVC): Plate Count Agar (PCA), Coliform Count: Violet Bile Red Agar (VBRA), Yeast and Mold Count: Potato Dextrose Agar (PDA). The Total Viable Count was calculated by multiplying the number of Colony-Forming Units (CFUs) observed on the plates with the corresponding dilution factor, followed by converting the result to logarithmic form to standardize the data. The Coliform Count was determined using the Most Probable Number (MPN) method, which provides an estimate of microbial load in the sample based on statistical probability. For the Yeast and Mold Count, colonies formed on the PDA plates were directly enumerated to determine fungal contamination levels.

### Statistical analysis

Two kinds of statistical techniques were followed namely, the analysis of variance (two-way ANOVA) was used for

the determination of significance between the control and treated samples during the assessment of quality parameters by IBMSPSS®20.0 (14) and conjoint analysis [13] for selection the ingredients levels for the development of flavoured drink.

## Results and discussion

**Table 1:** Micronutrient analysis for papaya flavoured yoghurt

Sample (PY:PP)	Vitamin A (IU)	Vitamin C Phosphorus Calcium		
		(mg/100g)		
100:0	18.83 <sup>d</sup> ±0.21	12.20 <sup>d</sup> ±0.85	53.56 <sup>e</sup> ±0.05	42.14 <sup>c</sup> ±1.12
90:10	58.62 <sup>c</sup> ±0.33	14.80 <sup>e</sup> ±1.45	23.83 <sup>e</sup> ±1.02	18.67 <sup>c</sup> ±1.13
80:20	71.72 <sup>c</sup> ±0.47	15.54 <sup>e</sup> ±1.22	22.39 <sup>e</sup> ±1.38	15.96 <sup>b</sup> ±1.05
70:30	97.71 <sup>b</sup> ±0.62	17.79 <sup>b</sup> ±1.75	12.44 <sup>e</sup> ±1.22	13.96 <sup>b</sup> ±1.45
60:40	30.61 <sup>a</sup> ±0.56	12.58 <sup>ab</sup> ±1.45	45.71 <sup>e</sup> ±1.74	9.60 <sup>b</sup> ±1.23
50:50	96.05 <sup>a</sup> ±1.05	12.60 <sup>a</sup> ±1.05	44.61 <sup>e</sup> ±1.55	6.99 <sup>a</sup> ±1.24

Values are mean ± standard deviation of duplication readings. Means on the same column with different superscripts are significantly different (P<0.05).

**Key:** PY= Plain yoghurt & PP= Papaya pulp

The selected vitamins and minerals composition of the flavoured yoghurt samples are shown in Table 1. It shows the effect of papaya flavour on micronutrients content of the formulated sample. The vitamin A content ranged from 18.83- 97.71 IU. The plain yoghurt sample PY:PP (100:0) had the lowest vitamin A content while sample PY+PP (70:30) had the highest value. However, there was significant (p < 0.05) difference in the vitamin A content of the samples PY (100:0) and the formulated flavoured yoghurt samples. The vitamin A content increased with increase in the addition of papaya pulp compared to the vitamin A content of the plain yoghurt sample PY+PP (100:0). This is probably due to the vitamin A content of papaya pulp. The result range (18.83- 97.71 IU) observed in this study concurred with the value range (35.02-280.18 IU) reported by [10]. The result also showed that the papaya pulp contained more vitamin A than its pulp.

The ascorbic acid (vitamin C) content (Table 1) had a range between 12.20 mg/100 g in plain yoghurt and 17.79mg/100g in the sample flavoured with 30% papaya pulp. The ascorbic acid content increased with the addition of papaya pulp. This is probably due to the high ascorbic acid content of papaya pulp. The flavoured yoghurt samples with papaya pulp contained higher amount of vitamin C compared those flavoured with the pulp. Studies had shown that ascorbate favours iron absorption by reducing the inorganic iron III (ferric) complexes in food to iron II (ferrous), a form in which it is more readily absorbed according to [11]. Vitamin C (ascorbic acid) content of formulated yoghurt samples flavored with solar- dried bush mango pulp reported by [10] was far lower than that obtained in this study.

Phosphorus (P) content is ranged from 12.44 mg/100g in the sample containing with 30% papaya pulp to 53.56 mg/100g in sample plain yoghurt (Table 01). Phosphorus content decreased with increase in concentration of the papaya pulp content of the yoghurt. Also, phosphorus decreased with increase in concentration of papaya pulp compared with the plain yoghurt. The plain yoghurt had the highest phosphorus content (53.56 mg/100g). There was significant (p < 0.05) difference in phosphorus content of the flavoured samples.

Table 1 showed that the calcium (Ca) content of the samples ranged between 6.99 mg/100g of the formulated yoghurt with papaya pulp to 42.14 mg/100mg. Plain yoghurt had the highest calcium content. There was significant ( $p < 0.05$ ) difference in the calcium content of the plain yoghurt sample and the samples. The lower level of calcium in the

samples containing papaya pulp could be attributed to the substitution of milk with papaya pulp which has lower calcium content. [5] reported that, papaya pulp had a calcium content of 4.0 mg/100 g and 20 mg/100 g reported by [8]. Plain Yoghurt however contains 120.8 mg of calcium per 100g [12].

**Table 2:** Microbial analysis of papaya flavoured yoghurt

Parameter (PY:PP)	TPC, log (CFU g-1)	Coliform (MPN g-1)	Yeast and Mold (CFU g-1)
100:00 – 0 <sup>th</sup> Day	1.3	0.00	0.00
100:00 – 3 <sup>rd</sup> Day	5.3	0.00	0.00
100:00 – 5 <sup>th</sup> Day	5.37	0.00	0.00
90:10 – 0 <sup>th</sup> Day	1.7	0.00	0.00
90:10 – 3 <sup>rd</sup> Day	4.6	0.00	0.00
90:10 – 5 <sup>th</sup> Day	5.24	0.00	5.45
80:20 – 0 <sup>th</sup> Day	1.75	0.00	0.00
80:20 – 3 <sup>rd</sup> Day	4.74	0.00	0.00
80:20 – 5 <sup>th</sup> Day	5.56	0.00	7.69
70:30 – 0 <sup>th</sup> Day	1.58	0.00	0.00
70:30 – 3 <sup>rd</sup> Day	3.38	0.00	0.00
70:30 – 5 <sup>th</sup> Day	4.98	0.00	12.48
60:40 – 0 <sup>th</sup> Day	1.82	0.00	0.00
60:40 – 3 <sup>rd</sup> Day	4.98	0.00	0.00
60:40 – 5 <sup>th</sup> Day	5.45	5.10	18.52
50:50 – 0 <sup>th</sup> Day	2	0.00	0.00
50:50 – 3 <sup>rd</sup> Day	4.9	0.00	0.00
50:50 – 5 <sup>th</sup> Day	6.41	7.00	22.00

The values for total viable count (TVC), coliform count and Yeast and molds count of control yoghurt drink and papaya yoghurt drink samples at 0 day, 5 days, 7 days and 9 days at storage temperature of 40°C were presented in Table 2. Highest number of total viable count was seen in experimental sample containing 50 % papaya pulp. The microbial load in experimental sample was more than the control sample. The coliform count was zero at zero time i.e. 0 day and 5 days, in later days its presence was in both the control and experiment of samples same was observed in case yeast and molds count. The results are similar to these reported by [12].

### Conclusion

The result of this study showed that addition of papaya pulp to yoghurt as flavouring agent improved the micronutrient and microbiological properties of the formulated product. The flavoured yoghurt contained a good amount of vitamin C, which is vital in iron metabolism and subsequent fight against iron deficiency anaemia (IDA). This could contribute significantly in improving the vitamin C. The use of underutilized natural flavour (papaya) helps in creating a variety of yoghurt and also increasing the nutritional as well as medicinal value of yoghurt. The addition of papaya pulp to yoghurt had a positive impact on the micronutrient of the formulated product. From the results obtained in this study, it can be concluded that the yoghurt blended with papaya pulp at a ratio of 70:30 was the most preferred among the flavoured yoghurt samples formulated.

Based on the result, it is recommended that more research be carried out on the papaya pulp flavour in order to improve its sensory characteristics and increasing the shelf life of the fruit pulp as flavouring agents. Consumers should also be enlightened on the nutritional and health benefits of papaya mango as a strategy for food diversification and domestication of papaya.

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