

# Development and Physico-Chemical Analysis of Probiotic Vegan Yogurt using *Artocarpus Heterophyllus* (Jackfruit Seed) and *Cocos Nucifera* (Coconut Milk)

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## ABSTRACT

The study of probiotic yogurt from jackfruit seed milk and coconut milk development was carried out at the Department of Food Technology, Parul Institute of Applied Sciences, Parul University, Vadodara. The main goal of developing probiotic vegan yogurt is to develop a lactose free vegan product for lactose intolerant groups with minor or no symptoms as well as for people who follow a vegan diet. Probiotic vegan yogurt is good for the digestive system, as it boosts the immune system and improves calcium absorption. Physical measures were conducted on the developed yogurt in terms of colour, appearance, texture, taste, and overall acceptance measurement. The yogurt was prepared by adding specific starter cultures (*Lactobacillus acidophilus*, *Lactobacillus rhamnosus*, *Bifidobacterium longum*, *Bifidobacterium bifidum*, and *Streptococcus thermophilus*) to pasteurized vegan milk. In addition to that, strawberry crush and edible agar were added to provide flavour and a desirable texture, respectively. Three formulations (T0, T1, and T2) were created by varying the amounts of edible agar (1%, 2%, and 2%) and strawberry crush (0%, 15%, and 20%). Flavoured yogurt with the formulation of T2 was accepted on the basis of sensory characteristics like taste, texture, colour, smell, mouthfeel and overall acceptability. Selected flavoured yogurt were assessed for physico-chemical, microbial, and sensory characteristics. The final product was found to have 0.40% fat, 1.00% protein, 0.22% ash, and 78.67% moisture.

**KEYWORDS:** Jackfruit seeds milk, coconut milk, probiotic, vegan yogurt

## 1. INTRODUCTION

One of the most popular probiotic-containing foods are yogurts. The Codex Alimentarius of 1992 defines yogurt as a coagulated milk product that is produced when *Lactobacillus bulgaricus* and *Streptococcus thermophilus* ferment lactose into lactic acid in milk (Bourlioux P, Pochart P, 1988). Yogurt can help people meet their nutritional needs as well as improve their gut microbiota, which has been linked to a decreased risk of gastrointestinal disease, improved lactose intolerance (especially in children), decreased risk of cardiovascular disease, metabolic syndrome, and improvements in lactose intolerance, better dental and bone health and type 2 diabetes, allergies, and respiratory conditions, as well as pregnancy outcomes.

Milk yogurt consumption is restricted for vegans, people with lactose intolerance, and people who are allergic to dairy products. As a result, using non-dairy-containing substrates in yogurt production is an alternative way to obtain the beneficial effects of yogurt. The majority of studies found that when lactose or milk was given as a single test dose without other nutrients, people with lactose intolerance or malabsorption could consume 12 g of lactose without experiencing any or only mild symptoms. (Shaukat, Aasma (2010)).

Jackfruit cotyledons are high in starch and protein (Singh, I.S., Singh, A.K. and Pathak, R.K., 2001). Protein, starch, calcium, and thiamine are all found in jackfruit (Burkill, H.M., 1997). The jackfruit seed's

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potential as a food source and antioxidant has not yet been fully investigated. Jackfruit seeds are a good source of starch, fiber, and protein. Additionally, jackfruit is a great source of numerous minerals, including N, P, K, Ca, Mg, S, Zn, and Cu. (Maurya & Mogra, 2016). Due to their high fiber content, the seeds help reduce the risk of heart disease, avoid constipation, and aid in weight loss. Additionally, they are rich in B-complex vitamins. Additionally, jackfruit seeds contain resistant starch, which maintains intestinal health and controls blood sugar. (Maurya & Mogra, 2016).

Coconut milk is the liquid obtained by manually or mechanically extracting grated coconut meat with or without the addition of water. In coconut-producing countries, coconut milk is an important part of the diet. It is valued primarily for its distinctive nutty flavour and nutritional content. Sugars and starch are the primary carbohydrates found. Phosphorus, calcium, and potassium appear to be the major minerals found in raw coconut milk (Anon., 1984). Freshly extracted milk will almost certainly contain trace amounts of water-soluble B vitamins and ascorbic acid (Chee C. Seow; Choon N. Gwee (1997)). The amount of water used for extraction greatly influences the composition of coconut milk. Moisture ranges from 47-56%, fat from 27-40%, protein from 2.8-4.4%, ash from 0.9-1.2%, and carbohydrates from 5.0-16.0% (Banzon et al, 1990).

Probiotics are “live microorganisms, when administered in adequate amounts confer a health benefit on the host” (FAO/WHO 2001). The “core benefits” of probiotics, which have been demonstrated in various probiotic species, include regulation of intestinal transit, normalization of disturbed microbiota, turnover of enterocytes, competitive exclusion of pathogens, colonization resistance, and production of short-chain fatty acids. Probiotic strain-specific additional health advantages include neurological effects, immune effects, endocrinological effects, and the synthesis of bioactive (Scourboutakos et al. 2017). Yogurt bacteria have been widely recognized for their contribution to the improvement of intestinal microflora (Tamime AY, et al., 1985).

The main purpose of this study is to assess the acceptability of probiotic vegan yogurt made with 50% jackfruit seed milk and 50% coconut milk as well as other ingredients. Assessment was carried out among various samples of yogurt (T0, T1 and T2) containing different amount of edible agar (1%, 2% and 2%) and strawberry crush (0%, 15% and 20%). To complete this product development experiment,

organoleptic, chemical, and microbiological quality assessments were performed. Microbiological tests were performed such as total plate count (TPC), total coliform count (TCC), Yeast and mold count and Escherichia coli count to determine the exact shelf life of the products and to observe microbial growth after acidity changes. In the laboratory, room temperature was maintained throughout the experiment.

## 2. MATERIALS AND METHOD

### 2.1. Material

Jackfruit seeds and coconut milk were purchased from the local market in Vadodara, Gujarat, India. Jackfruit seeds were refrigerated at 4 degrees Celsius until further use. Edible agar, strawberry crush, and powdered sugar were purchased from the local market in Vadodara, Gujarat, India. Vegan yogurt culture was purchased from Urban Platter.

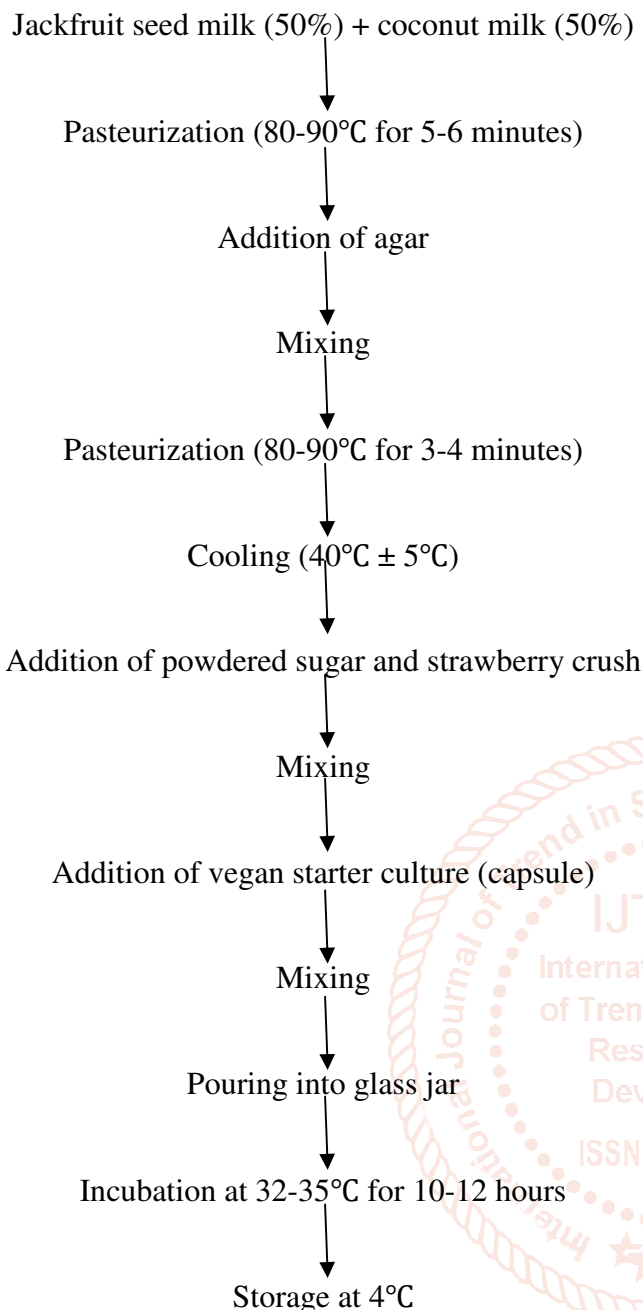
### 2.2. Methods

#### 2.2.1. Preparation of jackfruit seed milk

Jackfruit seeds were washed and soaked in clean water for 4–5 hours or overnight. After soaking, the water was drained and the peels from the seeds were removed. Seeds were blended with water at a seed-to-water ratio of 1:3 in a blender at medium speed for about 1 minute until smooth. The obtained milk was passed through muslin cloth to separate the residue.

#### 2.3. Preparation of probiotic vegan yogurt

Vegan yogurts were prepared by using 50% jackfruit seed milk and 50% coconut milk with different proportions of edible agar (1%, 2% and 2%) and strawberry crush (0%, 15% and 20%). Here in after samples are referred as T0, T1 and T2 respectively. Whereas, in the preparation of T0 sample 100% jackfruit seed milk was used. Initially, for T1 and T2 samples jackfruit seed milk and coconut milk were mixed and pasteurized at 80-90°C for 5-6 minutes followed by adding agar and pasteurized for 3-4 minutes. The mixture was cooled at 40°C ± 5°C afterwards powdered sugar (10%) with edible agar and strawberry crush was added. Furthermore, vegan yogurt culture capsule was added containing species like (*Lactobacillus acidophilus*, *Lactobacillus rhamnosus*, *Bifidobacterium longum*, *Bifidobacterium bifidum* and *Streptococcus Thermophilus*). The glass bottles were washed and then sterilized at temperature above 100°C for 15 minutes before filling the final product. The yogurt was allowed to ferment at 32-25°C for 10-12 hours approximately until desired degree of acidity and coagulation is achieved. The final product was stored at 4°C at refrigeration until used.



**2.3.1: Flowchart of preparation of vegan yogurt**

**Table 2.3.1: - Formulations of yogurt**

Ingredients	T0	T1	T2
Jackfruit seed milk	100 ml	50 ml	50 ml
Coconut milk	-	50 ml	50 ml
Agar	1 gm	2 gm	2 gm
Strawberry crush	-	15 gm	20 gm
Powdered sugar	10 gm	10 gm	10 gm
Yogurt culture (tablet)	1	1	1

**Note:** - One tablet of vegan culture contains 0.7 billion% of each species value based on 2320 calories diet.

**2.4. Organoleptic Quality Analysis Procedure**

A questionnaire of produced foods or food categories is the most common method used to measure food preferences, with a hedonic scale used to rate the degree of likings. The hedonic scale is a rating scale of organoleptic quality on which the judge expresses his level of liking. Overall tests were performed using

a 9-point Hedonic scale. The following rated used the general form of the organoleptic Hedonic scale: 1) Dislike very much, 2) Dislike extremely, 3) Dislike moderately, 4) Dislike slightly, 5) Neither like nor dislike, 6) Likely slightly, 7) Like moderately, 8) Like very much, 9) Like extremely. This test had carried out by semi trained panellists who were teachers at Department of Food Technology, Parul University, Vadodara, Gujarat.

**2.5. Chemical Composition Analysis Procedure**

All the samples were exposed to chemical quality assessment. Moisture was determined using hot air oven drying. Total ash was determined by incineration method, Fat was determined by Roesse-Gottlieb method and protein was determined by Kjeldahl method. Additionally, the FSSAI Manual of Methods of Analysis of Foods of Dairy & Dairy Products 2022 was used to calculate lactose and starch levels.

**2.6. Microbial Analysis Procedure**

Total plate count (TPC), total coliform count (TCC), E. coli count and total yeast and mould count (TFC) microbiological tests were performed in accordance with Indian standard methods for the examination of dairy products.

**3. RESULTS AND DICUSSION**

**3.1. Organoleptic Analysis of Different Formulations of Yogurt**

Organoleptic evaluations of formulated yogurt are based on the sample's overall flavour, colour, texture, consistency, and appearance. Table 3.1.1 compares the factors that determine the organoleptic quality of various yogurt preparations.

**Table 3.1.1: - Comparison of Physical Qualities of Formulated Yogurt Samples**

Constituents	T0	T1	T2
Appearance	7.3	7.5	8.3
Colour	6.8	7.5	8.3
Flavour	6.5	7.3	8.2
Texture	6.5	7.5	7.7
Overall acceptance	6.8	7.6	8.2

Mean of 6 scores for each sensory characteristic was taken. T0 (vegan milk + 0% strawberry crush), T1 (vegan milk + 15% strawberry crush), T2 (vegan milk + 20% strawberry crush).

**Appearance:**

Different types of formulated yogurt were compared in terms of appearance and given a physical score shown in table 3.1.1 and figure 1. Average appearance score of formulated yogurt samples T0, T1 and T2 were 7.3, 7.5 and 8.3 respectively. Highest and lowest appearance score were recorded for T2 and T0 respectively. Variation in appearance of the

yogurt was found to be distinct and the reason can be the concentration of strawberry crush, amount of vegan milk and processing technique. According to panellist's score T2 sample was acceptable ad compare to T0 and T2.

#### Colour:

Different types of formulated yogurt were compared in terms of colour and given a physical score showed in table 3.1.1 and figure 1. Average colour score of prepared yogurt samples T0, T1 and T2 were 6.8, 7.5 and 8.3 respectively. Highest and lowest score were recorded for sample T2 and T0 respectively. Colour of the yogurt depends on concentration of strawberry crush and treatment given to the vegan milk.

#### Flavour:

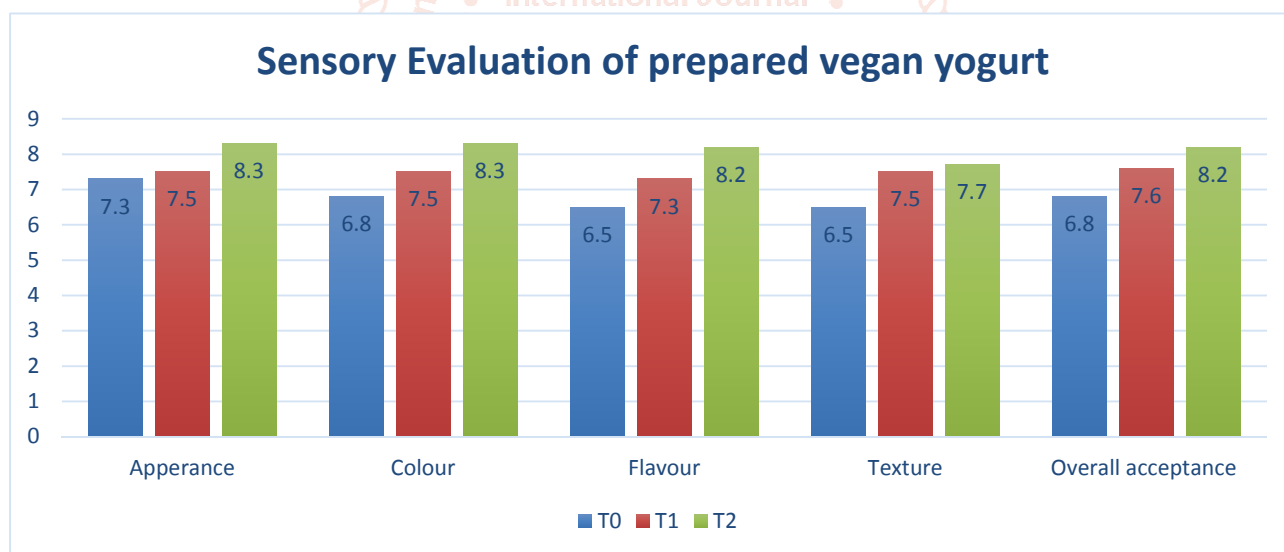
Different types of formulated yogurt were compared in terms of aroma and flavour and given physical score is shown in table 3.1.1 and figure 1. Average flavour score of prepared yogurt samples T0, T1 and T2 were found to be 6.5, 7.3 and 8.2 respectively. Highest and lowest flavour score were of T2 and T0 respectively. It was observed that, the addition of strawberry crush increased the flavour score. T0 was not acceptable due to the aftertaste of the jackfruit seed.

#### Texture:

Different types of formulated yogurt are compared in terms of texture and given a physical score showed in table 3.1.1 and figure 1. Average texture score of prepared yogurt samples T0, T1 and T2 were 6.5, 7.5 and 7.7 respectively. Highest (7.7) and lowest (6.5) texture score were recorded for sample T2 and T0 respectively. Texture may be depended upon amount of the agar and the rate of development of the acidity i.e., type of organisms presents in the starter culture. The texture of T0 vegan yogurt was not acceptable as 100% jackfruit seed milk was used.

#### Overall acceptance:

The quality of the raw ingredients used in the production of formulated yogurt also had an impact on flavour. The quantitative evaluation of the general flavour of various kinds of prepared yogurt are given in table 3.1.1 and figure 1. Average overall acceptance of the prepared yogurt samples T0, T1 and T2 were 6.8, 7.6 and 8.2 respectively. Both the prepared yogurts were significantly different from T0 (plain yogurt). However, yogurt containing 20% of strawberry crush and 2% agar was acceptable in terms of all sensory evaluation.



**Figure1:** - Comparison of the Sensory Evaluation of Different Types of Yogurts

Yogurt with T2 formulation was the most acceptable sample and was selected for additional research based on the findings of the organoleptic characteristics measured by the hedonic scale.

### 3.2. Chemical composition of different prepared yogurt samples

Chemical composition of formulated yogurt samples is presented in Table 3.2.1. Moisture, total ash, protein, fat, carbohydrate and energy of the selected samples were analyzed for their chemical qualities. Additionally, presence of lactose and starch were also analyzed.

**Table 3.2.1:** - Chemical composition of various yogurt preparations.

Constituents	Units	T2
Moisture	%	78.67
Total ash	%	0.22
Fat	g/100g	0.40
Protein	g/100g	1.00
Carbohydrate	g/100g	19.71
Energy	Kcal/100g	86.44
Lactose	%	3.96
Starch	-	Present

### 3.3. Microbiological Quality Assessments of Different Types of Prepared Yogurt

This study compared the microbiological quality of all the formulation of vegan yogurt samples using four different tests: Total plate count, total coliform count, Yeast and mould count and Escherichia coli.

**Table 3.3.1: - Microbiological Quality Assessments of Different Types of Prepared Yogurt**

Microbial parameters	Units	T2
TPC	cfu/g	95,400
Yeast and mould count	cfu/g	550
E. coli count	per g	Absent
TCC	per g	Absent

#### 3.3.1.1. Total plate count

Total plate count is used to count the microbial load in the sample. This indicates the level of sanitation maintained during preparation. Colony forming units, or cfu, are used to measure it.

#### 3.3.1.2. Yeast and mould count

The amount of yeast and mould in the yogurt after it has been prepared depends on how it was handled, stored, and prepared. Due to their capacity to produce toxic by-products known as mycotoxins, a number of foodborne moulds and possibly yeasts may also be harmful to human or animal health.

#### 3.3.1.3. E. coli count

The bacterium Escherichia coli (E. coli) is typically found in the digestive tracts of warm-blooded animals and people. E. coli strains in general are not harmful. However, some strains, like Shiga toxin-producing E. coli (STEC), can result in serious foodborne illness.

#### 3.3.1.4. Total coliform count

The total number of pathogenic bacteria present in the yogurt was estimated from the total coliform count of various types of prepared samples. The dangerous bacterium known as coliform is typically found in nature and can result in diarrhoea.

### 4. Conclusion

According to the research carried out it can be concluded that Jackfruit seed can be best substitute for the production of Vegan Products. Also, the utilization of jackfruit seed can reduce the waste. The presence of coconut milk and probiotic strain in developed Vegan Probiotic Yogurt can help in digestion as well as lowering the cholesterol level in body. Furthermore, coconut milk helps to boost immunity, increases stamina and promotes heart health. The study's findings demonstrated that it is feasible to manufacture plant-based yogurt to meet consumers' organoleptic needs, particularly those of vegans and those who are lactose intolerant. Coconut

milk was added to give creamy texture same as milk yogurt to the vegan yogurt. According to the results obtained above, T2 was determined to be the most effective treatment out of all the formulations that contained varying concentrations of jackfruit seed milk, coconut milk, agar, strawberry crush and powdered sugar which contains 78.67% moisture, 0.22% total ash, 1.00% protein, 0.40% fat, 19.71% carbs, and 86.44 kcal of energy. Besides this, it also contains 3.96% of lactose which can be ingested by lactose intolerant group with minor or no symptoms.

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