

# Development of Pokkali Rice-Based Fruit Blended Probiotic Drink and Evaluation of its Sensory Parameters and Nutritional Content

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## ABSTRACT

**Background:** The World Health Organization (WHO) defines probiotics as live microorganisms that, when consumed in adequate amounts, offer health benefits to the host. Probiotics can be derived from dairy-based sources like bovine milk or non-dairy sources like fruits, vegetables, cereals and legumes. They offer various benefits such as reducing cholesterol levels, boosting the immune system and improving lactose metabolism, protein digestibility and vitamin and mineral synthesis.

**Aim:** The probiotic foods are mostly found in milk-based products on the market worldwide, with very few attempts being undertaken to create probiotic foods utilising other fermentation substrates, like cereals, pulses and vegetables. The focus has shifted to their utilisation as raw materials for the creation of new fermented functional products due to their wide availability and significant nutritional value. In the present study, addition of pokkali rice with different fruit pulp in variant concentrations to enhance the flavor with the intention of consumers' acceptance. Pokkali rice has distinct taste and high protein content and it possesses several medicinal properties.

**Materials and Methods:** Pokkali rice and fresh and ripened fruits such as Mango, Papaya, Strawberry, Guava and *Aloe vera* were collected from the farmers from Ezhikara and local market in Ernakulam. Pure cultures of the probiotic strain (*Lactobacillus helveticus*) were purchased from KVASU College of Dairy Science and technology, Mannuthy, Thrissur. **Results:** Five products and three treatments (along with one control) were standardized, each with three replications. The yogurts were evaluated for taste and quality parameters using a 9-point hedonic scale by a panel of 10 judges. The best sample was chosen based on Kendall's coefficient of concordance. The Pokkali rice-based probiotic drink T<sub>3</sub> was the most preferred among the treatments. The proximate value was highest in the Pokkali rice-based papaya blended probiotic drink. **Conclusion:** The greatest form of milk for hypoallergenicity is thought to be rice milk. If you have soy or cow milk allergy, it is best to drink rice milk. Since rice milk has unsaturated fat and no cholesterol, it is suggested for people who are lactose intolerant. The results of the current study confirm that adding fruit pulp to the Pokkali rice-based probiotic drink significantly enhanced its sensory appeal and nutritional properties.

**Keywords:** Fermented products, *Lactobacillus helveticus*, Pokkali rice, Probiotic drink,

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## INTRODUCTION

The Functional Food Center defines "functional foods" as natural or processed foods containing biologically

active compounds. When consumed in effective, non-toxic amounts, these foods provide clinically proven health benefits, using specific biomarkers to promote optimal health, reduce the risk of chronic or viral diseases and manage their symptoms. "Natural or processed foods that contain biologically-active compounds; which, in defined, effective, non-toxic amounts, provide a clinically proven and documented health benefit utilising specific biomarkers, to promote optimal health and reduce the risk of chronic or viral

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diseases and manage their symptoms” is the definition of “functional foods” as given by the Functional Food Centre. Probiotic foods are an example of the kind of food that has a variety of positive benefits on the body.<sup>[1]</sup> Many probiotic strains support gut microbiota health and may prevent specific Gastrointestinal Tract (GIT) issues and many products containing probiotics are readily available in markets and their potential uses are expanding every day. As a result, they have been very actively studied and promoted.<sup>[2]</sup>

Pokkali rice is a type of rice grown in the Pokkali tract of Kerala; it has a distinct taste, medium-bold shape, good cooking quality and an average protein content of 7.5-8.57%.<sup>[3]</sup> It has a higher concentration of antioxidants, such as oryzanol, tocopherol and tocotrienol, compared to the medicinal rice variety.<sup>[4]</sup> The nutritional value of rice-based foods can be enhanced by fermenting them with amylolytic Lactic Acid Bacteria (LAB) like certain lactobacilli and bifidobacteria strains. This fermentation process improves starch digestibility in children and increases lysine availability.<sup>[5,6]</sup> Fermented rice extracts with 12 g/100 g of waxy maize starch, flavored with strawberry syrup and aroma, showed high antioxidant capacity, nutritional value and Total Phenolic Compounds (IPC). These extracts have strong market potential and are especially suitable as ready-to-eat options for consumers with special dietary needs, such as those allergic to soybean protein or lactose.<sup>[7]</sup>

The health benefits of fruits are widely recognized worldwide. This is due to their abundance of dietary fiber, minerals, vitamins and phytochemicals, which can function as antioxidants, anti-inflammatory agents and phytoestrogens.<sup>[8]</sup> By adding probiotics to underutilised fruits, their marketability and acceptability can be increased. Fruit juices in particular have several advantages over other non-dairy drinks, including flavour, refreshing quality and nutritional content.<sup>[9]</sup> Probiotic strains from non-dairy sources are tolerated, however the varied food media of dairy food carriers are the main obstacle to the probiotics’ survival. Probiotics *Lactobacillus* and *Bifidobacterium* are commonly used and usually considered safe.<sup>[10]</sup>

Mango is a super fruit, containing a diverse range of phytochemicals and nutrients that offer numerous potential health benefits. This fruit crop is known for its high nutrient content, making it a valuable addition to a healthy diet.<sup>[11]</sup> The *Fragaria hybrid* species, commonly known as strawberry and belonging to the *Rubiaceae* family, is grown extensively across the globe. Its fruit, an aggregate accessory fruit, is highly valued for its

distinctive aroma, bright red color, juicy texture and taste and is widely cultivated for consumption.<sup>[12]</sup> Papaya is a fruit that is easily accessible and affordable for the general population and is highly nutritious, being rich in natural vitamins and minerals and low in calories.<sup>[13]</sup> Guava is classified as a true berry and is recognized for its nutritional value. One of its most notable benefits is its abundance of Vitamin C, which helps support immune system function and protect against harmful free radicals. Additionally, guava is a good source of manganese, folate and fiber, which provide further health advantages.<sup>[14]</sup> *Aloe vera* can help heal wounds, reduce blood sugar levels in diabetes, soothe burns, ease digestive problems, reduce arthritic swelling, promote ulcer healing, stimulates the immune response against cancer and more.<sup>[15]</sup> Considering these factors, pokkali rice, fruits like mango, papaya, strawberry, guava and *Aloe vera* were chosen for incorporating probiotics. Developing a probiotic product from these ingredients would likely offer significant health benefits, the fermented products and yogurt are highly digestible and contain starter cultures that protect the microflora and attract consumer attention and improve its economic value and additionally, they can be safely consumed by individuals with lactose intolerance.<sup>[16]</sup>

The goal of this study was to make a probiotic drink based on Pokkali rice using different flavoured fruit pulp. As well as to study the chemical analysis of pokkali rice and sensory property of the products

## MATERIALS AND METHODS

### Selection and Collection of Materials

Pokkali rice and fresh and ripened fruits such as Mango, Papaya, Strawberry, Guava and *Aloe vera* were collected from the farmers from Ezhikara and local market in Ernakulam. Pure cultures of the probiotic strain (*Lactobacillus helveticus*) were purchased from KVASU College of Dairy Science and technology, Mannuthy, Thrissur. Other ingredients such as homogenized milk and sugar were purchased from the local market. The study was conducted at St. Teresa’s College Ernakulam, during 2022-2023.

### Preparation of rice milk

Rice milk was prepared as follows according to<sup>[17]</sup> the washed Pokkali rice was soaked in water for 2 hr, drained, cooked in a 1:3 ratio (rice to water) for 30 min until very soft, then blended with water (200 g rice+400 mL water). The blended rice mixture was sieved twice to achieve a smooth texture, resulting in rice milk.

### Standardisation of fruit juices and *Aloe vera* pulp

Fruit juices and pulps are used to impart flavour to the probiotic drink. To prepare fruit puree, start by selecting fresh and fully ripened fruits such as Mango, Papaya, Strawberry and Guava. Wash them thoroughly to remove any dirt or contaminants. Remove seeds and thorns from fruits. Cut the fruits into very small pieces to aid in blending. Using a blender, blend the fruit pieces until smooth. Strain the blended mixture to remove any solid pieces or fibers, resulting in a smooth puree. Heat the strained puree over 15 min, beginning with 5 min on high flame and then reducing to low flame, maintaining a temperature of approximately 90°C. Allow the heated puree to cool naturally until it reaches around 40°C.

To prepare *Aloe vera* pulp, start by cutting a leaf from the plant and allowing the yellow latex to drip out for a few min. Wash the leaf thoroughly to remove any remaining latex, then cut off the spiky edges and slice the leaf lengthwise to expose the gel-like pulp. Use a spoon to scoop out the pulp, ensuring no green leaf residues are mixed in. Blend the pulp until smooth, then heat the puree for a total of 15 min: first on high flame for 5 min, then on low flame for 10 min, maintaining a temperature of 90°C. Finally, cool the puree down to 40°C before use.<sup>[18]</sup>

### Preparation of Pokkali Rice-Based Fruit Blended Probiotic Drink

The pokkali rice milk were pasteurised at 90°C for 20 min separately and allowed to cool. The rice milk was then inoculated with 2% *Lactobacillus helveticus* and incubated for 16 hr at 37°C until the pH reached 4.6. After incubation, the beverages were refrigerated overnight, stirred and divided into 5 equal portions. The first portion was left without additives to serve as a control ( $T_0$ ). Pasteurized fruit pulp was added to the second, third and fourth portions ( $T_1$ ,  $T_2$  and  $T_3$ ) at concentrations of 30%, 35% and 40%, respectively. The fruit-flavored fermented rice milk beverages were then evaluated for sensory qualities, pH and proximate composition.

### Organoleptic Evaluation

Sensory evaluation is a science that assesses, analyzes and interprets the responses of the senses-sight; smell, sound, taste and texture-to products. From the standardized 5 flavors and their 3 proportions, the best proportion and most acceptable fruit flavour was selected by a panel of judges. The sensory attributes tested in the product are appearance, color, flavour, taste, texture and overall acceptability. A panel of

10 judges conducted a sensory assessment of the newly created product, with 9 hedonic scales.

To determine the best combination of organoleptic characteristics among different treatments, the data was analyzed using the Kruskal-Wallis test suggested by.<sup>[19]</sup>

### Chemicals Analysis of the Probiotic drink

The proximate chemical composition of the selected samples was determined according to.<sup>[20]</sup> pH was determined using digital pH meter.<sup>[21]</sup>

### Statistical Analysis

The data were statistically analyzed using Kendall's coefficient of concordance. The observations were analysed statistically in Completely Randomised Design (CRD) and the differences among treatments in nutritional qualities were assessed using Duncan's Multiple Range Test (DMRT).

## RESULT

### Development of pokkali rice-based fruit blended probiotic drink

Pokkali rice-based probiotic drinks with different flavours, namely papaya, strawberry, mango, guava and *Aloe vera* and control with different combinations were tried (Table 1); in which, the percentage of the fruit pulp varied from 30 to 40 and percentage of rice slurry is incorporated with 25%.

**Table 1: Proportion of ingredients used for Pokkali rice-based fruit blended probiotic drink.**

Treatments	Ingredients (%)	
	Rice slurry	Fruit pulp
$T_1$	25	30
$T_2$	25	35
$T_3$	25	40
$T_0$ (Control)	25	-

The evaluation aimed to assess the sensory attributes, including appearance, colour, flavor and taste, texture and Overall Acceptability (OAA) of each drink. The study employed the Kruskal-Wallis test to compare the mean scores obtained from different treatments and the control group to determine if there were significant differences between them. The study evaluated four treatments ( $T_1$ ,  $T_2$  and  $T_3$ ) and a control group ( $T_0$ ) for each probiotic drink flavor. The organoleptic evaluation was conducted based on a panel of assessors who rated each sensory attribute on a numerical scale. The Mean Rank Value (MRV) and Mean Score (MS)

**Table 2: Mean scores for organoleptic evaluation of Pokkali rice-based Papaya blended Probiotic drink.**

Treatment	Appearance		Colour		Flavor and taste		Texture		OAA	
	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS
T <sub>1</sub>	13.6	6.0	16.6	6.7	15.8	6.8	15.2	7	20.8	7.1
T <sub>2</sub>	25.15	7.4	24.1	7.6	23.5	7.5	25.05	7.9	20.75	7.1
T <sub>3</sub>	34.5	8.6	33.45	8.7	34.6	8.5	32.8	8.7	33.35	8.6
Control T <sub>0</sub>	8.75	5.3	7.85	5.6	8.1	6	8.95	6.3	7.10	5.4
K W Value	30.69		27.17		29.92		26.29		26.43	
$\lambda^2$ (0.05)	7.81									

(MS-Mean score, MRV-Mean rank value).

were calculated for each attribute in each treatment group.

The results for the (Table 2) papaya-blended probiotic drink showed a significant difference among the treatments in terms of appearance, color, flavor and taste, texture and overall acceptability. The result showed that in all attributes the sensory score of the papaya-blended probiotic drink tend to increase from T<sub>1</sub> to T<sub>3</sub>. The overall acceptability of the treatment T<sub>3</sub> consistently scored the highest mean rank value of (33.35) followed by T<sub>1</sub> (20.8) and T<sub>2</sub> (20.75) lowest by control T<sub>0</sub> (7.10). This may be because, as the amount of papaya pulp increases, it enhances consistency of the final products, thereby increasing their acceptability. For the strawberry-blended probiotic drink (Table 3),

the result indicated a significant difference among the treatments. Here also, the organoleptic properties tend to increase from T<sub>1</sub> to T<sub>3</sub>. The mean scores for overall acceptability were 7.1, 8 and 8.6 respectively for T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> the control was 6.3 (T<sub>0</sub>). Treatment T<sub>3</sub> demonstrated the highest mean scores in appearance, flavor and taste and overall acceptability, making it the preferred option among the strawberry-flavored probiotic drinks. As shown in Table 4, the organoleptic evaluation of the mean rank value for overall appearance of mango-flavored probiotic drink ranged between 5.6-8.7. The highest mean rank score was obtained by T<sub>3</sub> (29.15) followed by T<sub>2</sub> (17.85) and T<sub>1</sub> (76.95) while the lowest was obtained by T<sub>0</sub> (9.15).

**Table 3: Mean scores for organoleptic evaluation of Pokkali rice-based Strawberry blended Probiotic drink.**

Treatment	Appearance		Colour		Flavor and taste		Texture		OAA	
	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS
T <sub>1</sub>	24.4	7.8	16.65	6.8	22.45	7	25.2	8.1	15.6	7.1
T <sub>2</sub>	15.9	6.9	25.25	7.7	17.05	6.4	16.2	7.2	25.8	8
T <sub>3</sub>	33.15	8.7	32.75	8.5	33.65	8.5	12.35	6.9	31.8	8.6
Control T <sub>0</sub>	8.55	6	7.35	5.7	8.85	5.3	28.25	8.4	8.8	6.3
K W Value	26.13		27.70		24.68		13.09		24.86	
$\lambda^2$ (0.05)	7.81									

(MS-Mean score, MRV-Mean rank value).

**Table 4: Mean scores for organoleptic evaluation of Pokkali rice-based Mango blended Probiotic drink.**

Treatment	Appearance		Colour		Flavor and taste		Texture		OAA	
	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS
T <sub>1</sub>	13.7	6.4	15.8	6.8	31.45	6.5	31.1	8.3	5.85	6.6
T <sub>2</sub>	26.5	7.8	25.8	7.9	25.75	7.6	25.2	7.6	17.85	7.9
T <sub>3</sub>	33.9	8.6	31.9	8.8	16.15	8.5	16.15	6.5	29.15	8.7
Control T <sub>0</sub>	7.9	5.7	8.5	5.8	8.65	5.6	9.55	5.4	29.15	5.6
K W Value	32.43		25.09		23.42		20.77		30.29	
$\lambda^2$ (0.05)	7.81									

(MS-Mean score, MRV-Mean rank value).

**Table 5: Mean scores for organoleptic evaluation of Pokkali rice-based Guava blended probiotic drink.**

Treatment	Appearance		Colour		Flavor and taste		Texture		OAA	
	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS
T <sub>1</sub>	12.75	6	23.2	7.8	24.8	7.6	16.0	7.0	28.1	8.3
T <sub>2</sub>	25.95	7.4	15.8	7.0	10.6	5.8	8.4	6.0	13.3	6.7
T <sub>3</sub>	33.30	8.4	10.0	6.2	13.8	6.2	26.95	8.2	8.6	6.1
Control T <sub>0</sub>	10.0	8.7	33.0	8.8	32.8	8.6	24.08	8.6	32.0	8.7
K W Value	28.09		22.86		23.85		24.08		29.67	
$\lambda^2(0.05)$	7.81									

(MS-Mean score, MRV-Mean rank value).

The organoleptic evaluation revealed that the mean rank value for appearance of guava-blended probiotic drink ranged between 10.00-33.30. The maximum mean score was obtained by T<sub>0</sub> (8.7) followed by T<sub>3</sub> (8.4) and T<sub>4</sub> (7.4) while the minimum mean rank value was fetched by T<sub>1</sub> (6.0). Overall acceptability of the four treatments is clearly depicted in Table 5. Among the four treatments T<sub>1</sub> obtained the maximum mean score of 8.3 after the control T<sub>0</sub> (8.7). The organoleptic evaluation revealed that (Table 6) the mean rank value for appearance of *Aloe vera*-flavored probiotic drink ranged between 10.2-32.1. The mean rank values were analyzed and it was observed that T<sub>1</sub> obtained the first rank (24.2) after control (32.1), while T<sub>2</sub> got least mean rank value of 10.2. The mean rank value for colour of *Aloe vera*-flavored probiotic drink ranged between 8.85-32.85. There was a significant difference between the mean rank scores of colour. From the organoleptic analysis of flavour it was noticed that T<sub>2</sub> obtained the maximum mean rank value (23.2) after control T<sub>0</sub> (32.75). While T<sub>2</sub> obtained the minimum mean rank value 9.95. The highest mean score value for texture was noticed in T<sub>1</sub> (24.15) after control T<sub>0</sub> (32.7) followed by T<sub>2</sub> (16.6) and T<sub>3</sub> (8.55). T<sub>1</sub> had the highest mean rank score for overall acceptability (22.65) after control T<sub>0</sub> (31.72). Statistical analysis of the data revealed that there was significant difference between the mean rank scores of

the different quality attributes of the *Aloe vera*-flavored probiotic drink at 5% level.

Statistical analysis by applying of Kruskal Wallis test revealed that there was a significant difference between the appearance, colour, flavour, texture, taste and overall acceptability of the probiotic drink prepared from Papaya, strawberry, mango, guava and *Aloe vera*. On the basis of analysis of mean scores treatment T<sub>3</sub> was selected as the best combination. However, it's important to consider that individual preferences can vary and different consumers may have different preferences for the various flavors.

#### Chemical Analysis of the Probiotic drink

The selected pokkali rice based probiotic drinks along with the control were subjected to chemical analysis and Table 7 depicts the results.

The results showed that pH of the control samples was found to be 4.21 whereas the highest pH value was obtained in pokkali rice based strawberry probiotic drink (4.34) followed by papaya (4.31) and mango (4.27). There were significant differences are there in control and treatments.

The pokkali rice-based fruit-blended probiotic drink has a moisture content ranging from 84.0% to 81.823%, moisture content was higher in the control than the fruit-blended probiotic drink. The control yogurt contains 84.0% moisture, whereas papaya, strawberry

**Table 6: Mean scores for organoleptic evaluation of Pokkali rice-based *Aloe vera* blended probiotic drink.**

Treatment	Appearance		Colour		Flavor and taste		Texture		OAA	
	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS
T <sub>1</sub>	24.2	7.4	24.95	7.7	23.2	7.1	24.15	7.5	22.65	6.5
T <sub>2</sub>	15.5	6.4	15.35	6.7	16.1	6.1	16.6	6.6	15.95	5.7
T <sub>3</sub>	10.2	5.8	8.85	5.9	9.95	5.2	8.55	5.6	10.85	5.1
Control T <sub>0</sub>	32.1	8.3	32.85	8.6	32.75	8.4	32.7	8.5	31.72	7.7
K W Value	21.39		25.68		21.72		24.44		18.55	
$\lambda^2(0.05)$	7.81									

(MS-Mean score, MRV-Mean rank value).

**Table 7: Macronutrient composition of Pokkali rice based probiotic drink.**

Treatments	Proximate composition				
	Energy (kcal)	Total Carbohydrate (%)	Dietary fibre %	Protein (%)	Moisture (%)
Papaya	67.66	8.85	0.96	2.40	81.82
Strawberry	57.83	8.10	0.73	2.30	83.50
Mango	66.76	8.40	0.87	2.21	82.76
Control	60.70	3.66	0.37	0.89	84.00
CD	4.45	0.79	0.41	0.35	5.50

and mango probiotic contain 81.82, 83.50 and 82.76%, respectively and there is a significant difference in the moisture content of control and pokkali rice-based fruit-blended probiotic drink. There is a significant difference in energy content between the plain probiotic drink and the pokkali rice-based fruit-blended probiotic drink. The pokkali rice-based fruit-blended probiotic drink has higher energy content than the control, which may be attributed to the presence of pokkali rice and added fruit pulps. The energy content of the papaya-flavored pokkali rice-based probiotic drink is the highest (66.77), followed by mango (66.76) and then strawberry (57.83). The papaya flavored probiotic drink has the highest carbohydrate content (8.85) and lowest was in control (3.66). Papaya flavored probiotic drink was found highest amount of protein (2.40) followed by strawberry (2.30) and mango (2.21). The control analyzed has only trace amounts of dietary fiber, whereas the developed probiotic drink contains more dietary fiber due to the addition of fruits and pokkali rice. As supported by<sup>[22]</sup> papaya is one of the fruits that has a high dietary fiber content of 0.8 g per 100 g of fruit. This is further confirmed by the analysis conducted, which showed that papaya, along with mango, has the highest amount of dietary fiber, followed by strawberry, among the different variations of the probiotic drink.

## DISCUSSION

The appearance of food affects its appeal and acceptance even before it is tasted. Sensory evaluation reflects an individual's preferences for a product, shaped by biological differences and perceptions of desirable sensory attributes. It provides valuable product insights that are hard to obtain through other methods.<sup>[23]</sup> According to<sup>[24]</sup> combining two or more juices can create beverages with enhanced sensory qualities, nutritional benefits and medicinal properties.

Fermented dairy products, including yogurt, are highly digestible and contain starter cultures that protect the microflora. These cultures inhibit harmful microorganisms and exhibit anticancer, antitumor and

cholesterol-lowering properties. Additionally, they can be safely consumed by individuals with lactose intolerance.<sup>[25]</sup> Probiotic bacteria ferment the carbohydrate of food and this leads to changes in flavor, aroma and taste of the probiotic product, adversely affecting the sensory properties of the product.<sup>[26,27]</sup> The passion fruit and mango-based probiotic drink study found that the treatment with 50 percent passion fruit juice and 50 percent mango juice (T<sub>5</sub>) achieved the highest scores for sensory attributes. This combination received mean scores of 8.84 for appearance, 8.71 for color, 8.48 for flavor, 8.02 for texture, 7.84 for taste and 8.37 for overall acceptability, with a total score of 50.26.<sup>[28]</sup> Developed Passion fruit and yam flour-based probiotic drinks have proven to be excellent materials for exploration and use in combination, as they help enhance probiotic survival and mask the off-flavors associated with fermentation.<sup>[29]</sup> Developed a probiotic fermented beverages from Snake fruit juice it is a suitable medium for probiotic bacteria and remains of sufficient quality after 30 days of cold storage.

## Chemical Analysis of the Probiotic drink

The decrease in pH is attributed to the production of lactic acid by lactic acid bacteria during fermentation.<sup>[30]</sup> These findings align with<sup>[31]</sup> which noted that the acidity of fermented drinks rose with higher concentrations of banana, papaya and watermelon pulps. Similarly,<sup>[32]</sup> observed that adding kumquat fruit to functional beverages made from whey and permeate also increased their acidity.<sup>[33]</sup> Reported that pH of the low-fat yogurt (control) was found to be 4.11 whereas that of the koozha yogurt was 4.61 and varikka was 4.63. Plain yogurt was found to be more acidic than fruit yogurts, aligning with the findings of<sup>[34]</sup> who reported a lower pH value of 4.32 for plain yogurt and a higher pH value of 4.50 for coconut-enriched yogurt. Similarly,<sup>[35]</sup> compared the physicochemical properties of plain and fruit yogurts, discovering that fruit yogurts had a higher pH (6.3) and were less acidic than plain yogurts (4.50). Similar study conducted by<sup>[28]</sup> probiotic beverages based on passion fruit and different concentrations

yam flour, the highest moisture content was obtained in at the concentration of 2% of yam flour in the beverages (93.50). The study in<sup>[27]</sup> found that the total energy content was 60.32 kcal in non-probiotic drinks and 56.08 kcal in probiotic drinks.<sup>[36]</sup> Reported that both *Lactobacillus* and *Bifidobacterium* genera require high levels of free amino acids, peptides, vitamins and fermentable carbohydrates for their growth and development. The decrease in energy content of the probiotic drink compared to the non-probiotic drink was attributed to the higher carbohydrate and fat content in the fresh juice compared to the probiotic juice.<sup>[37]</sup> The nutritional content of 100 g of mango includes 17 g of carbohydrates, 0.5 g of protein, 0.27 g of total fat, 0 mg of cholesterol and 1.8 g of dietary fiber.<sup>[38]</sup> Mangoes are not only widely available and frequently consumed in large quantities, but they are also rich in lycopene,  $\beta$ -carotene, phenols, antioxidants and minerals.<sup>[39]</sup> Papaya (*Carica papaya*) contains a wide range of phytochemicals, including carotenoids, phenolics and glucosinolates.<sup>[40]</sup> It is an excellent source of carbohydrates, vitamins, proteins and minerals such as calcium, magnesium, sodium and potassium. Papaya also has high levels of flavonoids and phenols, which are beneficial to health. While ripe papaya is sweet and enjoyable to eat, unripe papaya is recommended for its higher nutritional value.<sup>[41]</sup>

### Key point

This study revealed that a new potential for creating an acceptable fermented pokkali rice-based probiotic drink blended with mango, papaya, strawberry, guava and *Aloe vera* pulp, which serve as suitable substrates. These beverages, therefore, combine interesting nutritional qualities with probiotic characteristics. Such research can aid in the development of innovative, fermented, nutritionally balanced food products with unique physical properties. However, it's essential to consider that individual preferences may vary and further studies could explore consumer preferences to develop successful commercial probiotic drink products.

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### CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

### ABBREVIATIONS

**WHO:** World Health Organization; **MRV:** Mean Rank Value; **MS:** Mean Score, **OAA:** Over All Acceptability.

### SUMMARY

In this study, Treatment T3 consistently scored the highest in appearance, flavor and taste and overall acceptability, making it the most preferred blend for each flavor. The proximal composition of the drink revealed that the nutrient content is highest in papaya compared to other pokkali rice-based fruit drink. This study aims to develop a nutrient-dense probiotic drink using hygienic methods and natural ingredients, without any added preservatives or food additives. Incorporating selected fruits and rice enhanced the acceptability and nutritional value of the final product. The preparation process also generated minimal waste.

### ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was not needed for this study. The results were based on organoleptic evaluation and chemical analysis, with no supplementation study conducted.

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