Standardization and Quality Evaluation of Jackfruit based Low Fat Yogurt

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ABSTRACT
The state fruit of Kerala, jack, is a miraculous fruit due to its nutrient profile, health benefits and greater potential for value addition. It can be better utilised if consumer acceptable products are prepared from this fruit. The growing demand for “healthy food” is stimulating the innovation and development of new products nationally and internationally. Yogurt, a milk-based product, is a healthy food which offers high nutritional value with concentrated amounts of protein, carbohydrates, and fat. The added value of yogurt over milk lies in the presence of beneficial bacteria as well as certain bioactive components. The study was aimed at developing a low-fat yogurt. Hence in this study, yogurts were prepared by incorporating varying proportions of blanched jackfruit pulp (10%, 20%, and 30%) along with equal volumes of homogenized and skimmed milk. Both koozha and varikka variety of jackfruits were prepared. The jackfruit bulbs were steam blanched for five minutes and pulped to prepare the yogurt. Plain yogurt served as the control. The prepared yogurts were organoleptically evaluated using a 9 point hedonic scale with a panel of 15 judges. The selection of the best sample was done based on Kendall’s coefficient of concordance. Among the fruit yogurts, the yogurt with 30% jackfruit pulp scored maximum for the sensory attributes. Chemical parameters like pH, moisture, fat, protein, crude fiber and a total ash content of the yogurts were determined.

Keywords: Jackfruit pulp, Lactobacillus acidophilus, Physicochemical evaluation, Yogurt.

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INTRODUCTION
The largest tree-borne fruit in the world, the jackfruit is a treasure of nutrients and several bioactive components. There are two main varieties of jackfruits—one is fibrous, soft, and mushy, known as the kooza whereas the other variety which is crisp and crunchy, called the varikka. The fruit is a rich source of vitamins, minerals, and many other nutrients. Despite the benefits, most of them remain wasted during the season due to improper utilization. Unlike the raw jackfruit, product diversification of ripe jackfruit is limited to products like jackfruit halwa, candies and chakka varatty (a traditional food item). To boost the marketability of jackfruit, novel products have to be developed and popularized.

Yogurt is one of the popular fermented milk product around the world. It is healthy and offers a concentrated amount of protein, carbohydrate, fat and so it is considered superior to milk in a nutritional point of view. Yogurt is produced by the fermentation of milk and the bacterial strains used are Lactobacillus bulgaricus and Streptococcus thermophilus. The added value of yogurt over milk lies in the presence of these bacteria and the bioactive components produced during fermentation.

Yogurt is a part of regular diet in south Eastern Europe and the Middle East for centuries. In India, it is prepared in the eastern region by adding sugar and a small amount of starter culture and kept overnight for fermentation (Meenakshi et al., 2018). The term dahi was used for the product developed in such a manner. Nowadays yogurt is being enjoyed all over the world for its beneficial properties. For many years, plain yogurt was available in the world market. Recently, the sugar and fruit fortified yogurts became available in the market and resulted in the enhanced popularity of the product. The sweet, fruit yogurt is preferred by children, adolescents and elderly. There is immense scope for popularizing the fruit-based yogurts. Several fruit-based yogurts are becoming an inevitable part of our market. Fruits like mango, guava, and pineapple were flavoring the yogurt market of which mango is the most popular one. Hence, in the present study, an attempt was done to assess the suitability of jackfruit pulp obtained from the ripe bulbs of both koozha and varikka variety for the development of the quite unfamiliar jackfruit based yogurt using a combination of skimmed and homogenized milk and to evaluate its nutritional properties.

MATERIALS and METHODS
Selection and Collection of Jackfruit
For the present study, koozha and varikka cultivar of jackfruits were (raw mature 90–110 days) procured from the local households and allowed to ripe.
**Processing of Jackfruit Pulp**
The ripe fruits were cleaned thoroughly before processing under running water. After cutting the fruit, bulbs and seeds were separated. The bulbs were cut into small pieces and steam blanched for five minutes. Once the blanched bulbs come to room temperature, the bulbs were pulped. The procedure for pulp preparation was the same for both the varieties. The smooth pulp obtained was used for the preparation of jackfruit yogurt (Fig. 1).

**Procurement of Other Ingredients**
Other ingredients namely homogenized milk, skimmed milk, skimmed milk powder, and sugar were purchased from the local market. The yogurt cultures were *(Lactobacillus bulgaricus* and *Streptococcus thermophilus)* obtained from the Department of Dairy Microbiology, Kerala Veterinary and Animal Sciences University, Mannuthy, Thrissur, Kerala.

**Preparation of Yogurt**
The yogurts were prepared as per the method described by Varga (2006) after slight modifications (Fig. 2). Varga (2006) prepared yogurt with nonfat dry milk with the incorporation of acacia honey at 1%, 2%, and 5%. The plain yogurt was served as the control. In the present study, a combination of homogenized and skimmed milk was used and instead of honey, the milk was incorporated with 10, 20 and 30%
of jackfruit pulp. The various treatments used for the preparation of jackfruit yogurts are given in Table 1.

**Organoleptic Evaluation**

A series of acceptability trials were carried out using a simple triangle test at the laboratory level and selected a panel of fifteen judges between the age group of 18–35 years as suggested by Jellinek (1985). The yogurts were evaluated organoleptically by the judges using a 9 point hedonic scale.

**Chemicals Analysis of the Yoghurt**

Moisture, fat, protein, crude fiber and total ash of the selected samples were determined according to the standard methods of AOAC (1994). pH of the samples was analyzed using a pH meter.

**Statistical Analysis**

The data were statistically analyzed using Kendall’s coefficient of concordance, DMRT, and independent t-test.

**RESULTS AND DISCUSSION**

**Organoleptic Evaluation of Yogurts**

Sensory evaluation is the expression of an individual likes or dislikes for a product as a result of biological variation in man and what people perceive as appropriate sensory properties. It is a unique source of product information not easily obtained by other means (Iwe, 2003).

All the prepared yogurts were organoleptically evaluated by the panel of selected judges. The mean score obtained for the organoleptic qualities of each treatment were statistically analyzed using Kendall’s coefficient of concordance and the mean scores were worked out. The mean scores and mean rank score obtained by the koozha yogurt is explained in Table 2.

From the table, it is clear that the sensory scores of the jackfruit yogurts tend to increase from T₁ to T₃. The most acceptable treatment was T₃ with a mean score of 8.66 followed by T₂ (7.82) and T₁ (7.35). The mean scores for the sensory parameters of the treatments show a trend to increase from T₁ to T₃ (Graph 1). This may be because as the amount of jack pulp increases, it provides body and consistency to the final products which in turn increased its acceptability. As the treatment T₃ got the highest mean score for overall acceptability among the jackfruit yogurts, it was selected as the best treatment and further analysis were done on this.

The same procedure was repeated with the varikka variety also. The organoleptic qualities of which are given in Table 3. As seen in the koozha variety, in varikka variety also the treatment with 30% incorporation of jackfruit pulp has got maximum scores for the organoleptic parameters. Here also, the organoleptic properties tend to increase from T₁ to T₃ (Graph 2). The mean scores for overall acceptability were 7.40, 8.13 and 8.67 respectively for T₁, T₂, and T₃. Hence from both the varieties jackfruit yogurt with 30% incorporation of fruit pulp were selected for further analysis.

The results of the study conducted by Ndife et al., (2014) also reported a similar result. They prepared functional yogurt with 10%, 20% and 30% incorporation of coconut milk slurry and the one with 30% got the maximum overall acceptability.

**Graph 1:** Organoleptic scores of jackfruit yoghurt (koozha)
Findings of the present study were in agreement with that of Kumar and Mishra (2003) who dealt with the preparation of mango pulp fortified yogurt. They reported that the overall acceptability of the product increases as the concentration of fruit pulp increases. Gad et al. (2015) prepared functional yogurts fortified with carrot juice and cantaloupe juice and the fruit yogurts were subjected to sensory evaluation. They come to a conclusion fruit juice incorporation increased the acceptability of the yogurts when compared to the plain yogurts.

The yogurt prepared with the varikka variety was more acceptable with reference to flavor and texture. The increased flavour of varikka yogurts can be attributed to the presence of increased volatile compounds in the varikka variety. Maia et al. (2004) identified the major aroma concentrates of the jackfruit varieties i.e. isopentyl isovalerate and butyl isovalerate. Isopentyl isovalerate of varikka variety was found to 28.4% and butyl isovalerate was 25.6% whereas that of koozha variety was 18.3% and 12.9% respectively. Varikka variety got good texture than the koozha variety and this may be due to the increased water content and juiciness of koozha (soft fleshed) jack fruit. Gad et al. (2015) opined that increased water content of fruit juice will lead to a pronounced decrease in the body and texture of fruit enriched yogurts.

**Chemical Analysis of the Yogurts**

The selected jackfruit yogurts along with the plain yogurt (control) were subjected to chemical analysis and Table 4 depicts the results.

pH of the developed low-fat yogurt and fruit pulp enriched yogurts differ significantly. 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. Lowering of pH happened due to the production of lactic acid by lactic acid bacteria during fermentation (Elke et al., 2013). The plain yogurt was more acidic than the fruit yogurts and this result is in accordance with the findings of Ndife et al. (2014). They reported low pH value (4.32) for plain yogurt and higher (4.50) for the coconut enriched yogurt. Nazni and Komathi (2014) compared the physicochemical properties of plain as well as fruit yogurts and found out that the fruit yogurts were less acidic (6.3) when compared with the plain yogurts (4.50).

Moisture content was higher in the control of low-fat yogurt than the jackfruit yogurts. The control yogurt contains 83% moisture, whereas koozha and varikka yogurts contain 81.84 and 81.67%, respectively and there is a significant difference in the moisture content of control and fruit yogurts. Barakat and Hassan (2017) reported increased moisture content in the control yogurt than the pumpkin incorporated yogurts. Matter et al. (2016) also came up with a similar result when preparing cactus pear yogurt and papaya yogurts. The moisture content of the plain yogurt was maximum (89 %) than the cactus pear (84.21%) and papaya (85.12%) yogurt.

Fat content of the fruit yogurts was lower when compared with that of the control yogurt. The fat content of control yogurt was 1.02 whereas that of fruit yogurts were 0.68 % and 0.52%. This value is in accordance with the fat specification range for partly skimmed milk yogurt by FSSAI (2011). According to the specification, the fat content of partly skimmed milk yogurt should not be less than 0.5 percent and not more than 3.0 percent. The fat content of the plain...
yogurt was higher than that of the fruit yogurts. This can be attributed to the incorporation of jackfruit, which is not a good source of fat. The same kind of observations was made by Roy et al., (2015) while analyzing different fruit yogurts and control yogurt. The control yogurt was found to contain 3.75 percent fat while banana, papaya, and watermelon incorporated yogurts were containing 3.56, 3.44 and 3.37 percent of fat respectively.

Protein content was found to be more in control yogurt than the fruit yogurts. The control yogurt contains a significantly higher amount of protein than the fruit yogurts. This can also be attributed to the incorporation of fruit pulp. This result can be supported by the finding of Roy et al., (2015). They found out that the protein content of fruit yogurts tend to decrease on increasing the fruit content of yogurt. The papaya yogurt containing 5, 10 and 15 percent fruit pulp has a protein content of 3.76, 3.73 and 3.68 percent, respectively.

Unlike the other parameters, crude fiber and total ash were found to be low in the control (0.60 and 0.72 percent respectively) yogurt than the fruit yogurts. The reason for more fiber in the enriched yogurt is attributed to the presence of jackfruit especially. The quantity of crude fiber in jackfruit fluctuates from 0.33–0.40% (Ong et al., 2006). While the level of the soluble dietary fiber content of jackfruit is comparable with other fruits, the insoluble fraction of fiber is found to be much higher than that of soluble fiber (Ndife et al., 1993; Rahman et al., 1999).

Ash is important in terms of nutrition because it tells how dense the minerals are in a particular food sample. Generally, low ash content indicates that the food product analyzed is not a rich source of minerals. According to Ndife et al., (2014), the crude fiber content of plain yogurt was 0.20±0.46 percent and ash content was 0.53 ± 0.20 percent, whereas this value becomes 2.18 ± 0.45% and 1.01 ± 0.15 when the yogurt was enriched with 30 percent coconut.

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