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RESEARCH ARTICLE

Standardization and evaluation of physico chemical properties of jackfruit based bio-yoghurts

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Abstract: Jackfruit, the state fruit of Kerala, is often regarded as a wonder fruit due to its nutrient profile, nutraceutical and health benefits and the immense scope for value addition. However, it is mostly underutilized due to lack of knowledge and technical facilities. It can be better utilised, if consumer acceptable, simple as well as nutritious products are prepared out of the fruit. The growing demand for "healthy food" is stimulating the innovation and development of new products nationally and internationally. Yoghurt, a milk based product, is a simple, healthy and nutritious food which offers high amounts of protein, carbohydrates and fat. The added value of yoghurt over milk lies on the presence of beneficial bacteria as well as certain bioactive components. The study was aimed at developing jackfruit based bio-yoghurts and to evaluate its physico- chemical properties.*Lactobacillus acidophilus* was used as the probiotic organism in this study. Hence in this study, yoghurts were prepared by incorporating varying proportions of blanched jackfruit pulp (10%, 20% and 30%) along with equal volumes of homogenized milk. Both *koozha* and *varikka* variety of jackfruits were used for the preparation of bio-yoghurts. The jackfruit bulbs were steam blanched for five minutes and pulped to prepare the bio-yoghurt. Plain yoghurt served as the control. The prepared bio-yoghurts were organoleptically evaluated using a 9 point hedonic scale with a panel of 15 judges. The selection of best sample was done on the basis of Kendall's coefficient of concordance. Among the fruit based bio-yoghurts, the yoghurt with 30% jackfruit pulp scored maximum for the sensory attributes. Physico-chemical parameters like synerisis, water holding capacity, curd tension, viscosity, pH, moisture, fat and protein of the bio-yoghurts were determined.

Introduction

Being 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: the fibrous, soft, and mushy, *koozha*and the crisp and crunchy, *varikka*. The fruit is a rich source of vitamins, minerals and many other nutrients. Despite these benefits, most of them remain wasted during the season due to improper utilization and lack of technical skills. The raw jackfruit underwent several value addition trials and product diversification processes, whereas, the ripe jackfruit has limited scope and we have products like jackfruit halwa, candies and *chakkavaratty (*a traditional food item*)* out of it.To boost the marketability of ripe jackfruit, simple as well as novel products have to be developed and popularized.

Yoghurt is one of the popular fermented milk products around the world. It is healthy and offers concentrated amount of protein, carbohydrate, fat and so it is considered superior to milk in a nutritional point of view. Yoghurt is produced by the fermentation of milk and the bacterial strains used are *Lactobacillus bulgaricus* and *Streptococcus thermophillus*. The added value of yoghurt over milk lies on the presence of these bacteria and the bioactive components produced during fermentation. Apart from all these, the probiotic strain *Lactobacillus acidophilus* was also added during the process to make the product probiotic. The bio-youghurts are more beneficial than the ordinary yogurts as they boost the gut micro flora.

Yoghurt is a part of regular diet in south Eastern Europe and Middle East for centuries. In India, it is prepared in the eastern region by adding sugar and 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. Yoghurt is enjoyed all over the world for its beneficial properties. For many years, plain yoghurt was available in the world market. Recently, the sugar and fruit fortified yoghurts became available

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in the market and resulted in the enhanced popularity of the product. The sweet, fruit yoghurt is preferred by children, adolescents and elderly. There is an immense scope for popularizing the fruit based yoghurts.

Hence, the present study is an attempt to assess the suitability of jackfruit pulp for the development of the quite unfamiliar jackfruit based bio-yoghurt using a combination of homogenized milk and to evaluate its physic-chemical properties.

Materials and Methods

Selection and collection of jackfruit: For the present study, *koozha* and *varikka* cultivar of jackfruits were (raw and mature but not yet riped 90-110 days) procured from the local households and allowed to ripe. The soft and fibrous bulbs were of *koozha* and the firm bulbs were of *varikka* jackfruit

Processing of jackfruit pulp

The ripe fruits were cleaned thoroughly under running water before processing. 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 came to room temperature, they were pulped by making puree with the help of mixer grinder. The smooth pulp thus obtained was used for the preparation of jackfruit yoghurt.

Procurement of other ingredients

Other ingredients namely homogenised milk, skimmed milk powder and sugar were purchased from the local market. The yoghurt cultures were (*Lactobacillus bulgaricus* and *Streptococcus thermophilus*) obtained from the department of Dairy Microbiology, Kerala Veterinary and Animal Sciences University, Mannuthy, Thrissur, Kerala. The probiotic strain, *Lactobacillus acidophilus* was obtained from IMTECH, Chandigarh.

Preparation of yoghurt

The yoghurts were prepared as per the method described by Varga (2006) after slight modifications (Figure1). The plain bio-yoghurt served as the control. The various treatments used for the preparation of jackfruit yoghurts are given in Table. 1.

Organoleptic evaluation

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

Physico- chemical analysis of the yoghurt: Synerisis, water holding capacity, curd tension, viscosity, pH, moisture, fat, protein, crude fibre and total ash contentof theselected samples were determined according to the standard methods of AOAC (1994). pH of the samples were analysed using a pH meter(Infra digi).

Statistical analysis

The data were statistically analysed using Kendall's co efficient of concordance, DMRT (Duncan's Multiple Range Test) and independent t test

Results and Discussion

Organoleptic evaluation of yoghurts:Sensory evaluation is the expression of an individual like or dislike 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 yoghurts were organoleptically evaluated by the panel of selected judges. The mean score obtained for the organoleptic qualities of each treatment were statistically analysed

Table 1: Mean scores of organoleptic qualities of jackfruit bio-yoghurts *koozha* variety

Treatments	Sensory Attributes					
	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
T_0	9.00 (3.50)	9.00 (3.50)	9.00 (3.50)	9.00 (3.50)	9.00 (3.50)	9.00 (3.50)
T_1	7.62 (130)	7.53 (1.70)	7.60 (1.83)	7.22 (1.43)	7.28 (1.27)	7.35 (1.27)
T_2	7.95 (2.07)	7.71 (1.87)	7.62 (1.73)	7.77 (1.93)	7.82 (1.97)	7.82 (2.00)
T_3	8.62 (3.23)	8.26 (2.90)	8.37 (2.9)	8.64 (3.27)	8.66 (3.37)	8.66 (3.37)
Kendalls W	0.68**	0.52**	0.54**	0.64**	0.74**	0.72**

Figures in parenthesis indicates mean rank scores
**- Significant at 1% level

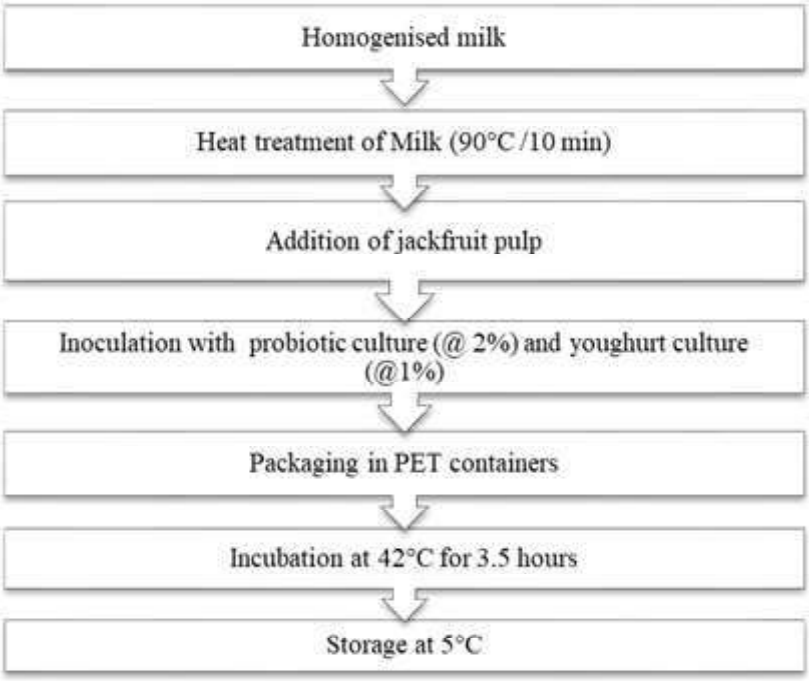

Fig. 1 Flow diagram for the preparation of yoghurt

using Kendall's coefficient of concordance and the mean scores were worked out. The mean score for different treatments are represented in Table2.

Treatment T_3 got the highest mean score for overall acceptability among the jackfruit yoghurts and hence selected as the best treatment. The mean scores for the sensory parameters of the treatments showed a trend to increase from T_1 to T_3. This may be due to the fact that as the amount of jack fruit pulp increased, it provided body and consistency to the final products which inturn increased the acceptability.

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 tended to increase from T_1 to T_3.

Findings of the present study were in agreement with those of Kumar and Mishra (2003) who dealt with the preparation of mango pulp fortified yoghurt. They reported that, the overall acceptability of the product increased as the concentration of fruit pulp increased. The results of the study conducted by Ndife et al. (2014) also reported a similar result. They prepared functional yoghurt with 10%, 20% and 30% incorporation of coconut milk slurry and the one with 30% got the maximum overall acceptability. Gad et al. (2015) prepared functional yoghurts fortified with carrot juice and cantaloupe juice and the fruit yogurts were subjected to sensory evaluation. They came to a conclusion that fruit juice incorporation increased the acceptability of the yoghurts when compared to the plain yoghurts.

Comparison of organoleptic scores of selected fruit yoghurts

Sensory attributes of the selected jackfruit bio-yoghurts (*koozha* and *varikka*) were compared statistically and the results are given in Table 4.

From the table, it is clear that there is no significant difference among the sensory attributes of the two varieties except for flavour and texture. The *varikka*variety was the one with high scores for flavour and texture.

The bio-yoghurt prepared with the *varikka* variety was more acceptable with reference to flavour and texture. Increased flavour of *varikka* yoghurts 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. Isopentylisovalerate of *varikka* variety was found to be 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 would lead to pronounced decrease in the body and texture of fruit enriched yoghurts.

Table 2: Mean scores of jackfruit *varikka* variety

Treatments	Sensory Attributes					
	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
T_0	9.00 (3.50)	9.00 (3.50)	9.00 (3.50)	9.00 (3.50)	9.00 (3.50)	9.00 (3.50)
T_1	7.93 (1.77)	8.20 (1.80)	8.13 (1.80)	7.67 (1.73)	7.40 (1.57)	7.40 (1.57)
T_2	8.67 (2.37)	8.67 (2.33)	8.33 (2.20)	7.93 (1.77)	7.93 (1.90)	8.13 (2.00)
T_3	9.00 (2.93)	9.00 (2.93)	8.47 (2.47)	8.67 (3.00)	8.67 (3.03)	8.67 (2.93)
Kendalls W	0.33	0.39	0.50	0.64	0.65	0.61

Figures in parenthesis indicates mean rank scores
**- Significant at 1% level

Table 3: Comparison of sensory attributes of selected yoghurts

Treatments	Sensory Attributes					
	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
T_3 *(koozha)*	8.62	8.26	8.37	8.64	8.66	8.66
T_3 *(varikka)*	9.00	9.00	8.47	8.67	8.67	8.67
t value	0.44	0.22	2.50	2.78	1.91	1.91
Significance	NS	NS	S	S	NS	NS

Table 4: Physico-chemical properties of jackfruit based bio-yoghurt

Parameters	Control (T_0)	*Koozha*(T_3)	*Varikka*(T_3)
Synerisis	4.25^a	3.70^b	3.55^c
Waterholding capacity	95.75^a	96.30^b	96.45^c
Curd tension	0.115^c	0.128^b	0.157^a
Viscosity	27200^c	28800^b	29200^a
pH	4.11^b	4.61^a	4.63^a
Moisture (%)	75.29^c	78.52^a	76.03^b
Fat (%)	3.42^a	2.40^b	2.39^b
Protein (%)	3.60^a	3.03^b	3.05^b

DMRT row wise comparison.
Values with different super script differ significantly at 5% level

Physio-chemical analysis of the yoghurts

The selected jackfruit bio-yoghurts along with the plain bio-yoghurt (control) were subjected to physic-chemical analysis.

Synerisis of bio-yoghurts was found to follow the order of control>*koozha*>*varikka*bio-yoghurts. The observed rank of bio-yoghurtsin the descending order of water holding capacity was *varikka* based >*koozha* based>control bio-yoghurts. As the water holding capacity of yoghurt gel network increases, the percentage of synerisis decreases.

Study also revealed that the addition of jackfruit pulp was found to increase the curd tension, and viscosity of the yoghurts.

Meenakshi et al. (2018) developed fruit based banana yoghurts with the incorporation of sapota and banana pulp and the study reported an improvement in the physical properties of the fruit based probiotic yoghurts than the control sample The synerisis of control plain yoghurt was 30% whereas that of banana and sapota yoghurts were 6.2 and 21.4% respectively. In the present study the syneris of control yoghurt was 4.25% and that of jackfruit yoghurts were 3.70 and 3.55 % respectively for *koozha* and *varikka* varieties. Viscosity was also improved by the addition of fruit pulp and the viscosity of plain yoghurt of present study was 27200cP and that of *koozha* and *varikka* yoghurts were 2800cP and 29200 cP , respectively. Meenakshi et al. (2015) reported the viscocity of plain, banana and sapota yoghurts as 4450, 11400 and 5200Cp, respectively.

Lowering of pH happened due to the production of lactic acid during fermentation (Elke et al. 2016). The plain yoghurt was more acidic than the fruit yoghurts and this result is in accordance with the findings of Ndife et al. (2014). They reported low pH value (4.32) for plain yoghurt and higher (4.50) for the coconut enriched yogurt. Nazni and Komathi (2014) compared the physicochemical properties of plain as well as fruit yoghurts and found out that the fruit yoghurts were less acidic (6.3) when compared with the plain yoghurts (4.50).

The *koozha* jackfruit based yoghurts were having more moisture than the *varikka* due to the higher moisture content in *koozha* pulp. Pandey and Ukkuru (2004) reported the moisture content of *varikka* jackfruit pulp as 77.98 per cent and that of *koozha* as 79.03 per cent.

The findings of the present study are in line with several other authors. Hossain et al. (2012) reported that the incorporation of 15 per cent strawberry juice during preparation increased the moisture content of yoghurt from 74.03 to 74.29 per cent. Matter et al. (2016) developed cactus pear and papaya yoghurts and the moisture content of the plain, cactus pear and papaya yoghurts were 84.21, 89 and 85.12 per cent respectively.

Fat as well as protein content of the plain yoghurt was higher than that of the fruit yoghurts. This can be attributed to the incorporation of jackfruit, which is not a good source of fat. Same kind of observations were made by Roy et al. (2015) while analyzing different fruit yoghurts and control yoghurt. The control yoghurt was found to contain 3.75 per cent fat while banana, papaya and watermelon incorporated yoghurts were containing 3.56, 3.44 and 3.37 per cent of fat respectively. The papaya yoghurt containing 5, 10 and 15 per cent fruit pulp had a protein content of 3.76, 3.73 and 3.68 per cent respectively. A similar result was also reported by Jayalalitha et al. (2016) during the development of soymilk and mango pulp incorporated yoghurt. Protein content of the yoghurt with 10% mango pulp was 7.12% which decreased to 6.58% with 15% incorporation of mango pulp.

Conclusion

The study put forward the possibility of producing bio-yoghurt enriched with jackfruit pulp. Both the *koozha* and *varikka* varieties were found to be suitable for the product preparation. Incorporation probiotic organism into the product was a novel idea for bringing up a healthier product without compromising the product quality. Both the yoghurts were organoleptically highly acceptable as well as nutritious.

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