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Effect of roasting on functional and sensory parameters of jackfruit seed flour

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Abstract
Jackfruit is widely cultivated in India, after the consumption of the edible portion, the seeds rich in nutrients are discarded as waste. The study was aimed at investigating the functional and sensory qualities of the roasted jackfruit seed flour. The jackfruit seeds of the *varikka* and *koozha* cultivar were gelatinized and roasted to produce the jackfruit seed flour. Functional quality analysis showed that the results of both *varikka* roasted jackfruit seed flour and *koozha* roasted jackfruit seed flour were on par. *Varikka* roasted jackfruit seed flour and *koozha* roasted jackfruit seed flour showed 47.0%, 44.6%, yield ratio, 0.34%, 0.32%, rehydration ratio, 0.86%, 0.76% solubility index, 238.0%, 240.03%, water absorption capacity and 3.20 g/g, 2.95 g/g respectively swelling power. The sensory parameters of the *varikka* and koozha jackfruit seed flour incorporated milk sample indicated that the samples were not significantly different based on all sensory attributes. The sample drink made using roasted jackfruit seed flour yielded good sensory score. The results show that roasted jackfruit seed flour can be used in formulations as a major ingredient in developing novel food products.

Keywords: Jackfruit seed, flour, roasted, functional, sensory, properties

Introduction
Research in recent years has been centered on the quest for less-known and underutilized crops, many of which have the potential to be valuable as food for humans. The jackfruit, *Artocarpus heterophyllus*, is a member of moraceae (Mulberry family), is indigenous to India, and is widely distributed in Western Ghats, a region rich in biodiversity. Jackfruit is also frequently grown in tropical and subtropical nations outside of India, particularly in Sri Lanka, Bangladesh, Thailand, Indonesia, Malaysia and Brazil. It is widely dispersed over the Indian states of Assam, West Bengal, Uttar Pradesh, Maharashtra, Kerala, Tamil Nadu, and Karnataka (Jagadeesh *et al.*, 2007) [9]. Jackfruit is also known as "poor man's food". Although jackfruit seeds account for 10% to 15% of the weight of the fruit, they are often overlooked and underestimated despite their great nutritional benefits (Hossain, 2014) [7]. The seeds of the jackfruit are a good source of carbohydrates, fibre, and protein. Moreover, jackfruit is a great source of numerous minerals, including N, P, K, Ca, Mg, S, Zn, and Cu (Maurya and Mogra, 2016) [10]. Moreover, jackfruit seeds are a reliable source of resistant starch, which controls blood sugar and upholds intestinal health. Huge numbers of seeds are lost each year as a result of the challenges associated with processing and storage. The seeds are typically thrown away as waste due to their perishable nature, but they can last for about a month if they are kept in a cold, moist environment. In a number of culinary processes, the jackfruit seeds are utilised. They can be dried and salted as table nuts or boiled or roasted before consumption. The roasted seeds can be ground into flour and incorporated to various food products to increase their value and enhance the shelf life. The objective of this research is to ascertain the impact of roasting technique on the functional and sensory characteristics of jackfruit seed flour.

Materials and Methods
The jackfruit cultivars *koozha* and *varikka* was selected for the study. Whole jackfruits were purchased from Instructional farm, College of Agriculture, Vellayani, Kerala Agricultural University and from local markets.

Preparation of jackfruit seed flour
Fully ripe fruits from both cultivars are cut open to remove the seeds. Seeds from both cultivars were taken separately.

Seed coat (white arils) and the brown spermoderm were removed from the seeds using stain-less steel knife. The seeds were cleaned and washed under running water. Then it was gelatinized at a temperature of 65 °C for 10 minutes. After gelatinization the seeds were sliced and dry roasted at 70 °C for 10 minutes. After roasting seeds from both cultivars were ground to powder and sieved through a fine wire mesh (150 micron), packed in polyethylene pouches and used for further analysis.

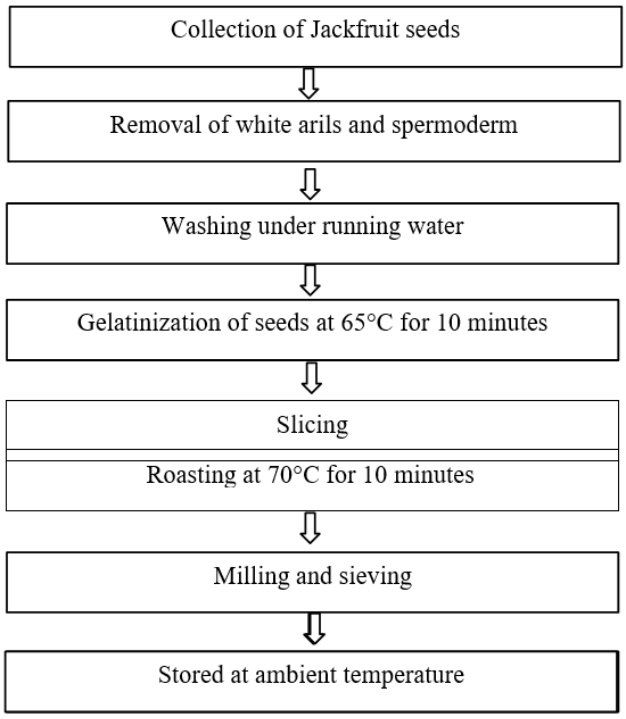

Fig 1: Preparation of jackfruit seed flour

Functional quality analysis

Functional properties are very critical to the quality of food. The elements of food, particularly the carbohydrates, proteins, fats and oils, moisture, fiber, and ash, as well as the structures of these elements, have an impact on the functional qualities of foods and flours (Awuchi, 2017) [4].

Functional qualities such as yield ratio, rehydration ratio, solubility index, water absorption capacity and swelling power of the JSF were evaluated using the following methods.

Yield ratio

Yield ratio of the JSF were analyzed using the formula.

$$\text{Yield Ratio} = \frac{\text{Final weight of product (g)}}{\text{Weight of ingredients (g)}} \times 100$$

Rehydration ratio

Rehydration ratio of jackfruit seed flours were determined by taking about ten grams of the sample, it was mixed with 100 ml of distilled water, stirred and kept for 5 minutes. The contents were filtered using a filter paper. The rehydrated sample was weighed and rehydration ratio was calculated using the formula (Ranganna, 1995) [12].

$$\text{Rehydration ratio} = \frac{\text{Weight of the sample (g)}}{\text{Drained weight of the sample (g)}}$$

Solubility index

Solubility index was determined according to the method of (Anderson *et al.*, 1969) [2] with slight modifications. One gram of sample was suspended in 10 ml of distilled water in a centrifuge tube at room temperature for 30 minutes with gently intermittent stirring and then centrifuged at 3000 rpm for 10 minutes. The supernatant was poured in a weighed petri dish and dried in hot air oven at 110 °C. The solubility index is the weight of dry soluble solids in supernatant, is expressed as a percentage of the original weight of sample (g/g).

The percentage solubility of the supernatant was calculated by,

$$\% \text{ Solubility} = \frac{\text{Weight of dry solids}}{\text{Volume of Supernatant}} \times \frac{100}{\text{Weight of sample}}$$

Swelling power

Swelling power, which is a weight measurement of swelled starch granules and their occluded water, is a measure of hydration capacity (Asaoka *et al.*, 1992) [3].

One gram of the sample was mixed with 10 ml of distilled water in a centrifuge tube and heated at 80 °C for 30 minutes. The mixture was continually shaken during the heating period. After heating, the suspension was centrifuged at 1000 rpm for 15 minutes. The supernatant was decanted and the weight of the paste was taken.

$$\text{Swelling power} = \frac{\text{Weight of the paste}}{\text{Weight of dry sample}}$$

Sensory Evaluation of the JSF

The organoleptic evaluation the *Varikka* roasted jackfruit seed flour (VR-JSF) and *Koozha* roasted jackfruit seed flour (KR-JSF) was performed by 20 semi trained panelists. 200ml of cold milk was mixed with 10g each of VR-JSF and KR-JSF to develop the sensory sample. The sensory attributes of the JSF, such as their color and appearance, taste, texture, flavour, and overall acceptability, are scored using a 9-point hedonic scale. The difference in the scores was analyzed using Kruskal – Wallis test.

Statistical Analysis

All data obtained from various analysis were pooled and subjected to CRD analysis using the online statistical analysis platform KAU-GRAPES. Kruskal-Wallis test was used to evaluate the differences in the sensory scores of the jackfruit seed flour.

Result and Discussion

Functional properties including Yield ratio, Rehydration ratio, Solubility index, Water absorption capacity and swelling power of the roasted Varikka and Kooza JSF were analyzed and the results are depicted in the Following Table No: 1

Table 1: Functional properties of RJSF

Treatments	Yield ratio (%)	Rehydration ratio (%)	Solubility index (%)	Water absorption capacity (%)	Swelling power g/g
VR	47.0a	0.34	0.86	238.0	3.20a
KR	44.6b	0.32	0.76	240.3	2.95b
±SE(m)	0.236	0.009	0.078	6.6	0.026
CV%	0.891	4.445	16.58	4.779	1.454

Values are means of triplicates

From the result it was observed that the yield ratio ranged from 44.6 – 47%. VR had highest (47.0%) yield ratio than KR. The obtained values are similar with the results of 46% yield reported by Chowdhury *et al.* (2012) [5] and 48.25% by Hossain *et al.* (2014) [7].

From the result it was analyzed that there is no significant differences between the treatments for rehydration ratio.

The solubility index value ranged from 0.76 – 0.86%. For solubility index there was no significant difference has been observed between the samples. According to Akter and Haque (2018) [1] the solubility index of jackfruit seed flour was observed as 1.80%. Islam *et al.* (2015) [8] reported that the solubility index of JSF as 2.31%. The reported values are higher than obtained values.

From the result it was noted that the WAC of RJSF ranged from 238 – 240.3%. There was no significant difference between the treatments. According to Ocloo *et al.* (2010) [11], the jackfruit seed flour's water absorption capability was 25%. Islam *et al.* (2015) [8] reported the WAC of JSF as 72ml/100g.

The swelling power of RJSF ranged from 2.95 – 3.20 g/g. it was observed that VR had highest (3.20) swelling power than KR. Islam *et al.* (2015) [8] reported the swelling power of jackfruit seed flour as 1.46%. According to Akter and Haque (2018) [1] the swelling power of jackfruit seed flour was observed as 3.62 g/g. These values are similar to the obtained values. The RJSF shown a swelling power of 6.84%, according to the study findings of Eke-Ejiofor *et al.* (2014) [6]. However, the swelling power of VRJSF and KRJSF was lower than the values reported by Eke-Ejiofor *et al.* (2014) [6].

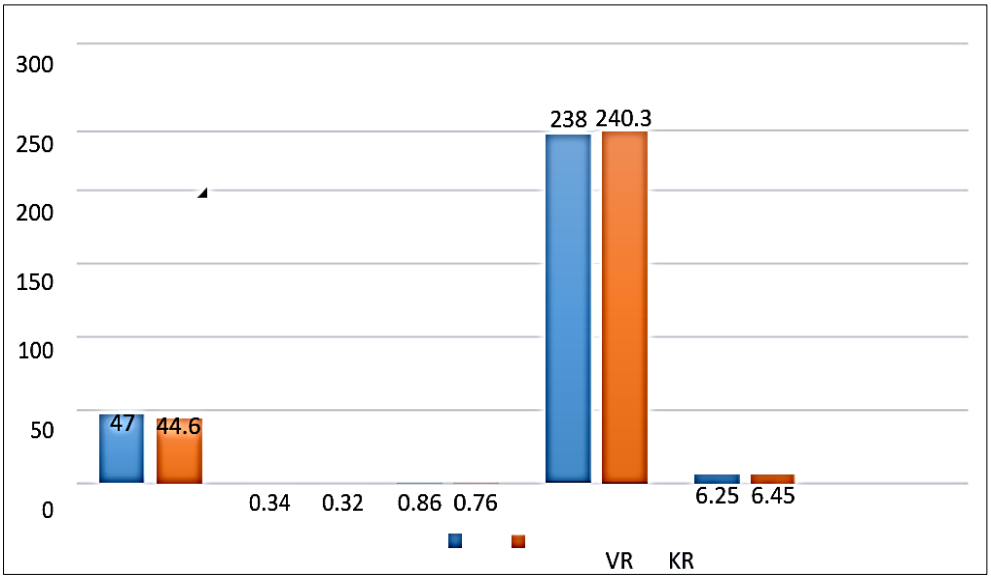

Fig 2: Functional properties of RJSF

Table 2: Sensory Assessment of RJSF

Treatments	Colour and Appearance	Taste	Texture	Flavor	Overall Acceptability
VR	6.7	6.3	7.0	5.8	6.25
KR	6.5	5.9	6.8	5.8	6.45
χ^2	0.078	0.254	0.061	0	0.092
p_value	0.78	0.614	0.805	1	0.761

Colour and appearance

Colour and appearance is the important and first criteria for judging the quality and safety of food. Food which is not acceptable in appearance will be rejected by the consumer. From the above table it was observed that there is no significant difference between the VR and KR for the attribute colour and appearance.

Taste

The sense of taste is a chemical sense due to taste stimuli falling on taste receptors located on the tongue called taste buds. There is no significant difference between the treatments for attribute taste. The treatments were found to be on par.

Texture

Texture encompasses mouthfeel, masticatory properties, residual properties and even visual and auditory properties of a food. From the result it is evident that, there is no significant difference between the treatments for the attribute texture.

Flavour

Flavor is utilized by the consumer for checking the genuineness of the food. From the result it was observed that the treatments are on par.

Overall Acceptability

Overall Acceptability of a product can be judged through their colour, Appearance, Taste, Texture and Flavor of the product. From the statistical analysis it was analyzed that there is no significant difference between the treatments. The treatments were found to be on par.

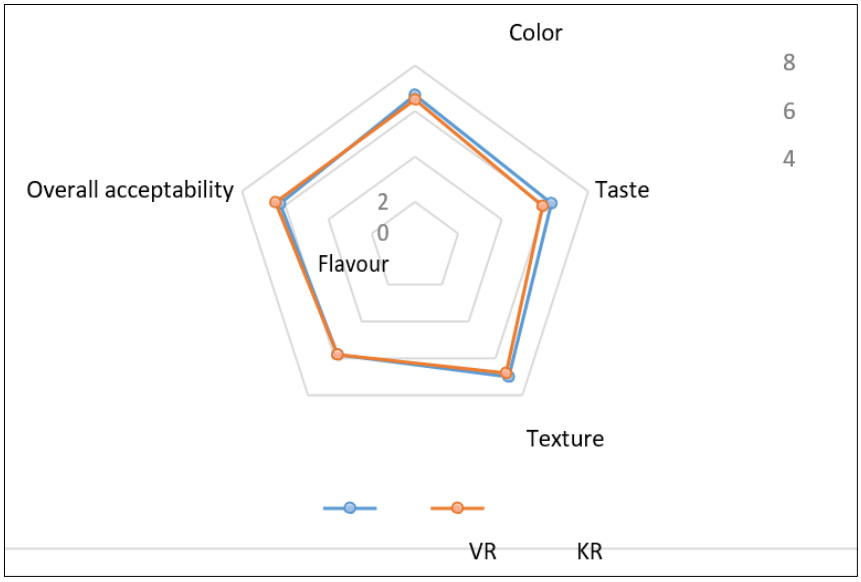

Fig 3: Sensory assessment of RJSF

Conclusion

The research was conducted to evaluate the functional qualities and the sensory characteristics of the jackfruit seed flour. The processing methods used in this study to develop the jackfruit seed flour were gelatinization and roasting. The functional parameter such as yield ratio, rehydration ration, solubility index, water absorption capacity and swelling power of the VR-JSF and KR-JSF was documented. The effect of roasting on the sensory characteristics of the sample drink made out by blending jackfruit seed flour (10 g) and cold milk (200 ml) were assessed using a nine-point hedonic scale. There was no significant difference in the overall acceptability of both the samples. Roasting process can alter the color, aroma and textural properties of the seed samples. This technique can be easily implemented on household level to develop value added novel products using jackfruit seed flour and can help to enhance the nutritional status of the population. The results showed that jackfruit seed flour can be used as the main ingredient to develop myriad of nutrient dense food products.

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