Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2582-2845.8823

ISSN: 2582 – 2845

Ind. J. Pure App. Biosci. (2021) *9*(6), 77-84

Indian Journal of Pure & Applied Biosciences

Peer-Reviewed, Refereed, Open Access Journal

Research Article

Standardization and Development of Jackfruit-Based Nutri Flour

Soumya P.S.[1*] and Suma Divakar[2]

[1]PhD Scholar, [2]Professor,

Department of Community Science, College of Agriculture, Vellayani, Kerala Agricultural University

*Corresponding Author E-mail: soumyahsc@gmail.com

Received: 17.09.2021 | Revised: 14.11.2021 | Accepted: 21.11.2021

ABSTRACT

Jackfruit is a tropical fruit species found in high rainfall and humid areas of the world. The fruit is the gigantic syncarp and is known as the largest fruit of the world, considered as a wonder fruit due to its nutritional profile and health promoting factors. The most of the fruits are wasted due to lack of processing units and marketing facilities. The present study was conducted to develop jackfruit parts based nuri flour and to made three breakfast dshes like 'puttu, ada and oratti' by using twelve different parts of koozha and varikka. The bulbs, perigones, seeds, rind, core and testa of each fruit parts were used. Nutri- flour formulations was made based on the results of glycemic index. The major components (50-60%) of flour was contributed from the fruit parts with low glycaemic index and 40 % was formed by other components in different proportions. Based on organoleptic evaluation, mean score was high for products formulated F_9, with combination in the ratio of 20% koozha jack rind flour, 10% koozha jack testa flour, 9% varkka jack testa flour, 8% varikka jack rind flour, 8.5% koozha jack perigone flour, 2% varikka jack perigone flour, 2.5% koozha jack core flour, 2% varikka jack core flour, 12% koozha jack bulb flour, 7% koozha jack seed flour, 12% varikka jack bulb flour, 7% varikka jack seed flour, where 100% jack bulb flour served as control. The mean scores for overall acceptability of puttu, ada and oratti were 7.3, 7.7 and 8.2 respectively.

Key words: *Perigones, Seeds, Rind, Core and Testa.*

INTRODUCTION

The jackfruit is "an underutilized crop" in the tropical-to-subtropical climate, it belongs to family Moraceae scientifically known as *Artocarpus heterophyllus*. Where most of the fruits get wasted due to ignorance, lack of post-harvest technology and gaps in supply chain systems. Fresh fruit containing health promoting constituents including antioxidants, minerals, vitamins (such as A, C, and E) phytochemicals, (such as folate glucosinolates, carotenoids, flavonoids and phenolic acids lycopene, selenium) Jackfruit contains more protein, calcium, iron, and other essential nutrients when compared to the common fruits (Prem et al., 2015).

Cite this article: Soumya, P. S., & Divakar, S. (2021). Standardization and Development of Jackfruit-Based Nutri Flour, *Ind. J. Pure App. Biosci. 9*(6), 77-84. doi: http://dx.doi.org/10.18782/2582-2845.8823

Jackfruit is that is widely consumed as a fresh fruit has also been reported the therapeutic qualities since ancient times. It is also used in a traditional medicine as an analgesic and immunomodulator. Jackfruit is gluten free and casein free, thus offering systemic anti-inflammatory benefits to skin. Jackfruit has beneficial nutritional parameters including low glycemic index (GI). This could be due to the collective contributions of dietary fibre and slowly available glucose. The postprandial glycemic response to raw and ripe jackfruit elicits low glycemic index (Hettiaratchi et al., 2011). The flvanoids present in the extract have been identified to be responsible for the non -toxic hypoglycemic action (Chandrika et al., 2005).

Jackfruit has a low shelf life *i, e,* 2-3 days, after which they will start to rot. Therefore, it is necessary to process the fruit and transform it into different food products to give it an economic value (Sharma et al., 2013). The processing qualities of jackfruit was excellent with good sensory appeal and hence it is highly suitable for value addition and processing Shruthy (2005). Waste and by-products make up about 70 to 80 percent of a jackfruit. About 55 to 60 percent of this fruit is made up of the outer rind or peel, inner core, and perianth (Subburamu et al., 1992). Seed is a valuable by-product that accounts for about 12- 14 percent of a jackfruit's total weight (Prathima, 2008).

In recent years, the demand of instant food mixes is increasing day by day due to increase in urbanization, breaking up of the traditional joint family system, time, convenience and changing lifestyles. Low calorie and high nutritious instant food mixes are most preferred by consumers. The food industry has focused its efforts in the development of new products with properties that not only provide the necessary nutrients for human food, but also help prevent diseases related to nutrition such as diabetes, obesity, hypertension, and cardiovascular complications. It has been found that there is a significant correlation between the regular intake of phytochemicals and the prevention of these lifestyle-related diseases. (Gresele et al., 2016).

Jackfruit could be considered as a functional food because it has valuable compounds in different parts of the fruit that display functional and medicinal effects. Hence the present study was conducted by Standardization and development of jackfruit-based nutri flour.

MATERIALS AND METHODS

Preliminary processing

Jackfruit type, Local cv Koozha and cv varikka were collected from the Instructional farm, College of Agriculture, Vellayani and also from the adjacent home yards. The fresh weight of whole jackfruit was recorded. Vegetables and fruits are subjected to several pretreatments after harvesting and before processing. Then preliminary processing comprised of washing, peeling, cutting of the parts followed by blanching and drying.

The bulbs, perigones, seeds, rind, core and testa were separated from the jackfruit and weight of each fruit parts were recorded. As the fruit contains sticky latex, small quantity of vegetable oil was applied on hands before separating the bulbs. The white arils or seed coat were peeled off manually. The spermoderm layer was removed by rubbing the seeds between the hands. All parts were washed under tap water to remove dust and dirt. Selection of appropriate dimension of slices is an important factor prior to drying, because thicker slices will dry at a slower rate or may not dry fully. The raw material was cut in dimensions of 2.5 x 1 cm. Blanching is a unit operation prior to freezing, canning or drying in which fruits or vegetables are heated for the purpose of inactivating enzymes, modifying texture, killing microorganisms, preserving colour, flavour and nutritional value and removing trapped air (Corcuera et al., 2004). It is a mild heat treatment accomplished at a temperature below 212^0F for less than 2 to 3 minutes before drying. This process also helps in the removal of air from the food tissues to reduce oxidation, softening of tissues facilitates packing and also inactivation of

anti-nutritional properties. All jackfruit parts were subjected to thermal treatment to inactivate antinutritional factors present in it. Then the blanched slices were dried below 65^0 C in the electric drier for 6-7 hours. Proper care was given to avoid the cross contamination from other foreign particles. After drying to record the dry weight of each part of jackfruit to get the flour. The dried jackfruit parts were milled into fine flours separately. The flours were sieved through a 0.05 mm sieve properly and packed in PP covers for further analysis.

Initial standardization of the combination of ingredients of the nuti mixes

Jack fruit varieties (*koozha* and *varikka*) twelve different parts using for preparing jackfruit-based nutri flour. The bulbs, perigones, seeds, rind, core and testa of each fruit parts were used. Nutri- flour formulations was made based on the results of glycemic index. The major components (50-60%) of flour was contributed from the fruit parts with low glycemic index and 40 percent will be formed by other components in different proportions. The flours of all jackfruit parts were processed separately after pre-treatments and the processed raw materials were mixed in 12 different blends; all other ingredients proportions were changed. Where the proportion of major components that is *koozha* jack fruit rind flour. (Table 1).

Table 1: **Formulation of nutri flour**

Treatments	Formulations (100g)											
	Jackfruit parts with low GI					Jackfruit parts with high GI						
	KJRF	KJTF	VJTF	VJRF	KJPE	VJPF	KJCF	VJCF	KJBF	KJSF	VJBF	VJSF
T_1	**20**	**10**	**9**	**8**	**8.5**	7.5	7.5	7	6	6	5.5	5
F2	**20**	**10**	**9**	**8**	**8.5**	10	8	6	8	5	3.5	4
F3	**20**	**10**	**9**	**8**	**8.5**	7	8	6	10	6	5.5	2
F4	**20**	**10**	**9**	**8**	**8.5**	5	5.5	5	9	5	6	9
F5	**20**	**10**	**9**	**8**	**8.5**	4.5	4	3.5	4.5	8	8	12
F6	**20**	**10**	**9**	**8**	**8.5**	6.5	7	7	8	4	10	2
F7	**20**	**10**	**9**	**8**	**8.5**	7.5	10	9	6	7	3	2
F8	**20**	**10**	**9**	**8**	**8.5**	7	6	5.5	7	8	6	5
F9	**20**	**10**	**9**	**8**	**8.5**	2	2.5	2	12	7	12	7
F10	**20**	**10**	**9**	**8**	**8.5**	5	4.5	3	7	12	7	6
Control	100 % jackfruit bulb flour (50% KJBF+50% VJBF)											

(KJRF- *Koozha* Jackfruit Rind Flour, KJTF- *Koozha* Jackfruit Testa Flour, VJTF - *Varikka* Jackfruit Testa Flour, VJRF - *Varikka* Jackfruit Rind Flour, KJPF - *Koozha* Jackfruit Perigones Flour, VJPF- *Varikka* Jackfruit Perigones Flour, KJCF - *Koozha* Jackfruit Core Flour, VJCF - *Varikka* Jackfruit Core Flour, KJBF - *Koozha* Jackfruit Bulb Flour, KJSF- *Koozha* Jackfruit Seed Flour, VJBF- *Varikka* Jackfruit Bulb Flour, VJSF - *Varikka* Jackfruit Seed Flour).

Acceptability of the nutri flour by preparing the product

The treatments were evaluated for their organoleptic qualities by incorporating the nutri flour into 3 commonly consumed popular breakfast dishes like "puttu", "ada" and "oratti".

Preparation of 'Puttu'

Normal puttu flour was prepared using rice flour. Jackfruit based nutri flour was prepared using 100g of nutra flour, 70 ml of water, 2g of salt and 1 table spoon grated coconut. Nutri flour was mixed with salt and add water in batches thoroughly, make a moist flour with crumbly texture. The nutri puttu flour was steamed with layers of grated coconut. It yielded1 puttu.

Preparation of 'Ada'

Hundred grams of nutri flour, 2g of salt and 95 ml of hot water was mixed in a bowl and knead into a soft dough. A portion of dough was spread on flamed banana leaf and flattened. A table spoon of grated coconut was placed in the center of the dough. the banana leaf was then folded and steamed for 10 minutes. Thus 3 adas were obtained.

Preparation of 'Oratti'

Hundred grams of jackfruit-based nutri flour was mixed with 1 table spoon of grated coconut, ½ teaspoon cumin seeds, 15 gm chopped onions, 1 gm green chilli and 120 ml water. Orati was made on a hot greased tawa

by spreading the dough manually into rounds. It yielded 3 orattis.

Sensory Evaluation

The sensory evaluation of freshly prepared products namely 'puttu', 'ada' and 'oratti' from jackfruit based nutri flour, using a nine-point hedonic scale with a panel of 10 judges considering the 6 sensory parameters such as appearance, colour, flavor, texture, taste and overall acceptability.

Statistical Analysis

The statistical analysis was carried out for the mean score obtained from sensory evaluation. The best treatment was identified from the interpretation of Kruskal-Wallis test.

RESULT AND DISCUSSION

The mean score and the mean rank values obtained for different sensory attributes of 'puttu', 'ada' and 'oratti' prepared with raw jackfruit-based nutri flour in combination with jackfruit different parts and control are presented in Table 3, 4 and 5. There has been tremendous change in the role of sensory evaluation over the years. In partnership with research and development as well as marketing departments it helps in the formulation of profitable strategy. Now a days, chemical and physical properties of the product driving sensory attributes are ascertained by combining data obtained from sensory and instrumental testing. sensory evaluation is used to estimate shelf life of the food products as sensory characteristics of the product depreciate ahead of microbial quality. It explores new technologies for product development and understanding the consumer behavior (Sharif et al., 2017).

Table 2: Mean scores for organoleptic evaluation of 'Puttu' prepared with jackfruit-based nutri flour

Treatment	Appearance		Colour		Flavour		Texture		Taste		OAA	
	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS
F_1	9.70	4.3	33.83	5.2	34.22	6.2	17.77	4.4	31.65	3.5	15.66	3.4
F_2	14.72	4.7	17.90	4	17.10	5.2	18.66	4.1	27.25	3.3	23.40	3.5
F_3	29.94	5.1	24.50	4.4	28.40	5.8	31.60	4.7	24.45	3.1	21.50	3.4
F_4	29.96	5.2	31.83	4.7	25.85	5.7	30.60	4.6	49.40	4.2	41.65	4.2
F_5	45.00	5.7	34.38	5.2	47.35	6.6	34.30	4.9	41.40	3.8	46.70	4.5
F_6	54.70	6.2	30.16	4.3	34.72	5.4	50.00	5.6	69.70	5	49.65	4.7
F_7	64.70	6.7	67.00	5.7	66.83	6.8	70.60	6.9	50.50	4.2	54.45	4.9
F_8	72.35	7.1	**85.10**	**7.4**	74.18	7.3	**77.80**	**7.4**	48.15	4.1	71.85	5.8
F_9	81.66	7.4	82.65	7.1	**81.90**	**7.8**	77.61	7.2	**90.05**	**6**	**93**	**7.3**
F_{10}	**83.65**	**7.7**	72.60	6.3	78.77	7.5	75.94	6.9	73.95	5.1	80.70	6.4
Control (F_{11})	98.80	8.2	99.50	8.6	102.00	8.5	100.66	8.2	104	7.3	102.5	8.3
K W Value	92.81		87.88		81.47		82.10		69.76		86.47	
λ^2 (0.05)	18.31											

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

The appearance of a food influences its craving and acceptance, before the product ever touches the lips. The organoleptic evaluation revealed that (table 30) the mean rank value for appearance of jack fruit nutri flour based "puttu" ranged between 9.70 – 83.65. The mean rank values were analyzed and it was observed that F_{10} obtained the first rank (83.65) after control (98.80). While F_1 got least mean rank value of 9.70. F_3 (29.94) was on par with F_4 (29.96). The mean rank value for colour of jack fruit nutri flour based – 'puttu" ranged between 17.90 – 85.10. The highest mean rank value was obtained by F_8 (85.10) followed by F_9 (82.65) and lowest by F_2 (17.90). There was a significant difference between the mean rank scores of colour. From the organoleptic analysis of flavour it was noticed that F_9 obtained the maximum mean rank value (81.90) after control F_{11} (102);

while F_2 obtained the minimum mean rank value 17.10. The highest mean score value for texture was noticed in F_8 (77.80) after control F_{11} (100.66) followed by F_9 (77.61), F_{10} (75.94), F_7 (70.60). The minimum texture rank value was noticed in F_1 (17.77). F_9 had the highest mean rank score for taste (90.05) and over all acceptability (93). Statistical analysis of the data revealed that there was significant difference between the mean rank scores of the different quality attributes of the jack fruit nutri flour based puttu at 5% level. Instant 'puttu' mix was prepared with finger and foxtail millet, (50:50) Millet puttu remained in good condition up to 14 days at refrigerated temperature and 28 days in deep freezer. Millets contain high nutritional value compared to rice and wheat (Mamatha Rani et al., 2019).

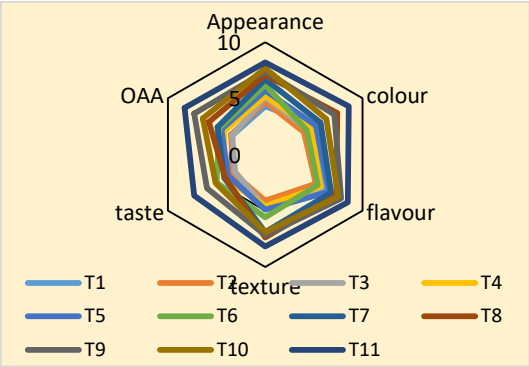

Fig. 1: Organoleptic evaluation of 'Puttu'

Table 3: Mean scores for organoleptic evaluation of 'Ada' prepared with jackfruit-based nutria flour

Treatment	Appearance		Colour		Flavour		Texture		Taste		OAA	
	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS
F_1	35.40	5.8	53.15	5.5	30.60	6.4	24.10	4.6	28.20	3.6	14.90	3.5
F_2	21.80	5.3	20.10	4	21.05	5.8	16.60	4.2	23.65	3.4	18.55	3.8
F_3	24.40	5.4	28.80	4.4	15.20	5.4	30.60	4.9	20.15	3.1	12.30	3.2
F_4	32.80	5.7	34.95	4.7	29.38	6.1	28.50	4.8	48.15	4.5	44.10	4.7
F_5	35.10	5.8	46.40	5.2	47.90	6.9	37.00	5.2	25.15	3.4	50.40	5.1
F_6	51.95	6.4	27.30	4.3	43.83	6.3	54.80	6.2	69.50	5.4	47.20	4.9
F_7	68.75	7	68.40	6.3	65.75	7.1	59.72	6.6	54.60	4.8	61.90	5.9
F_8	76.95	7.3	54.22	5.7	80.16	8	**87.90**	**7.7**	71.70	5.6	79.30	7.2
F_9	79.35	7.4	**88.05**	**7.4**	80.15	7.9	84.80	7.4	**88.75**	**6.4**	**87.60**	**7.7**
F_{10}	**82.25**	**7.5**	81.75	7.1	**81.65**	**8.1**	78.35	7.1	79.45	5.9	84.00	7.5
Control(F_{11})	100	8.2	101.80	8.4	96.38	8.7	102.44	8.7	101.20	7.3	101.10	8.6
K W Value	76.94		76.09		83.73		90.22		83.70		97.277	
$\lambda^2(0.05)$	18.31											

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

As shown in Table 3, the organoleptic evaluation of the mean rank value for appearance of jack fruit-based "Ada" ranged between 21.80 – 82.25. The highest mean rank score was obtained by F_{10} (82.25) which was on par with F_9 (79.35) and F_8 (76.95) while the lowest was obtained by F_2 (21.80). The highest mean rank value for colour was obtained by F_9 (88.05) after control F_{11} (101.80); while F_2 obtained the least mean rank value (20.10). Considering the flavour of jackfruit based "ada" (Table.31) the maximum mean score was obtained by F_{10} (81.65) after control F11 (96.38). The least score was obtained by F_3 (15.20) followed by F_2 (21.05), F_4 (29.38), and F_1 (30.60) respectively. The maximum mean rank value for texture was observed in F_8 (87.90) which was on par with F_9 (84.80) and F_{10} (78.35) while the minimum mean rank was (16.60) was obtained by F_2. The maximum mean rank value for taste and overall acceptability were obtained F_9 (88.75 and 87.60) and lowest mean rank value for taste was obtained by F_3 (20.15) followed by F_2 (23.65), F_5 (25.15) and F_1 (28.20). The lowest overall acceptability was observed by F_3 (12.30). Statistical analysis of the data revealed that there was significant difference

between the mean rank scores of the different quality attributes of the jack fruit based "ada" at 5% level. Islam et al. (2015) reported that Jackfruit seed flour was utilized in composite flour-based biscuit. Biscuits were prepared with 10%, 20%, 30% and 40% jackfruit seed flour and were compared with plain biscuits (0% seed flour).

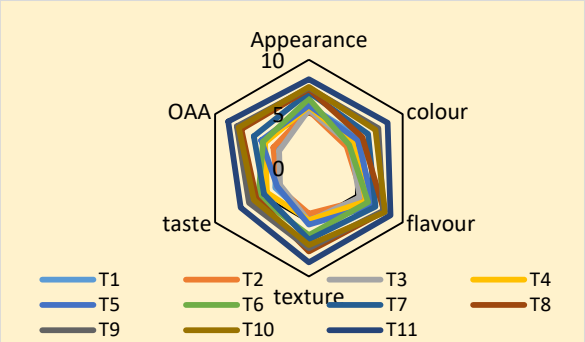

Fig. 2: Organoleptic evaluation of of 'Ada'

Table 4: Mean scores for organoleptic evaluation of 'Oratti' prepared with jackfruit-based nutri flour

Treatment	Appearance		Colour		Flavour		Texture		Taste		OAA	
	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS
F_1	22.88	5.4	49.90	5.6	40.30	6.6	19.75	5.1	26.60	4.1	26.55	4.3
F_2	32.75	5.7	25.60	4.6	19.00	5.5	12.65	4.7	13.90	3.2	31.20	4.6
F_3	22.85	5.3	30.45	4.8	33.66	6.2	25.40	5.4	23.40	3.9	9.65	3.2
F_4	35.65	5.8	33.10	4.9	16.15	5.3	29.60	5.6	46.00	5.6	33.90	4.7
F_5	27.80	5.5	42.25	5.3	37.40	6.4	40.05	6.2	21.80	3.8	49.50	5.5
F_6	54.80	6.6	24.80	4.5	31.05	5.8	61.10	7.2	62.70	5.8	43.80	5.2
F_7	64.30	6.9	63.81	6.5	74.25	7.5	57.95	6.9	66.10	5.2	71.40	7
F_8	83.45	7.8	63.40	6.2	78.55	7.7	79.55	8.1	81.90	6.3	79.20	7.6
F_9	**86.05**	**7.9**	**91.50**	**7.6**	**88.85**	**8.2**	**92.30**	**8.3**	**87.00**	**6.6**	**89.90**	**8.2**
F_{10}	79.10	7.6	85.90	7.3	82.85	7.9	85.10	7.8	76.00	6.1	77.18	7.9
Control(F_{11})	92.15	8.2	103.77	8.5	93.00	8.4	97.10	8.6	102.10	7.6	101.60	8.8
K W Value	77.78		77.99		91.64		98.67		93.25		87.80	
λ^2 (0.05)	18.31											

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

The organoleptic evaluation revealed that table 4, the mean rank value for appearance of jackfruit nutri flour based "oratti" ranged between 22.85 to 86.05. The maximum mean rank value was obtained by F_9 (86.05) followed by F_8 (83.45) and F_{10} (79.10) while the minimum mean rank value was fetched by F_3 (22.85), which was on par with F_1 (22.88) and F_5 (27.80). In case of colour maximum mean score was observed for F_9 (91.50) after control F_{11} (103.77). The minimum score was observed in F_6 (24.80), followed by F_2 (25.60), F_3 (30.45), F_4 (33.10). The highest mean rank value for flavour was obtained by F_9 (88.85) and the lowest mean rank value of 16.15 was obtained by F_6. From the organoleptic analysis it was observed that the higher value for texture was obtained by F_9 (92.30) after control F_{11} (97.10) and least value for F_2 (12.65). Among all the parameters used for organoleptic analysis, taste is the most desirable characteristic for acceptability. The mean rank values for taste of the eleven treatments of "ada" ranged between 13.90 to 102.10. The highest mean rank score (87) for taste was obtained by F_9 after control F_{11} (102.10) while lowest mean rank value was obtained for F_2 (13.90). Overall acceptability of the eleven treatments is clearly depicted in table 32. Among the eleven treatments F_9 obtained the maximum mean rank value of 89.90 after the control F_{11} (101.60). Least mean rank value of 9.65 and lesser acceptability was noted for F_3. Result of tests indicates that there was significant difference in the mean rank scores obtained for the eleven treatments F_1 to F_{11}. Hema (2015) studied the development of nutritious instant dried powder by mixing bulb and seeds of the jackfruit. The study suggested that the increment of the

jackfruit seeds powder in the formulation resulted into higher protein content and lower moisture content in the instant powder.

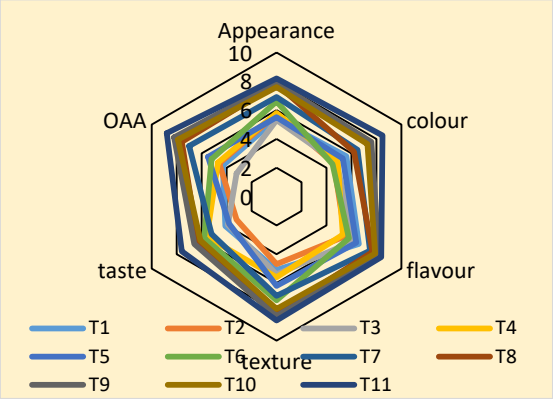

Fig. 3: Organoleptic evaluation of of 'Oratti'

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 products like '*puttu', 'ada'* and '*oratti'*. On the basis of analysis of mean scores F_9 was selected as the best combination. Among the three products based on comparative scores of each parameter '*oratti'* was found to be more acceptable.

CONCLUSION

All the food sources comprise edible and non-edible waste portions, with increasing demand for food the current agriculture is focusing on agro-processing to utilize the maximum portion of the plant resources. With increasing pressure on the existing resources, there has been a substantial effort for the use of more and more agricultural waste and by-products to value-added products. Using jackfruit wastes and by-products for further exploitation have gained augmented interest because of their high value contents.

Acknowledgement

The researchers place their gratitude to Kerala Agricultural University for the technical and financial support rendered in the conduct of the study.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Conflict of Interest

The author(s) declares no conflict of interest.

Author Contribution

All authors contributed equally to establishing the topic of the research and design experiment.

REFERENCES

Chandrika, V. G., Jangz, E. R., & Warnasuny, N. D. (2005). Analysis of carotenoids in ripe jackfruit in Kerala and study the bioconservation, *J. Sci. Food Agric. 85*(2), 186-190.

Corcuera, J. I., Cavalieri, R. P., & Powers, J. R. (2004). In: Encyclopedia of agriculture, *Food Biol. Eng*. 38p.

Gresele, P., Cerletti, C., Guglielmini, G., Pignatelli, P., de Gaetano, G., & Violi, F. (2016). Effects of resveratrol and other wine polyphenols on vascular function: An update, *J. Nutr. Biochem. 22*, 201–211.

Hema, J. (2015). Development of nutritious instant dried powder by mixing bulb and seeds of the jackfruit. MSc Thesis, Department of Agro-processing, Bangabandhu Sheikh Mujibur Rahman Agricultural University.

Hettiaratchi, U. P. K., Ekanayake, S., & Welihinda, J., (2011) Nutritional

assessment of a jackfruit (*Artocarpus heterophyllus*) meal, *Ceylon Med. J. 56*(2), 238-243.

Islam, M. S., Begum, R., Khatun, M., & Dey, K. C. (2015). A study on nutritional and functional properties analysis of jackfruit seed flour and value addition to biscuits, *Int. J. Eng. Res. Technol. 4*(12), 139-147.

MamathaRani, R., Chavan, U. D., Kotecha, P. M., & Lande, S. B. (2019). Preparation and storage study of millet puttu, *Int. J. Clin. Sci*. *7*(3), 4453-4457.

Prathima, K. S. (2008). Processing and utilization of jack fruit seeds for value addition. Doctoral dissertation, University of Agricultural Sciences, Bangalore, India.

Sharif, M. K., Butt, M. S., Sharif, H. R., & Nasir, M. (2017). Sensory evaluation and consumer acceptability. *Handbook of food sci. Technol*. pp.361-386.

Sharma, N., Bhutia, S. P., & Aradhya D. (2013). Food processing and technology process optimization for fermentation of wine from jackfruit (*Artocarpus hetrrophyllus Lam*.). *J. Food Sci. Technol. 4*(2), 46-49.

Shruthy, P. (2005). Utilisation of jackfruit for product development and by product recovery. Ph. D thesis, Kerala Agricultural University, 210p.

Subburamu, K. M., Singaravelu, A., Nazar & Irulappan, I. (1992). A study on the utilization of jack fruit waste, *Bioresour Technol*. *40*(1), 85-86.