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Development of textured vegetable protein (TVP) based on raw jackfruit

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A novel product namely textured vegetable protein was standardised in this study. Textured vegetable protein or TVP is a meat substitute that mainly focuses on vegetarian population. Even though *Koozha*, fibrous type of jackfruit (*Artocarpus heterophyllus*) is highly available it is an underutilized fruit. Jackfruit bulb flour, seed flour and gluten in varying proportions were used for the development of TVP. The sensory quality of textured vegetable protein produced was evaluated. The cooked product was served to panelists to compare sensory acceptability of the TVP. Based on the sensory attributes treatment T_7 was selected as the best treatment.

Key Words : TVP, Underutilized, Fermentation, Sensory attributes, Development, Acceptability

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INTRODUCTION

New product development is a crucial process for the survival of firms, especially small businesses. The small business environment today is very dynamic and competitive. For small enterprises to withstand competition from multinationals, they have to continuously update their products to conform to current trends. The product development process is the cycle that a new product has to undergo from conceptualization to the final introduction into the market (Anand, 2011). It is the process of developing a new product or service for the market. This type of development is considered to be the preliminary step in product or service development and involves a number of steps that must be completed before the product can be introduced to the market. New product development may be done to develop an item to compete with a particular product/ service or may be done to improve an already established product. New product development is essential to any business that must keep up with market trends and changes.

Many jackfruit products have been developed, notably jackfruit juice, candy and a fruit bar from ripe jackfruit. Unripe jackfruit pulp can be made into flakes, which can be preserved for a long time (Abraham and Jayamuthunagai, 2014 and Haq, 2006). The various products developed from ripe jackfruit are candy, finger chips, fruit bars, fruit leather, halvah, ready to-serve beverages, toffee and milk-based srikhand, ice cream and kulfi (Swami *et al.*, 2014). Half-ripened bulbs can be processed into bulb powder and this can be utilized for the preparation of traditional snacks such as pakoda, biscuits and mufins (Akanbi *et al.*, 2011). The State Board of Horticulture Mission and Center for Innovation in

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Science and Social Action (CISSA), Kerala, October 2011, organized a "Mobile Jack Bazaar" where in as many as 20 jackfruit products were displayed at the mobile market set up in an altered car which would move through major points in the city and sell "solar dried jackfruit," "*Chakkakkuru peda*," "jackfruit wine, *Chakka varatti*," jackfruit jam, fresh jackfruit arils, jackfruit chips, and many more such dishes (Sidhu, 2012 and Jagtap *et al*., 2010). Jackfruit is a typical Indian fruit mainly grown in West Bengal, Bihar, Assam and the west coast. Fully ripe jackfruit is sweet and has exotic flavour. The bulbs (edible flakes) contaian 7.5 per cent sugar on dry weight basis and a fair amount of carotene which is Vitamin-A (Ejiofor *et al*., 2014). Many more such line products from jackfruit are contemplated. Apart from the better utilisation of the perishable fruit this would also result in considerable value addition (Akubor and Badifu, 2004; Tejpal and Amrita, 2016). Jackfruit (*Artocarpus heterophyllus*), also known as jack, doesn't win any prizes for being cute or convenient to eat but it's sure winning praises among vegan and vegetarians as a tasty meat alternative (Okaka and Potter, 1979 and James and Kuipers, 2003). Textured vegetable protein or TVP mainly focuses on the vegetarian population, as a meat substitute. Even though *Koozha* is highly available it is an underutilized fruit due to its extra fibrous nature. Hence, this study was envisaged.

METHODOLOGY

Location and year of experimentation:

College of Agriculture, Vellayani, Thiruvananthapuram.

Year of experimentation :2017-2018.

Development of textured vegetable protein (TVP) from jackfruit:

The various steps involved in the standardisation of the product are described below.

Selection and optimization of raw ingredients for TVP:

Jackfruit bulb flour, seed flour, gluten, tapioca starch and soya flour were selected as the ingredients for the development of TVP.

Development of gluten from wheat flour:

Gluten is a wheat protein which is extracted manually from wheat flour. Once extracted the dried wheat gluten is an insoluble high protein powder, which regains its original characteristics after rehydration and mixing. It has unique functionalities and can serve many applications in food and feed products.Wheat flour (250 g) was taken in a bowl and made in to a dough. After that it was kept in refrigerator overnight. Next day, it was taken out and washed thoroughly, till pure gluten was obtained (confirmed through iodine test).

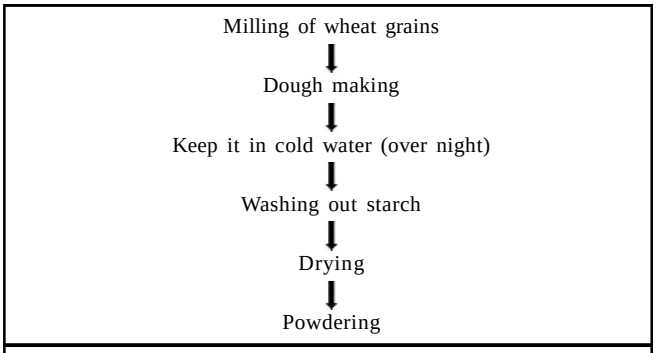

Fig. A : Flow chart on processing of gluten

Processing of tapioca starch:

Due to the excellent binding property, tapioca starch is used as a binder in the TVP. Tapioca was purchased from the local market. It was washed in tap water to remove mud and dirt. The cleaned tuber was then peeled and cut in to small pieces with the aid of sharp knife. The pieces were taken to mixer grinder for grinding. The ground paste was mixed with excess water and stirred well and strained through filter. This mixture was allowed to settle to get tapioca starch. The excess water was drained out. The sediment was collected, dried in sun to get fine tapioca starch. This was used as a binding agent for development of TVP.

Processing of other adjuncts:

Slightly heated soyaballs were powdered and sieved. It was used in a constant ratio in all the treatments. Yeast culture was prepared using *Saccharomyces cerevisiae*.

Development of jackfruit based TVP:

Jackfruit based TVP was processed by using ingredients such as jackfruit bulb flour, seed flour, gluten, yeast culture and soya flour to form chunks. For this totally eleven combinations of TVP were worked out and from this the best treatment was selected for further investigation (Table A).The best combination was selected based on the sensory qualities. The best treatment was

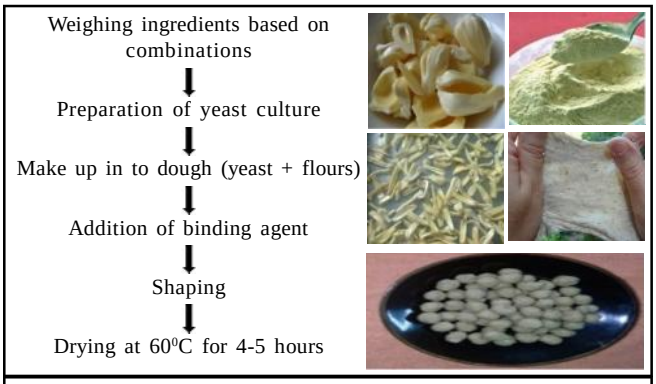

Fig. B : Flow chart on development of TVP

Table A: The treatments of TVP evaluated

Treatments	Gluten	JFBF	JFSF
T_1	50	20	30
T_2	50	30	20
T_3	50	10	40
T_4	50	25	25
T_5	50	-	50
T_6	50	50	-
T_7	70	20	10
T_8	70	10	20
T_9	70	15	15
T_{10}	70	-	30
T_{11}	70	30	-

(JFBF – Jackfruit bulb flour, JFSF – Jackfruit seed flour)

thus, identified. The processing steps involved in the development of TVP is detailed in Fig. B

Sensory evaluation has an essential role in new product development with regard to its acceptability. The developed TVP was cooked using uniform procedures and presented to a panel of semi trained members. The panel evaluated the sensory characteristics *viz.*, colour, appearance, flavour, texture, taste on a score card using a 9 point hedonic scale. The scores were analyzed using statistical procedures to obtain a suitable conclusion.

OBSERVATIONS AND ASSESSMENT

Jackfruit, cv. KOOZHA was selected for product development (Tulyathan *et al*., 2002 and Gupta *et al*., 2011). Raw mature jackfruits were collected from the local market. Standardization plays a key role in product development, which facilitates the growth of food industries. A standardized recipe is one that has been tried, adopted and retried several times for use by a given food service and which has been found to produce the same acceptable results and yield, each time when the exact procedures are used with the same type of equipment and the same quantity and quality of ingredients (Robinson, 2012). One of the foremost purpose of standardization is to facilitate the smooth movement of materials and products through all stages of production in any industrial activity, starting from the raw material to the finished products, then to the dealer and finally to the retailers and consumers (Amin,2009).

Sensory evaluation is a scientific discipline that analyses and measures human responses to the composition and nature of foods and drink e.g. appearance, touch, odour, texture and taste. Food sensory analysis is the use of the human senses to objectively analyse foods - for properties such as taste, flavour and texture (Kulkarni *et al*., 2012). It is used in assessing the quality of products, troubleshooting problems and new product development (Munishamanna, 2012). Sensory evaluation does not just deal with likes and dislikes, but the process scientifically elicits, measures, analyses and interprets psychological and physiological responses to physical stimuli produced by a food product (Ocloo *et al*., 2010). All the eleven treatments were cooked and evaluated by ten panel members (Manay and Swamy, 2000).

Appearance is the one of the important criteria for the desirability of any food product. From this table it was observed that T_7 scored the highest (99.60) among all the eleven treatments for appearance. Treatment T_7 was immediately followed by T_8 with a score of 88.40. The lowest score was obtained for T_4 (15.15). The values obtained for other treatments were T_9 (79.40), T_1 (69.60), T_2 (60.80), T_{10} (51.00), T_3 (47.40), T_{11} (41.25), T_6 (35.10) and T_5 (22.80). From this table it was observed that T_7 and T_8 were on par and other treatments were significantly different from each other.

Colour is another important visual attribute that has been used to judge the overall quality of products. If the colour is unattractive, a potential consumer may not be impressed by any other attributes. The highest score was secured by T_7 (91.75) followed by T_8 (78.60), T_9 (67.05), T_6 (55.30), T_2 (51.55), T_{10} (51.50), T_1 (47.70), T_{11} (47.60), T_3 (43.70), T_5 (39.85) and T_5 (35.90). It was observed that T_7 and T_8 were on par and other treatments were significantly different from each other.

Taste is one of the major attributes which determine the acceptability of a food. Taste is the sensation produced when a substance in the mouth reacts chemically with receptors of taste buds. The highest score was obtained by T_7 (100.15) followed by T_8 (93.35), T_9 (69.55), T_1 (58.50), T_2 (58.50), T_{10} (50.00), T_{11} (41.50), T_3 (40.05), T_6 (40.05), T_5 (34.40) and the lowest score was obtained by T_4 (24.45). From this table it was observed that T_7 and T_8 were at par and other treatments were significantly different from each other.

Odour preference is generated by stimulation of sensory cells by specific volatile compounds present in foods. The highest score was obtained by T_7 (83.40) followed by T_6 (71.05), T_8 (63.40), T_{11} (54.40), T_9 (54.00), T_3 (51.85), T_{10} (51.45), T_5 (46.75), T_4 (46.35), T_2 (45.00) and the lowest score was obtained by T_1 (42.85). The treatments T_6, T_7 and T_8 were on par and other treatments were significantly different from these three.

Texture contributes a physical property of food stuffs apprehended by the eye, skin and muscle senses located in the mouth. In the case of TVP, texture is an important parameter that is to be considered. The highest score was obtained by T_7 (101.70) which was followed by T_8 (91.30), T_9 (75.50), T_1 (60.25), T_2 (60.25), T_{10} (52.40), T_{11} (41.60), T_3 (39.40), T_6 (35.80), T_5 (28.20) and the lowest score was obtained by T_4 (25.50). The treatments such as T_7, T_8 and T_9 were at par and other treatments were significantly different from these three. In the case of TVP texture is an important attribute which determine the quality of this product. Texture of the product was also compared with soya chunks available in the market and there was a remarkable similarity with respect to its crispiness, hardness, toughness and stringiness. Based on the sensory attributes such as appearance, colour, flavour, texture and taste (overall acceptability) the highest score was obtained for T_7 which was followed by T_8 and these two treatments were on par. The lowest score was obtained by treatment T_4. The highest score obtained by T_7 (92.40) followed by T_8 (72.30), T_6 (63.50), T_3 (59.40), T_5 (55.90), T_9 (55.90), T_{10} (49.50), T_{11} (48.30), T_1 (41.90), T_2 (36.30) and the lowest score obtained by T_4 (35.10). Thus, T_7 was identified as the best treatment.

Conclusion:

A lot of underutilized crops like jackfruit have a great potential to answer the issue of food security. Reportedly, upto 75 per cent of jackfruits grown in India goes to waste, partly because the fruit goes bad if it is not eaten or preserved within a few weeks. Besides, jackfruit has a reputation for being a poor man's fruit. "It is not the food product of demand that many people would ever think of buying because it grows almost everywhere in India. Value added convenience foods with health value will be of demand among the urban population. In this direction

Table 1: Sensory evaluation of textured vegetable protein (TVP) from jackfruit

Treatments	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
T_1	69.60	47.70	42.85	60.25	58.50	41.90
T_2	60.80	51.55	45.00	60.25	58.50	36.30
T_3	47.40	43.70	51.85	39.40	40.05	59.40
T_4	15.15	35.90	46.35	25.50	24.45	35.10
T_5	22.80	39.85	46.75	28.20	34.40	55.90
T_6	35.10	55.30	71.05	35.80	40.05	63.50
T_7	99.60	91.75	83.40	101.70	100.15	92.40
T_8	88.40	78.60	63.40	91.30	93.35	72.30
T_9	79.40	67.05	54.00	75.50	69.55	55.90
T_{10}	51.00	51.50	51.45	52.40	50.00	49.50
T_{11}	41.25	47.60	54.40	41.60	41.50	48.30
Critical vriance (CV 0.05%)			18.31			

Indicated are mean rank values

jackfruit based ''TVP'' would prove to be a product of great demand. Fortunately for the fruit, it has a growing number of fans advocating for it, trying to raise awareness for its nutritional value.

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LITERATURE CITED

Abraham, A. and Jayamuthunagai, J. (2014). An analytical study on jackfruit seed flour and its incorporation in pasta. *Res. J. Pharma. Biol. Chem. Sci.,* **5** (2): 1597-1610.

Akanbi, T. O., Nazamid, S., Adebowale, A. A., Farooq, A. and Olaoye, A O. (2011). Breadfruit starch-wheat flour noodles: preparation, proximate compositions and culinary properties. *Int. Food Res. J.*, **18**: 1283-1287.

Akubor, P. I. and Badifu, G.I.O. (2004). Chemical composition, functional properties and baking potential of African breadfruit kernel and wheat flour blends. *Int. J. Food Sci. Tech.*, **39**: 223–229.

Amin, M.F.S. (2009). Optimization of jackfruit seed (*Artocarpus heterophyllus* Lam.) flour and polydextrose content in the formulation of reduced calorie chocolate cake. University Sains. Malaysia, 324p.

Anand, R. (2011). A study of determinants impacting consumers food choice with reference to the fast food consumption in India. *Soc. & Business Rev.*, **6** (2):176-187.

Ejiofor, J.E., Beleya, E.A. and Onyenorah, N. I. (2014). The effect of processing methods on the functional and compositional properties of jackfruit seed flour. *Internat. J. Nutr. Food Sci*., **3**: 166-173.

Gupta, D., Mann, S., Sood, A. and Rajinder, K.G. (2011). Phytochemical, nutritional and antioxidant activity evaluation of seeds of jackfruit (*Artocarpous heterolphyllus* Lam.). *Internat. J. Pharma. Bio Sci.*, **2**(4) : 336-343.

Haq, N. (2006). Jackfruit (*Artocarpus heterophyllus*). Southampton centre for underutilised crops. Southampton, U.K. University of Southampton.

Jagtap, U.B., Panaskar, S.N. and Bapat, V.A. (2010). Evaluation of antioxidant capacity and phenol content in jackfruit (*Artocarpus heterophyllus* Lam.) fruit pulp. *Plant Foods Hum. Nutr*., **65** : 99-104.

James, I.F. and Kuipers, B. (2003). *Preservation of fruits and vegetables*. Agromisa Foundation, Wageningen, 88p.

Kulkarni, S.S., Desai, A.D., Ranveer, R.C. and Sahoo, A.K. (2012). Development of nutrient rich noodles by supplementation with malted ragi flour. *Internat. Food Res. J.,* **19** (1): 309-313.

Manay, N.S. and Swamy, S. (2000). *Food facts and principles.* (2 Ed.) New age international (P) Ltd. Publishers, New Delhi, India, 525pp.

Munishamanna, K.B. (2012). Development of value added products from jackfruit bulb. *Mysore J. Agric. Sci*., **46**(2): 426 - 428.

Ocloo, F.C.K., Bansa, D., Boatin, R., Adom, T. and Agbemavor, W.S. (2010). Physico-chemical, functional and pasting characteristics of flour produced from jackfruits (*Artocarpus heterophyllus* Lam.) seeds. *Agric. Biol. J. N. Am*., **1**(5): 903-908.

Okaka, J.C. and Potter, N.C. (1979). Physio-chemical and functional properties of cowpea powders processed to reduce beany flavour. *J. Food. Sci.,* **4**: 1235-1240.

Robinson, J.G. (2012). *Drying fruits.* Food preservation. North Dhaka State University Extension Service. 1-4 p.

Sidhu, A.S. (2012). *Jackfruit improvement in the asia pacific region a status report*, IIHR 1-20 pp.

Swami, S.B., Thakor, N.J., Sanjay, O. and Kalse, S.B. (2014). Development of osmo-tray dried ripe jackfruit bulb. *J. Food Res. Technol*., **2**(2) : 77-86.

Tejpal and Amrita (2016). Jackfruit : a health boon. *Internat. J. Res. Ayurveda Pharm.,* **7** (3) : 59-64.

Tulyathan, V., Tananuwong, K., Songjinda, P. and Jaiboon, N. (2002). Some physico-chemical properties of jackfruit (*Artocarpus heterophyllus* Lam) seed flour and starch. *Science Asia,* **28***:*37–41.

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