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To Develop and Study the Shelf-Life of Jackfruit Seed (*Artocarpus heterophyllus* Lam) Flour Incorporated Wheat Halwa

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Abstract
The aim of the study is to formulate and standardize jack fruit seed flour incorporated wheat halwa. The objective of the study is to formulate and standardize jack fruit seed flour incorporated wheat halwa, selection of most acceptable proportion, nutrient analysis, shelf life analysis the product packed in polythene bag, cost analysis and popularization of the developed product among adolescent girl. Jack fruit seeds were dried and powdered and stored in an air tight container. The processed powder was incorporated in halwa by substituting the wheat flour at different levels such as 10%, 20%, 30%, and 40% instead of refined wheat flour in the standard recipe. The selected best product and the standard were subjected to nutrient analysis, shelf life study, cost analysis and finally the product was popularized among adolescent girls. The results of the sensory analysis showed that product B with 20% Jackfruit seed flour scored the highest. The standard and selected proportion of Jackfruit seed flour incorporated wheat halwa was packed in polythene bag and stored in refrigerated temperature and analyzed for a period of 7 days to find the shelf life. There was no microbial growth in both standard and sample during storage period. The nutrient analysis shows that the fiber and iron content were higher in 20%variation when compared to standard product. Cost calculation of the product showed total costs of the selected product is similar to the standard. The study creates the awareness to use underutilized seed to improve the health status.

Keywords
Wheat Halwa, Jackfruit, Sensory evaluation, microbial analysis

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INTRODUCTION:
Food product development involves more than just creating the perfect recipe. Companies must plan extensively, work hard, and research for an extended period of time in order to produce new food products. Prior to starting a new development venture, it is imperative to develop specific objectives and timetables that integrate the future direction of the business. [1]

Jackfruit (*Artocarpus heterophyllus* Lam) is the largest borne tree fruit in the world. [2] The name derived from the Greek words 'artos' means bread and 'karpos' means fruit this fruit are commonly called breadfruit. The name,'heterophyllus', in Latin, means leaves of different sizes and shapes. The word jackfruit comes from Portuguese Jaca, which convert into Chaka from Malayalam Language [3]. Jackfruit is native from India, but it is National fruit of Bangladesh. Jackfruit is grown all over in Bangladesh, but mainly in Jaishtha and Ashar month. [4] Climate and soil requirement for jackfruit is quite different from other. It was cultivated from 3000-6000 years ago in India. Climate required for growing jackfruit is tropical and subtropical. [5] Jackfruit is indigenous food crop, it contains some vitamins like vitamin A, vitamin C, thiamine, riboflavin also some minerals like calcium, potassium, iron, sodium, zinc, and niacin also many other nutrients. Jackfruit has a very low calories content that is 100 g of jackfruit contains only 94 calories. Besides, jackfruit is a rich source of potassium with 303 mg found in 100 g of jackfruit [6]. Jackfruit seeds contain 22% starch and dietary fiber 3.19%. It contains lignans, isoflavones, saponins, all phytonutrients and their health benefits are wide ranging from anticancer to antihypertensive, antiaging, antioxidant, and antiulcer [7].

Halwa refers to many types of dense, sweet confection prepared in North India. It is a type of desert with the consistency of a very thick pudding, made from various kinds of fruits, vegetables, grains and lentils. It is generally prepared from various raw materials, like fine sooji (semolina) from wheat, mung dhal, chickpea, carrot, etc. In North India, halwa is described as yellow brownish, opaque, soft and smooth in texture, while in Southern India it is a translucent jelly like product with luster. [8]

MATERIALS AND METHODS:

Jackfruit was obtained from the local market, cleaned and sun dried and made up into flour and stored in an air tight container. The processed powder was incorporated in wheat halwa by substituting the main ingredients at different levels such as 10, 20%, 30% and 40% instead of main ingredient in the standard recipe. Using 5-point hedonic scale the best variation was selected. The selected best product and the standard were subjected to nutrient analysis, shelf life study, cost analysis and finally the product was popularized among adolescent girls.

Processing of Jackfruit Seed Flour:

Jackfruit ⟶ Removal of Jackfruit seed from the fruit⟶The jackfruit seeds were cleaned manually and White arils (seed coat) were manually peeled off ⟶Seeds were lye peeled remove the thin brown spermoderm which covered the cotyledons ⟶ The spermoderm layer was removed by rubbing the seeds within the hands and washing thoroughly under running water ⟶The seeds were sliced into thin chips separately and tray dried chips were powdered in a grinder.

Figure 1-Processing of Jack Fruit

Preparation of Wheat Halwa:

Take 100g of ghee in a medium bottom pan ⟶ Add wheat flour and cardamom powder. ⟶Roast it well Keep roasting it for about 15 minutes ⟶ Dissolve jaggery in 2 cups of water ⟶ Pour jaggery solution in the pan ⟶ Keep stirring the pan continuously until it becomes thick.

Figure 2 - Prepared Product-Halwa

Sensory Evaluation:

Sensory analysis (or sensory evaluation) is a scientific discipline that applies principles of experimental design and statistical analysis to the use of human senses for the purposes of evaluating consumer products. The discipline requires panels of human assessors, on whom the products are tested, and recording the responses made by them [9]. The evaluation was done for the standard and prepared variations by 30 semi–trained panel members from the Department of Foods and Nutrition to select the best variation. The score card was prepared with different criteria such as appearance, color, texture, flavor and taste. And each criteria having the maximum score of five. After the sensory evaluation, the selected best product was subjected for further study. **Figure 3,** shows different variation of Jackfruit seed flour incorporated Wheat Halwa.

Figure 3- Different Variations of jack fruit flour incorporated halwa

Nutrient Analysis:

Nutrient analysis is done for the best sample of Jackfruit seed flour incorporated wheat halwa and standard. Nutrient analysis was carried out in Alpha lab, Coimbatore. Since Jackfruit Seed Flour has a good amount of iron and fiber, these two nutrients were analyzed in the standard and selected best product.

Microbial Analysis:

Microbial test was done every third day of the study for both standard and the selected product by using spread plate technique.

Popularization:

The prime aim of the popularization program was to create awareness among the public about the beneficial effect of Jackfruit seed flour incorporated wheat halwa and their contribution to health. The popularization was done among adolescent girls.

RESULT AND DISCUSSION:

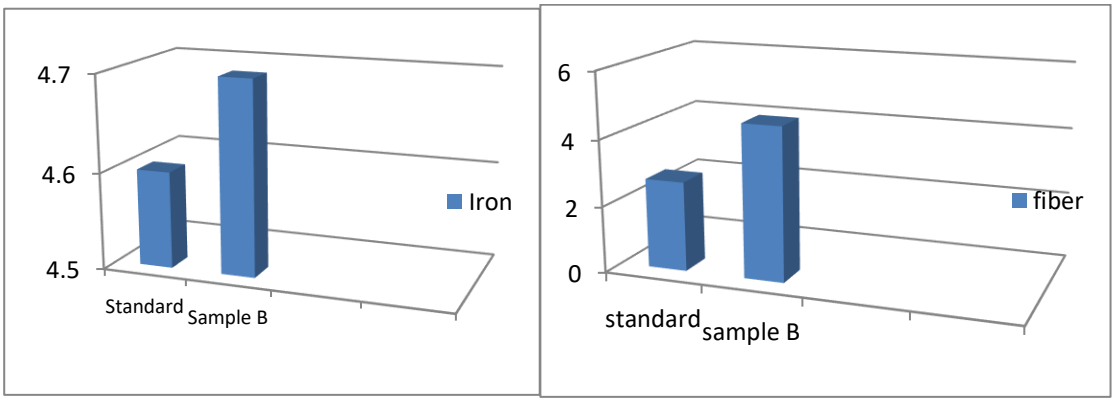
Table 1: Mean Sensory Scores of Standard and Jackfruit Seed Flour Incorporated Wheat Halwa

Product	Appearance Mean ± SD	Color Mean ±SD	Texture Mean±SD	Flavor Mean±SD	Taste Mean±SD
Standard	4.6±0.4	4.1±0.8	4.2±0.7	4.4±0.6	4.4±0.5
Sample A	4.3±0.7	4.16±0.7	4.1±0.79	4.2±0.69	4.6±0.4
Sample B	**4.5±0.5**	**4.2±0.7**	**4.5±0.5**	**4.5±0.62**	**4.7±0.46**
Sample C	4.2±0.8	3.5±1.0	4.2±0.8	4.3±0.66	4±0.76
Sample D	3.9±0.8	3.8±0.9	3.9±0.86	4.2±0.7	4±0.69

From the above Table-1 it is observed that standard Wheat Halwa had a highest mean score of 4.6±0.4 for appearance. On incorporation of Jackfruit seed flour, sample B had a mean score of 4.5±0.5. On incorporation of Jackfruit seed flour, sample B had a highest mean score of 4.2±0.76 for colour. The scores indicate that, 20% Jackfruit seed flour incorporation shows no much difference in color of standard product of wheat Halwa. It is observed that standard Wheat Halwa had a mean score of 4.2±0.7 for texture. On incorporation of Jackfruit Seed flour, sample B had a highest mean score of 4.5±0.5. The score indicates that increasing the amount of Jackfruit Seed flour incorporated at 20% level shows similar in flavor to that of standard Wheat Halwa. Standard Wheat Halwa had a mean score of 4.4±0.5 for taste. On incorporation of Jackfruit Seed flour, sample B had a highest mean score of 4.7±0.4. The score indicates that 20% incorporation of Jackfruit Seed flour was accepted in respect to taste. It is cleared that among the prepared products, Sample B had the highest mean score in all the criteria when compared to other samples like sample A, C and D. So that we can conclude that Sample B with 20% Jackfruit seed flour was selected as the best product.

Table-2: Nutrient Analysis of the Selected Product and Standard Product

NUTRIENT	STANDARD (per 100g)	SAMPLE B (per 100g)
Iron (mg)	4.66	4.7
Fiber (g)	2.7	4.6



Graph - 1: Iron and Fiber content in selected product and standard product

From the above table it was concluded that the iron content of the standard (4.66mg) and selected product B (4.7mg) which is more or less similar. The fiber content of selected product was 4.6gms and standard was 2.7gms. Thus, the formulated product nutrient content is slightly higher than the standard product.

Microbial Analysis of Selected and Standard Product: Microbial Analysis of the Standard and Selected Jackfruit Seed Flour Incorporated wheat halwa on storage.

A common practice employed to evaluate the shelf life of a given food product is to determine changes in

selected quality characteristics over a period of time. One may consider quality of a food as a gross measure of the food deterioration occurring in a food item. However, it should be recognized that the term quality is meant to encompass several quality attributes or characteristics. From a consumer's standpoint, the sensory expectations derived from the presence (or absence) of desirable (or undesirable) characteristics of a given food determine the quality of a product. Therefore, a food product noted for its high quality has more of the desirable characteristics [10].

The details regarding the microbial content in standard and selected proportion of Jackfruit Seed Flour Incorporated wheat halwa on storage is given in **Table 3.**

Table-3: Microbial Load of the Standard Product and Selected Product on Storage

Name of the Product	Food Group	Indicator Test Result (CFU / gram) and Interpretation/ *Standard Plate Count*			
		G	M/S	US	PH
WHEAT HALWA STANDARD& SAMPLE B	Day 1	✓	-	-	-
	Day 3	✓			
	Day 5	✓			
	Remark	On 5th day after sampling no contamination was found in standard and sample B			
Organism Identified	No bacterial growth was observed in all samples				

Good= G; Satisfactory = S; Marginal = M; Unsatisfactory = US; Potentially Hazardous = PH

From the above table the standard and sample are good during (1st, 3rd, 5th) day. And on the 5th day after sampling no contamination was found in standard and sample B.

Cost Analysis:

The results revealed that the cost of 20g Jackfruit seed flour incorporated in Wheat Halwa was Rs.89 whereas the cost of standard was Rs.90. Though the cost of the prepared product and standard almost same, it is rich in fibre and iron when compared with standard.

Popularization:

About 30 Adolescent girl's participant were selected randomly for the study and they were given a set of ten questions before popularization. From the study it was concluded that 30 of the adolescent girls know about jackfruit and have already tasted it but majority (20%) of the participants were not using jackfruit seed in any form and it was found that after popularization they were aware about the importance of nutrient and health benefits of Jackfruit. After the product was popularized all participants accepted the Jackfruit seed flour incorporated Wheat Halwa and ready to buy the product if it is available in the market.

CONCLUSION

From the study, it was concluded that the Jackfruit seed flour incorporated with 80% of the Wheat Halwa was accepted in studies. The prepared product is high in Iron and fiber when compare to the standard product. The prepared product is acceptable till 5th day without microbial deterioration if it is stored in polythene bag. The cost of the prepared best product was comparably same; it is good for all the age group. In the popularization study the entire participant accepted the product.

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