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Development and analysis of jackfruit seed powder enriched pasta

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Abstract
The present study was designed to developed nutrient rich pasta by using jack fruit seed powder. The developed products were analyzed for their nutritional quality and sensory characteristics using standard procedures. It was observed that the nutritional quality of all developed enriched pastas increased significantly (p<0.05) with increased in the level of supplementation of jack fruit seed powder with refined wheat flour. In sensory characteristics it was found that there was a significant (p<0.05) difference among the formulated pastas. Results indicated that JS_1(refined wheat flour 90% with jackfruit seed powder 10%) pastas were having higher nutritional value (moisture, ash, crude protein, crude fat, crude fiber, carbohydrate, calcium and phosphorus) and JS_2 (refined wheat flour 85% with jackfruit seed power 15%) pastas were having higher overall acceptability than all the formulated pasta and control (100% refined wheat flour) pasta. All the micronutrient enriched formulated pasta products were obtained in acceptable category between 30th days to 60th days at room temperature.

Keywords: Jackfruit seed powder, refined wheat flour, sensory characteristics evaluation, nutritional quality

Introduction
Pasta is being introduced in Italy in 13th century but efficient manufacturing equipment and high-quality product came only during 20th century. In India pastas are more favorite on account of their usefulness and palatability between toddlers and juveniles. The preparation of breakfast, snacks, and dinners these days includes a significant amount of pasta products. Due to its distinctive appearance, color, texture, and cooking quality, pasta prepared from durum wheat flour, and all-purpose flour is popular. The unique combination of stinginess, ease of medication, versatility, nutritional value and long shelf-life pasta will continue to play a part of significance as world demand for cereals increases. Pasta is a well-thought-out sports food, relatively low in fat, high in calorie and good in protein. Improving the nutritional value of pasta primarily involves increase protein as well as supplements that accompany vitamins, minerals and dietary fiber.

In the present age maintaining optimum nutrition and good health are the most exacting. By virtue of the increased awareness about food components for health promotion, it is important to improve the nutritional quality of pasta by addition of healthy ingredients which are rich in protein, fiber, minerals and vitamins etc. pasta is a favorable and filling meal which offers fiber and sustained energy. Several explorations have focused on possibility of adding healthy ingredients into pasta in order to enhance its nutritional quality.

Jackfruit (*Artocarpus heterophyllus* Lam) is the largest fruit in the world, owned the family of marovy. Although it originates from India, it can be found in most of Asia, Africa and some other regions of South America. Jackfruit holds vitamins and minerals like source of Vitamin-A, Vitamin-C, thiamine, riboflavin, calcium, potassium, iron and sodium etc. It has extreme antioxidant properties so that it will help to stop free radical reaction.

Jackfruit seeds are underutilized and less acknowledged by people, but they have considerable nutritional benefits and constitute about 10% to 15% of the fruit. Due to its perishable nature, the seeds are usually discarded as waste, but when stored in a cool, moist environment they have a shelf life of about one month. The roasted seeds can be ground into powder and added to various foods to increase their value and shelf life.

Powdered jackfruit seeds are used as a substitute for flour. Jackfruit seeds provide an ample supply of protein, fiber and starch. Due to their high fiber content, the seeds help reduce the risk of heart disease, prevent constipation, and aid in weight loss. Additionally, resistant starch, which regulates blood sugar and maintains intestinal health, is included in jackfruit seeds. Seeds have many medicinal characteristics in the way that constructive for reconstructing digesting. It acts as antagonistic-inflammatory, antagonistic malignant, antifungal power, and helps in restriction of melanin biosynthesis, wound healing.

Materials and Methods

There fined wheat flour (RWF) was procured from local market. Jackfruits were procured from college nutritional garden.

Preparation of jackfruit seed powder

Jackfruit seeds were cleaned, washed, cut to sliced, and oven dried then grounded in tofine powder.

Sample preparation

Refined wheat flour was incorporated with jackfruit seed powder at ratio of 90:10, 85:15, 80:20 and 75:25 percent to develop pasta by using extruder (La Monferrina P6 pasta extruder, Italy). The standardized flours were added to the feed tank of the extruder to mixed thoroughly, till a uniform powder was obtained by rotating action. Water taken was 30 ml per 100 gram dry ingredients and allowed for 30 minutes so that no lump remains, then the dough was passes through a single screw extruder fitted with an adjustable die. The pasta was allowed to cut into uniform length with a knife moving over the outer die surface. Pasta was dried in a tray at 60 °C for 4 h.

Control JS$_1$ JS$_2$ JS$_3$ JS$_4$

Determination of proximate and mineral composition

Moisture, ash, crude protein, crude fat, crude fiber contents of raw materials and refined wheat flour-jackfruit seed powder pastas were analyzed using standard methods. Carbohydrate content was determined by difference. Calcium and phosphorus contents of raw materials and refined wheat flour- jackfruit seed powder flour pastas were analyzed by employing the methodology of Jackson (1973) [18].

Sensory evaluation

The developed pasta products were prepared for sensory evaluation by cooking before testing and served hot to the panel members to evaluate for its sensory parameters like colour, flavour, texture and over all acceptability using 10 semi trained panel members with nine-point hedonic scale.

Statistical analysis

The nutritional composition & sensory qualities data were statistically analyzed by using analysis of variance (ANOVA) techniques to see the significant and non-significant difference among them.

Results and Discussion

Nutritional compositions of raw materials

Result in the Table 1 indicated that refined wheat flour contained 12.69% moisture, 3.53%, ash, 10.93% protein, 1.06% fat, 0.77% fiber and71.03% carbohydrates. Shree *et al*. (2018) [15] also reported comparable results of proximal contents for moisture %, fat%, protein %, carbohydrate %, fiber % and ash % i.e. 10.86, 1.56, 11.6, 71.38 and1.67respectively. The mineral contents of refined wheat flours as described in Table 1 were calcium 22.47 mg/100 g and phosphorus 120.46 mg/100 g which was obtained almost similar findings with Gopalan *et al* (2004) [7].

Jackfruit seed powder has low moisture content (4.48%) and ash content (5.55%) than jackfruit tender powder. Among all the raw materials jackfruit seed powder contents maximum crude protein (8.87%), crude fat (2.82%) and carbohydrates (73.13%). Jackfruit seed powder contains crude fiber 5.14%. It contains calcium 48.93 mg/100 g and phosphorus 97.13 mg/100 g. The results observed for jackfruit seed were in good agreement with the findings Gopalan *et al*. 2004 [7]; Nutritional Facts.

Table 1: Nutritional composition of raw materials (per 100 g on dry matter basis)

Nutritional composition	Refined wheat flour	Jackfruit seed powder	CD at 5%	P-Value
Moisture (%)	12.69^{a}±0.01	4.48^{d}±0.02	0.03	<0.01
Ash (%)	3.53^{d}±0.01	5.55^{c}±0.01	0.04	<0.01
Crude protein (5%)	10.93^{a}±0.04	8.87^{b}±0.10	0.17	<0.01
Crude fat (%)	1.06^{c}±0.01	2.82^{a}±0.02	0.33	<0.01
Crude fiber (%)	0.77^{d}±0.02	5.14^{c}±0.02	0.56	<0.01
Carbohydrate (%)	71.03^{b}±0.04	73.13^{a}±0.10	0.99	<0.01
Calcium (mg/100 g)	22.47^{d}±0.34	48.93^{b}±0.49	2.6	<0.01
Phosphorus mg/100 g)	120.46^{b}±0.35	97.13^{c}±0.50	1.4	<0.01

Note: Values are mean ± SE of three independent replications. Mean with same superscript (a and b) in the same column differ significantly (p>0.05).

Table 2: Nutritional composition of jackfruit seed powder enriched developed pasta products (per 100 g on dry matter basis)

Nutritional Composition	Control	JS_1	JS_2	JS_3	JS_4	CD at 5%	P-Value
Moisture (%)	$13.95^{a}\pm0.04$	$10.27^{c}\pm0.03$	$10.73^{d}\pm0.12$	$10.82^{c}\pm0.06$	$11.31^{b}\pm0.13$	0.27	<0.01
Ash (%)	$0.71^{d}\pm0.00$	$1.27^{c}\pm0.03$	$1.34^{b}\pm0.02$	$1.43^{a}\pm0.02$	$1.44^{a}\pm0.01$	0.07	<0.01
Crude protein (%)	$9.84^{c}\pm0.04$	$10.98^{b}\pm0.06$	$11.24^{a}\pm0.04$	$11.31^{a}\pm0.02$	$11.36^{a}\pm0.04$	0.08	<0.01
Crude fat (%)	$0.82^{d}\pm0.02$	$1.12^{c}\pm0.05$	$1.42^{b}\pm0.01$	$1.51^{a}\pm0.01$	$1.53^{a}\pm0.01$	0.14	<0.01
Crude fiber (%)	$1.06^{d}\pm0.03$	$1.34^{c}\pm0.06$	$1.64^{b}\pm0.06$	$1.69^{b}\pm0.01$	$1.77^{a}\pm0.02$	0.13	<0.01
Carbohydrate (%)	$73.62^{b}\pm0.13$	$75.03^{a}\pm0.09$	$73.63^{b}\pm0.06$	$73.24^{c}\pm0.07$	$72.58^{d}\pm0.19$	0.38	<0.01
Calcium (mg/100 g)	$24.17^{d}\pm0.18$	$24.87^{d}\pm0.44$	$25.41^{c}\pm0.27$	$26.33^{b}\pm0.34$	$28.18^{a}\pm0.22$	0.96	<0.01
Phosphorus mg/100 g)	$121.57^{a}\pm0.43$	$115.39^{e}\pm0.45$	$116.08^{d}\pm0.23$	$117.24^{c}\pm0.39$	$118.43^{b}\pm0.23$	1.14	<0.01

Note: Values are mean ± SE of three independent replications. Mean with same superscript (a, b, c, d, e) in the same column differ significantly (p>0.05).
Control- RWF:JS (100:0) JS1- RWF:JS (90:10) JS2- RWF:JS (85:15) JS3- RWF:JS (80:20)
JS4- RWF:JS (75:25) RWF- Refined wheat flour JS- Jack fruit seed

Nutritional compositions of developed pasta

The pasta products prepared by formulating Jackfruit seed powder with refined wheat flour were subjected to proximate compositions analysis and result observed were presented in the Table 2. The result obtained for proximal compositions of jackfruit seed powder incorporated pasta products were shown in the table 2. The proximal compositions moisture (10.27 to 11.31%), ash (1.27 to 1.44%), crude protein (10.98 to 11.36%), crude fat (1.12 to 1.53%), crude fiber (1.34 to 1.77%) were increased with increased level of jack fruit seed flour supplementation except for carbohydrate (75.03 to 72.58%) contents which was observed reverse relations with jack fruit seed powder substitutions. The mineral contents calcium (24.87 to 28.18 mg/100 g) and phosphorus (115.39 to 118.43 mg/100 g) of jackfruit seed powder incorporated developed pasta products increased with level of jackfruit seed powder substitutions up to 20% (table 2) as reported by Khan *et al*. (2017) [16].

Sensory evaluation of developed pasta

Results related to the organoleptic characteristics of pastas incorporated with carrot powder are shown in the Table 3 indicated that Increment of jackfruit seed powder substitutions adversely affected the sensory score of appearance (8 to 4.5), taste (8.1 to 3.6), colour (8 to 4.1), flavor (7.7 to 3.4), texture (7.9 to 4.3), overall acceptability (7.94 to 3.98) were described in table 3. pasta (JS_2 treatment 85:15) were more acceptable along with control. Similar results were reported by Abraham and Jayamuthunagai (2014) [17].

Table 3: Organoleptic acceptability of Jackfruit seed powder enriched developed pasta products

Types of pasta	Appearance	Colour	Flavour	Texture	Taste	OA
Control	$8.6^{a}\pm0.16$	$8.7^{a}\pm0.15$	$8.5^{a}\pm0.22$	$8.7^{a}\pm0.15$	$8.7^{a}\pm0.15$	$8.64^{a}\pm0.04$
JS_1	$8^{a}\pm0.26$	$8^{b}\pm0.21$	$7.7^{b}\pm0.21$	$7.9^{b}\pm0.18$	$8.1^{a}\pm0.23$	$7.94^{b}\pm0.07$
JS_2	$8.2^{a}\pm0.22$	$8.1^{c}\pm0.15$	$8.3^{b}\pm0.22$	$8.1^{b}\pm0.17$	$8.3^{b}\pm0.30$	$8.1^{c}\pm0.06$
JS_3	$6.3^{b}\pm0.37$	$6.5^{d}\pm0.17$	$6.6^{c}\pm0.27$	$6.7^{c}\pm0.21$	$5.9^{c}\pm0.46$	$6.4^{d}\pm0.14$
JS_4	$4.5^{c}\pm0.40$	$4.1^{e}\pm0.38$	$3.4^{d}\pm0.37$	$4.3^{d}\pm0.42$	$3.6^{d}\pm0.45$	$3.98^{e}\pm0.21$
CD at 5%	0.84	0.65	0.76	0.71	0.97	0.36
P-Value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Note: Values are mean ± SE three independent replications. Mean with same superscript (a, b, c, d, e) in the same column differ significantly (p<0.05).

Conclusion

It was found that control pasta exhibits contents moisture 12.69%, ash3.53%, crude protein10.93%, crude fat1.06%, crude fiber 0.77% and carbohydrate71.03% and mineral contents calcium 22.47 mg/100 g, and phosphorus 120.46 mg/100 g where as increment in jackfruit seed powder concentrations at 10%, 15%, 20% and 25% in pasta significantly (p<0.05) increase the nutritional quality. The highest proximal and mineral contents were obtained in JS_4 composite flour developed pasta and lowest contents were obtained in JS_1. Results indicated that JS2 (refined wheat flour 85% with jackfruit seed powder 15%) pastas were having higher overall acceptability than all the formulated pasta and control (100% refined wheat flour) pasta.

From the present study it was found that the jackfruit seed substituted developed pasta products were acceptable up to 60^{th} days of storage periods.

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