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EFFECT OF PROCESSING ON PROXIMATE COMPOSITION OF JACKFRUIT (*Artocarpus heterophyllus* Lam.) SEED FLOUR

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ABSTRACT

Jackfruit a tropical fruit possess 100-400 seeds which are oval, brown and edible after processing. A study was undertaken to investigate 'effect of processing on proximate composition of jackfruit seed flour'. Hard variety of jackfruits were procured from a single tree situated on University of Agricultural Sciences, Dharwad campus. Ripe fruits were cut, seeds separated and analyzed for physical quality characteristics. Further seeds were processed employing: boiling, pressure cooking, pan roasting, microwave roasting, baking. Unprocessed seeds served as control. The seeds were milled to flour and analyzed proximate composition. Protein, fat, ash was significantly higher in dry processed seed flour, whereas wet processing significantly increased moisture content. Pressure cooked and boiled jackfruit seeds had significantly higher moisture content of 11.84 and 11.42 per cent respectively whereas, dry processed seeds had significantly low moisture content. The protein content ranged from 11.68 percent in unprocessed seed flour to 14.42 per cent in baked seed flour. Boiling (1.04 ± 0.05 %) and pressure cooking (1.03 ± 0.03 %) resulted in significantly lower fat content. Crude fibre was significantly higher in pressure cooked seed flour (3.96 ± 0.01 %) and lower in baked seed flour (3.73 ± 0.03). The ash content ranged from 3.61 ± 0.02 per cent in unprocessed to 2.93 ± 0.04 per cent in pressure cooked seed flour. Total carbohydrate content of seed flour ranged from 68.57 to 67.56 per cent while available carbohydrate ranged from 72.30 to 71.03 per cent. Dry processing resulted in significant increase in energy with baked seed flour having higher energy content of 340 ± 4.00 kcal. Wet processing significantly decreased the energy with pressure cooked seed flour having lower energy content of 330 ± 3.00 kcal. Processing significantly influenced nutrient composition of jackfruit seed flour. Hence processed flour can be used in product development and value addition to enhance nutritional benefits.

KEY WORDS: *Dry processing, flour, jackfruit seed, moist processing, proximate*

INTRODUCTION

Jackfruit (*Artocarpus heterophyllus* Lam.) is the largest tree-borne fruit native to India. It belongs to family Moraceae. Mainly, jackfruit pulps are consumed, while rind, core and seeds are utilized as animal feed or discarded. Seeds are oval, ellipsoid or round in shape, having length of 2-4 cm and thickness of 1.5–2.5 cm. A single fruit may comprise 100 - 400 seeds. Though jackfruit seeds are consumed and are also source of starch for industries, their utilization is limited. Jackfruits being highly seasonal, seeds are available only during month from March to July.

Macronutrients are required for growth and development of body. Carbohydrate, protein, fats *etc.*

play an important role in providing energy to body, wear and tear of tissues and muscle building. These compositions are important in determining nutritive value of foods and play an important role in formulating food products. Jackfruit seeds are good source of nutrients and their consumption needs to be enhanced. Processing is known to improve palatability, nutritional quality and digestibility of foods. Numerous studies regarding jackfruit seeds are available, but systematic studies on the effect of processing are scanty. Hence, the present study was undertaken with the objective to analyze the effect of processing on proximate composition of jackfruit seed flour.

MATERIALS AND METHODS

Hard variety of jackfruits were procured from a single tree situated on University of Agricultural Sciences, Dharwad campus. Ripe fruits were cut and seeds were separated. Randomly ten jackfruit seeds were selected and analyzed for physical quality characteristics like colour, shape, size, weight and bulk density were recorded. Seed color and shape were recorded by visual observation, size in terms of length, width and thickness was recorded using vernier caliper (Kaushik *et al.,* 2007), weight and volume was noted using electronic balance and water displacement method respectively (Naik, 1991). Bulk density was calculated (Khattak *et al.,* 2007).

Seeds were processed employing common methods of cooking: **1) Boiling** – 50g of seeds was transferred to a vessel containing boiling water, and boiled with closed lid at 100°C till soft and cooked. **2) Pressure cooking** – 50 g of seeds was transferred to a vessel containing 20 ml water. Pressure cooked at 121°C till soft and cooked. From 1 and 2, water was drained, superfluous water was removed from seeds by dabbing on absorbent paper and cooled. **3) Pan roasting -** Seeds were roasted in a heated pan at 160°C with continuous agitation till sweet aroma developed and cooled. **4) Microwave roasting** – 50g of seeds were microwave roasted at 480 Power till the seeds turned soft, sweet and developed roasted aroma and cooled. **5) Baking** – Seeds were baked in pre-heated oven at 180°C till soft and sweet aroma developed for 15 min and cooled. Unprocessed seeds served as control.

Processed seeds were milled to flour and analyzed for proximate composition like moisture, protein, fat, crude fibre and ash (Anon., 2000). Total carbohydrate was calculated by deducting the total sum of percent values of moisture, protein, fat, ash and crude fibre from 100, available carbohydrate was calculated by deducting the total sum of percent value of moisture, protein, fat and ash from 100 (Anon., 2000). Mean, standard deviation and analysis of variance (One-way ANOVA) was applied to the results. All the analysis was done using SPSS software (version 16.0).

RESULTS AND DISCUSSION

Physical quality characteristics of jackfruit seeds (Table 1 See Appendix) like colour, shape, size, weight, volume, bulk density, length, width, thickness determine the quality, acceptability and marketability. Jackfruit seeds were brown in colour, oval in shape and weighed 5.47 ± 0.76 g, volume 5.25 ± 0.32 ml and bulk density 1.06 ± 0.05 per seed. On an average each seed was 3.52 cm long, 1.77 cm wide and 1.27 cm thick having length to width ratio of 2:1. The values are in comparison with results reported by Airani (2007), Butool and Butool (2013) and Islam *et.al* (2015) wherein seeds were 2 - 4 cm long and 1.5 - 2.5 cm thick. Slightly lower values for length (2 - 3 cm) and width (1 - 1.5 cm) of seeds were mentioned by Abraham and Jayamuthunagai (2014). Variations can be attributed to the differences in variety, maturity index, location and climatic conditions of cultivation.

Proximate composition in processed jackfruit seed flour are presented in Table 2 (See Appendix). Protein, fat, ash was significantly higher in dry processed seed flour, whereas wet processing significantly increased moisture content. Pressure cooked and boiled jackfruit seeds had moisture content of 11.84 and 11.42 per cent respectively whereas, dry processed seeds had significantly low moisture content ranging from 9.17 per cent in baked to 9.72 per cent in pan roasted. Moisture content increased in moist processing due to absorption of water. Dry processing reduced moisture due to removal of moisture and volatile compounds.

The protein content ranged from 11.68 percent in unprocessed seed flour to 14.42 per cent in baked seed flour. Dry processing significantly increased protein content of seed flour, baking reporting higher value (14.42 ± 0.23 %) followed by pan roasting (14.21 ± 0.20 %) and microwave roasting (13.71 ± 0.16 %). Pressure cooked and boiled seed flour had protein content of 13.17 ± 0.04 and 12.74 ± 0.16 per cent respectively. Release of bound nitrogen or non-protein nitrogenous compound might have increased protein content over raw seeds. Similar results were reported by Akubor and Obiegbuna (2014) and Ejiofor *et al.* (2014).

Boiling (1.04 ± 0.05 %) and pressure cooking (1.03 ± 0.03 %) resulted in significantly lower fat content whereas baked (1.21 ± 0.03 %), microwave roasted (1.16 ± 0.03 %) and pan roasted (1.14 ± 0.08 %) seed flour did not differ significantly with

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unprocessed seed flour (1.15 ± 0.05 %). Significant decrease in fat content of wet processed seeds can be attributed to leaching out of oil during cooking and may be due to evaporation of volatile fatty acids (Ijeh *et al.*, 2010 and Okafor *et al.*, 2015).

Pressure cooking significantly increased crude fibre content of seed flour (3.96 ± 0.01 %). Crude fibre content in boiled (3.84 ± 0.05 %), microwave roasted (3.83 ± 0.03 %) and pan roasted (3.80 ± 0.01 %) seed flour did not differ significantly, whereas, that in baked seed flour was significantly less. The results are comparable with values reported by Hettiaratchi *et al.* (2011) and Azeez *et al.* (2015) in jackfruit seed flour. Increase in fibre on dry processing may be due to formation of resistant starch and dextrins (Ramula and Rao, 1997).

The ash content in unprocessed, pan roasted, microwave roasted and baked seed flour was 3.61 ± 0.02, 3.67 ± 0.12, 3.84 ± 0.11 and 3.67 ± 0.36 per cent respectively, while pressure cooked seed flour exhibited significantly lower ash content of 2.93 ± 0.04 per cent. Significantly lower ash content in wet processed seed flour can be reasoned to leaching out of soluble minerals such as calcium chloride, chlorides of sodium and potassium etc. (Dakare *et al.*, 2014; Akubor and Obiegbuna, 2014 and Okafor *et al.*, 2015).

Total carbohydrate content of seed flour ranged from 68.57 to 67.56 per cent while available carbohydrate ranged from 72.30 to 71.03 per cent. Unprocessed jackfruit seed flour had significantly higher total and available carbohydrate content of 68.57 and 72.30 per cent respectively. Processed seed flour did not differ significantly in carbohydrate content. Decreased moisture, protein, fat, ash and fibre content in unprocessed seed flour have contributed to the increase in carbohydrate as it was computed by subtracting sum of these nutrients from 100.

Dry processing resulted in significant increase in energy with baked seed flour having higher energy content of 340 ± 4.00 kcal followed by microwave roasting (337 ± 4.00 kcal) and pan roasting (336 ± 3.00 kcal). Wet processing significantly decreased the energy with pressure cooked (330 ± 3.00 kcal) and boiled seed flour (332 ± 3.00 kcal) having lower energy content. Unprocessed seed flour possessed 331 ± 3.00 kcal of energy. Higher protein and fat content in baked seed flour resulted in higher energy. Hence, processing significantly impacted proximate composition of jackfruit seed flour.

CONCLUSION

Jackfruit seeds are good source of nutrients. Processing improves nutritional value in terms of protein, fat, ash, crude fibre and energy. As jackfruit seeds are perishable, flour is a best alternative for consumption, storage and further usage. Hence, flour of processed jackfruit seeds can be used for product development and value addition at domestic, commercial and industrial level for nutritional security.

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APPENDIX

Table 1 Physical quality characteristics of jackfruit seeds

Parameters	Mean ± S.D
Colour	Brown
Shape	Oval
Weight (g)	5.47 ± 0.76
Volume (ml)	5.25 ± 0.32
Bulk density (g/ml)	1.06 ± 0.05
Length (cm)	3.52 ± 0.18
Width (cm)	1.77 ± 0.15
Length : Width	2.00 ± 0.21
Thickness (cm)	1.27 ± 0.12

Note: Average of 10 seeds

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Table 2 Effect of processing on proximate composition of jackfruit seed flour

Treatment	Proximate composition (%)							
	Moisture	Protein	Fat	Crude Fibre	Ash	Carbohydrate		Energy (Kcal)
						Total	Available	
Unprocessed	10.26 ± 0.23[c]	11.68 ± 0.34[e]	1.15 ± 0.05[a]	3.66 ± 0.03[d]	3.61 ± 0.02[a]	68.57 ± 0.51[a]	72.30 ± 0.53[a]	331 ± 3.00[bc]
Boiling	11.42 ± 0.14[b]	12.74 ± 0.16[d]	1.04 ± 0.05[b]	3.84 ± 0.05[b]	3.27 ± 0.12[b]	67.59 ± 0.26[b]	71.43 ± 0.22[b]	332 ± 3.00[bc]
Pressure cooking	11.84 ± 0.03[a]	13.17 ± 0.04[c]	1.03 ± 0.03[b]	3.96 ± 0.01[a]	2.93 ± 0.04[c]	67.56 ± 0.31[b]	71.03 ± 0.07[b]	330 ± 3.00[c]
Pan roasting	9.72 ± 0.03[d]	14.21 ± 0.20[a]	1.14 ± 0.08[a]	3.80 ± 0.01[b]	3.67 ± 0.12[a]	67.82 ± 0.24[b]	71.36 ± 0.31[b]	336 ± 3.00[ab]
Microwave roasting	9.66 ± 0.08[d]	13.71 ± 0.16[b]	1.16 ± 0.03[a]	3.83 ± 0.03[b]	3.84 ± 0.11[a]	67.80 ± 0.32[b]	71.62 ± 0.30[b]	337 ± 4.00[a]
Baking	9.17 ± 0.19[e]	14.42 ± 0.23[a]	1.21 ± 0.03[a]	3.73 ± 0.03[c]	3.67 ± 0.36[a]	67.86 ± 0.44[b]	71.52 ± 0.41[b]	340 ± 4.00[a]
F value	199.25	71.75	8.10	35.32	11.98	5.99	4.65	4.09
S. Em. ±	0.16	0.24	0.05	0.04	0.19	0.40	0.39	3.89
C. D. at 5%	0.25*	0.37*	0.08*	0.06*	0.30*	0.62*	0.60*	5.99*

*Significant at 5 % level