POTENTIALITY OF JACKFRUIT SEED FOR VALUE ADDITION: A REVIEW

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Abstract

The Jackfruit (*Artocarpus heterophyllus)* is a well-known fruit in many Asian countries. Jackfruit seeds are underutilized and less acknowledged by people, but they have considerable nutritional benefits and can be considered as a potential functional food ingredient. Awide range of studies have been carried out concerning the composition and health implications of jackfruit seeds. However, in broder manner there is a need to explore the information about the commercial production of jackfruit seeds and their incorporation in food products. Products with incorporated jackfruit seed flour possess better nutraceutical appeal, leading to improved consumer acceptability. Therefore, the present study attempted to review the potentiality of jackfruit seed. It also reveals the incorporation of jackfruit seeds in various value-added products along with their effects on the different properties of the products.

Keywords:
Jackfruit seed flour, Value addition, Waste utilization, processing

Introduction

A wide range of underutilized fruits are grown in India,whose full potentials are not exploited. Besides the seasonal availability of fruits, unsuitable methods of storage and lack of information regarding the nutritional value limits the use of these underutilized fruits (Peter *et al.,* 2006). Jackfruit (*Artocarpus heterophyllus* Lam.) is one such most remunerative and important under exploited native fruits to India (Srivastava *et al.,* 2017), which is known for its therapeutic and nutritive value. Jackfruit seeds are underutilized and less acknowledged by people, but they have considerable nutritional benefits and constitute about 10% to 15% of the fruit weight **(**Hossain, 2014**)**.Theseedsarereportedtobemorenutritious than the bulb in terms of protein, fat, starch, dietary fibreandcarbohydratewith considerable amount of potassium, phosphorus and calcium (Hettiarachchi*etal.*,2011). Jackfruitseedcontainslignans,isoflavones, saponins, allphytonutrientsandhaveanticancer,antihypertensive,antiaging, antioxidant, antiulcer properties (Omale and Friday, 2010).

In many parts of India, the seeds are collected from the ripe fruit, dried in sunlight and stored adequately for use in the rainy season. Due to the difficulties encountered during processing and storage, massive amounts of seeds are annually wasted.Jackfruit seeds are recalcitrant, they germinate instantly after maturity. Therefore, fresh seeds cannot be stored for a long time and large amounts of the total seed remain unexploited (Deshmukh, 2014). Due to 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. In certain parts of India, the seeds are consumed by boiling or roasting them or used to supplement potato **(**Banerjee & Datta, 2015**).**

To extend the shelf-life, the nutritious seeds can be boiled or roasted and eaten likechestnuts,addedtoflourfor baking, or cooked in dishes (Roy *et al.*, 1995). The potential of jackfruit seed flour (JSF) can be explored as an alternative or as blends with traditional flour formulations like bread, snacks, and confectionery and extruder product or as a thickening and stabilizing agent. It can also be used as protein and carbohydrate supplements (Maduwage *et al.*, 2019). The demand for jackfruit seeds has been increased due to increased consumer awareness regarding the diet-disease relationship. It is believed to be a potent functional food ingredient since it imparts additional physiological benefits in addition to basic nutrition.

Value-added products prepared by incorporating jackfruit seed flour

Bakery products

The addition of jackfruit seed flour to numerous baked and cereal products enhanced their overall nutritional quality. Arpit and John (2015) carried out a study on the effect of varying levels of supplementation of jackfruit seed flour on the quality parameters of chocolate cake by mixing wheat flour and jackfruit seed flour in different proportions. The incorporation of 10 g jackfruit seed flour per 100 g of wheat flour, resulted in increase in the protein and ash contents and a decrease in the fat content of developed chocolate cake. Similarly, the incorporation of jackfruit seed flour in biscuits resulted in larger amounts of ash and crude fibre. A high ash content corresponds to the amount of mineral matter present in the flour. Since jackfruit seeds are rich in crude fibre, an increase in crude fibre was found in the biscuits, but the incorporation also resulted in losses in the protein and carbohydrate contents of the biscuits. Bread made with the incorporation of jackfruit seed flour showed a higher crude fibre content, whereas baked products are normally insufficient in dietary fibre (Islam *et al.*,2015). The colour of bread made with 25% substitution of jackfruit seed flour was the same as that of the control sample, but the addition of more jackfruit seed flour led to a change in colour from light brown to dark brown. Similarly, in the case of flavour, both the control sample and the sample with 25 per cent seed flour were more acceptable. The tastes of the control sample and of that supplemented with 25 per cent jackfruit seed flour were similar and the texture of the bread with 25 per cent seed flour was more preferred (Hossain, 2014). Biscuits and bread made with the incorporation of less than 30 per cent jackfruit seed flour showed good overall acceptability, but further increases in the jackfruit seed flour concentration decreased the overall acceptability of the bread and biscuits (Butool and Butool, 2015).

Table 1. Baked products prepared by jackfruit seed fortification in different forms and at different concentrations

Product name	Amount of supplementation (%)	Outcome	Reference
Bread	5	High protein and carbohydrate content, good water and oil absorption ability	Tulyathan *et al.*, (2002)
Bread	25	Increased crude fiber content	Butool and Butool (2015)
Bread	25	Nutritionally higher carbohydrate, fat, protein, and crude fiber content	Hossain (2014)
Biscuit	20	Good water and oil absorption capacity, swelling power, percent solubility, flour dispersibility and viscosity	Butool and Butool (2015)
Biscuit	10-40	Moisture, fat, crude fiber and ash content increased	Islam *et al.* (2015)
Cake	5-15	Increase in protein and reduction in fat content	Arpit and John (2015)
Chocolate cake	5-15	Improved dietary fiber and anti-oxidant activity	David (2016)
Composite cake	10-30	Better crumb, texture and nutritional characteristics	Khan *et al.* (2016)
Muffins	10-20	Specific gravity increased and viscosity decreased	Siti Faridah and Noor Aziah (2012)

Extruded products

In many food processing industries, extrusion cooking technology plays a pivotal role as continuous cooking, mixing, shearing and form-making technique, and the main reasons for customer acceptance of extruded foods are the convenience, value, appearance and texture (Gat and Ananthanarayan, 2015a). The effect of incorporating jackfruit seed flour on the moisture content of pasta was not significantly affected ($p \leq 0.05$) but the protein and ash content was increased significantly (Abraham and Jayamuthunagai, 2014). In comparison with the control sample, noodles fortified with jackfruit seed flour showed increases in the protein, ash, fat and crude fibre contents and reduced carbohydrate content (Nandkule *et al.*, 2015). The nutraceutical properties of extrudates were improved by the incorporation of jackfruit seed flour into the rice. The composition of the extrudate was improved at a concentration of 70:30 (rice:jfsf) with a barrel temperature of 180°C and a screw speed of 300 rpm. Increases in the total phenolic and flavonoid contents were reported with a decrease in the barrel temperature, and the extrudate obtained at 180°C and 300 rpm exhibited the highest antioxidant and reducing potential (Gat and Ananthanarayan, 2015b). The addition of different proportions of jackfruit seed flour to control pasta increased the nutrient content but showed similar cooking and rheological qualities. Kumari *et al.* (2015) developed jackfruit seed flour-based noodles which ensured the

presence of the functional properties. The addition of 10 and 20 per cent jackfruit seed flour in the development of noodles with a feeder speed of 16 rpm and drying temperature of 60°C resulted in lower energy and carbohydrate contents but higher protein, fibre, and mineral contents and better sensory quality. Noodles extruded with 20 per cent jackfruit seed flour showed higher yields and lower cooking times, as reported by Kumari and Divakar (2017), and the colour of the pasta changed with the addition of the jackfruit seed flour. The flavour of the jackfruit seed was easily recognizable in pasta with the addition of 15 and 20 per cent seed flour, and it was suggested that the firmness of the pasta also increased with the addition of the seed flour.

Table 2.Extruded products prepared by jackfruit seed fortification in different forms and at different concentrations

Product name	Amount of supplementation (%)	Outcome	Reference
Expanded snacks	10-40	Increase in nutritional and phytochemical properties	Gat and Ananthanarayan (2015b)
Pasta	10	Increased nutrient content	Abraham and Jayamuthunagai (2014)
Fortified noodles	5	Higher protein, fat, fiber, ash content and better organoleptic properties	Nandkule *et al.* (2015)
Noodles	10-20	Higher yield ratio and lower cooking time	Kumari and Divakar (2017)

Other products prepared by jackfruit seed

Cereal bars made with 30 and 40 per cent jackfruit seed flour showed high fiber contents, better sensory characteristics and nutritive values similar to those of other bars available on the market (Santos *et al.*, 2011). The development of a cereal bar with 15 per cent jackfruit seed flour maintained the hardness and crispness when compared with commercially available cereal bars without the addition of this exotic fruit (Torres *et al.*, 2011) and the protein content of the snack bar increased when jackfruit seed flour was incorporated (Meethal *et al.*, 2017). Jackfruit seed flour, bengal gram flour, and whole wheat flour were blended in different combinations to produce chapatis, the addition of 10 per cent jackfruit seed flour showed the best overall acceptance (Sultana *et al.*, 2014).

Table 3. Other products prepared by jackfruit seed fortification in different forms and at different concentrations

Product name	Amount of supplementation (%)	Outcome	Reference
Karasev and Jamun	25 and 50	Decreased fat absorption capacity	Sri Rajarajeshwari and Prakash (1999)
Cereal bar	30 and 40	High fiber content, better sensorial characteristics	Santos *et al.* (2011)
Cereal bar	15	Preserved hardness and crispness	Torres *et al.* (2011)
Snack bar	35-45	Increased protein content	Meethal *et al.* (2017)

Conclusion

Study suggested that the jackfruit seed powder is used as an alternative flour in bakery and confectionary products by blending it with wheat flour and other low-cost flours. Malnutrition is one of the major problems in India due to inadequate protein intake. Jackfruit seeds could be used as an economic alternative protein source to tackle the malnutrition. Additional experimentation is required to develop economical and efficient practices for the production of value-added products containing jackfruit seed flour.

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