ISSN 2521 – 0408
AEXTJ
AGRICULTURAL EXTENSION JOURNAL

Available Online at www.aextj.com
Agricultural Extension Journal 2018; 2(2):95-100

RESEARCH ARTICLE

Functional, Chemical, and Phytochemical Properties of Soup Thickener Produced from Blends of *Artocarpus heterophyllus* and *Detarium Microcarpum* Seed

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Received: 01-03-2018; Revised: 20-04-2018; Accepted: 02-05-2018

ABSTRACT

Blends of 50:50 g of jackfruit seed flour *(Artocarpus heterophyllus)* and ofor seed flour *(Detarium microcarpum)* were mixed together, sieved to pass 0.25 mm sieve and packaged in an airtight container. The proximate composition of the flour sample was determined to be 9.78%, 19.25%, 6.50%, 2.75%, 7.06%, and 54.66% for moisture content, crude protein content, fat and oil content, crude fiber content, ash content, and carbohydrate content, respectively. Furthermore, the mineral contents of the flour sample were Ca (34.00 mg/kg), K (303.00 mg/kg), Na (3.0 mg/kg), Mg (37.00 mg/kg), and Zn (0.42 mg/kg), respectively. Phytochemical values were also determined to be 0.42%, 1.00%, 2.80%, 1.60%, 0.82 mg/g, and 23.00 µg/100 g for flavonoid, tannin, alkaloid, saponin, phenol, and carotenoid, respectively. Furthermore, the functional properties of flour sample were determined to be 0.53 g/ml, 7.50%, 8.00%, 10.00%, 90.90%, 6.25%, 0.25%, and 95.00°C for bulk density, water adsorption capacity, oil absorption capacity, foam capacity, foam stability, emulsification capacity, gelation capacity, and gelation temperature, respectively. The flour sample and cocoyam flour were also used as thickener for soup and were sensory evaluated. The result shows that there were no significant differences ($P \geq 0.05$) between them.

Key words: *Artocarpus heterophyllus* seed, Chemical, Cocoyam, *Detarium microcarpum* seed, Flour, Functional, Phytochemical, Soup thickener

INTRODUCTION

Jackfruit (*Artocarpus heterophyllus*) is one of the most significance trees in tropical home gardens and perhaps the most widespread and useful tree in the important genus Artocarpus. It is a medium-size evergreen tree typically reaching 8–25 m (26–82 ft) in height that is easily recognized by its fruit, the largest among cultivated plant. The succulent, aromatic, and flavorful fruit is eaten fresh or preserved in myriad way. The nutritious seeds are boiled or roasted and eaten like chestnuts, added to flour for baking, or cooked in dishes; it is also known for its remarkable, durable timber, which ages to an orange or red-brown color. The leaves and fruit waste provide valuable fodder for cattle, pigs, and goats. Many parts of the plant including the back, roots, and fruit are attributed with medical properties. Wood chips yield a dye used to give the famous orange-red color to the robes of Buddhist priests. The tree can provide many environmental services. It is highly wind tolerant and therefore makes a good component in a windbreak or border planting. Growing in pastures, it can provide fallen fruit for livestock, shade, and long-term timber. In home gardens, the dense jackfruit canopy can provide a visual screen and is very ornamental. Introduced to the most Pacific island after European contact, the tree can be found throughout the Pacific, mainly in home gardens, where it finds a place among other favorite multipurpose plants. It is easy to grow and more adaptable than some of the other common Artocarpus species such as breadfruit (*A. altilis*). It is not considered to be an invasive species. It is a medium-size tree typically

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reaching 28–80 ft in height that is easily accessible for its fruit. The fruit is borne on side branches and main branches of the tree. Average weight of a fruit is 3.5–10 kg and sometimes a fruit may reach up to 2.5 kg. There are two main varieties of jackfruits; one is small fibrous, soft, and mushy, the carpels are sweet, with a texture like that of a raw oyster and the other variety is crisp and crunchy but not very sweet. The large seeds from this non-leguminous plant are also edible, even though they are difficult to digest.[22] A single seed is enclosed in a white avil encircling a thin brown spermoderm, which covers the fleshy white cotyledon. Jackfruit cotyledons are fairly rich in starch and protein.[23] Jackfruit has been reported to contain high level of protein, starch, calcium, and thramine;[4] mature jackfruits are cooked as vegetable and used in curries or salads. [14] Ripe fruits can be eaten raw or cooked in creamy coconut milk as dessert made into candied jackfruit or edible jackfruit leather. Jackfruit is also used for jackfruit chips can be made from dried jackfruit pulp;[13] pureed jackfruit is also manufactured into baby food, juice, jam, jelly, and base for cordials;[21] various parts of the jackfruit tree have been used in medicine and its wood as an important source in the timber industries.[21] It is more widely accepted that the beneficial effects of fruits and vegetables for the prevention of certain disease are due to the bioactive compounds they contain.

OFOR SEED (*Detarium microcarpum)*

D. microcarpum is an African tree belonging to the Fabaceae family (9 legumes).[1] It is a small tree or shrub growing up to 15 m tall but can reach 25 m in moist areas (Abdalbasit *et al* 2009). In terms of growth rate, the shoots of the trunk can reach a height of 1.5–2 m in 1–2 years and are much more vigorous than seedlings which on average grow to 0.6 m after 3 years and may reach 1.5 m in 4 years.[10]
It flowers during the rainy season (July–September/ November), but the main flowering period only lasts up to 8 days. It bears fruit from September to January/May and in November; the tree sheds its leaves and produces new leaves in March.[11]

MATERIALS AND METHODS

Sample Collection

A. heterophyllus seed and *D. microcarpum* seeds were bought from Eke Ekwulobia market in Aguata, Local Government Areas of Anambra State, Nigeria.

SAMPLE PREPARATION

Jackfruit fresh seeds were removed from the fresh. It was cleaned, the white cover was peeled, and the seeds were spread on the sun for about 2 weeks to reduce the moisture contents and ofor seed was toasted. Afterward, they were milled to pass over 0.25 mm sieve and a fine powder was obtained while *D. microcarpum* seed was roasted for about 30 min in a low stove light to avoid burning and to reduce the moisture contents. Afterward, it was milled and sieved to a fine powder.

Experiments

50:50 g of jackfruit seed flour and ofor seed flour (OFS) were mixed together in a container and were packaged for further analysis.
The mineral content of the samples was determined by the dry ash extraction method following specific mineral element as described by Association of Official Analytical Chemists (2005).[2] The minerals analyzed were Ca, Na, K, Mg, and Zn. Furthermore, the proximate composition of the blended jackfruit seed and OFS sample was analyzed for moisture, ash, crude protein, crude fat, crude fiber, and carbohydrate using the standard method of AOAC (2005)[2] while the phytochemicals and functional properties were determined using other recommended standard methods.

RESULTS AND DISCUSSION

Result of Functional, Mineral, Proximate, and Phytochemical Properties of Thickener from Blends of Jackfruit Seed and OFS

Are shown in the Tables below.

DISCUSSION

The functional properties of blends of jackfruit seed and ofor seed were presented in Table 1. Water absorption capacity: The water absorption capacity for the flour was 7.50%. The value is higher than 2.3 ml/g reported for raw jackfruit seed flour.[16] Values of 1.26–1.37 ml/g have also been reported

for tigernut flour.[18] Water absorption capacity describes flour-water association ability under limited water supply. The result obtained, however, is lower than those reported by Singh *et al*.[23] (141%) and[25] (205%), for whole jackfruit seed flour. The disparities observed could be attributed to the method used. The result obtained shows that the flour has a good ability to bind water.

Oil absorption capacity: The oil absorption capacity was found to be 8.00%. Oil absorption capacity is an important property in food formulations because it improves the flavor and mouthfeel of foods.[9] Values of 1.07–1.13 ml/g were reported for tigernut flour,[18] and values of 1.2–1.4 ml/g were reported for raw winged bean. Eke and Akobundu (1993)[7] also reported value of 1.2–1.4 ml/g for Africa yam bean. The result obtained, however, is lower than those reported by Singh *et al*.[23] 90.2% and[25] 2002, 92.6% for whole jackfruit seed and *D. microcarpum* seed flour. The disparities observed could be attributed to the method used and varietal differences. The result obtained shows that the flour is a high flavor retainer and may therefore fine useful application in food system.

Bulk density

Bulk density is depended on the particle size of the sample. The value obtained from the study was 0.53 g/ml [Table 1].

Odomelan[16] reported a bulk density value of raw flour from jackfruit seed to be about 0.61 g/ml. Bulk density is a measure of heaviness of a flour sample. Oladele and Aina[18] reported values of 0.55–0.62 g/ml for tigernut flours. Since flours with high bulk densities are used as thickeners in food products, the flour sample studied could be used as a thickener.

Foam capacity

The foam capacity of the flour is shown to be 10.00%. The result obtained is lower than values reported for pearl millet flour (11.30). Foamability is reported to be related to the amount of solubilized protein[15] and the amount of polar and non-polar lipids in a sample.

Foam stability

The foam stability of the flour is represented in Table 1. The percent foam stability is about 90.90% which is higher than that reported for soy flour (14.6%) and pigeon pea flour (20.0%).[19] However, it is comparatively higher than 50.6–58.99% reported for tigernut flour.[18] Values of 60–80% have been also reported for wheat flour and African breadfruit kernel flour.

Table 2 summarizes the mineral composition of the thickener. The flour prepared is rich in Ca (34.00 mg/kg), K (303.00 mg/kg), and Mg (37.00 mg/kg), and it is, however, low in Na and Zn. Akinmutimi[11] reported values of 0.4667% (P), 67% (iron), 7.05% (Cu), 28.85% (Mn), 73.4% (Zn), 0.099% (Ca), 1.21% (K), and 0.025% (Na). The differences observed could be attributed to the analytical methods used for estimation and the geographical location of the plant.

Table 3 summarizes the proximate composition of blends of jackfruit seed and OFS blend.

Moisture content

Moisture provides a measure of the water content of the seed flour. It is also an index of storage stability of the flour. Moisture content of the flour was 9.78%. The lower the moisture content, the longer the shelf life of the flour.

Moisture content of flour generally is depended on the duration of the drying process.

Crude fat

The fat content of the flour was 6.50% [Table 3]. This value is relatively low when compared to pearl millet (7.6%).[20]

Table 1: Results of functional properties

Parameters	Result
Bulk density (g/ml)	0.53
WAC (%)	7.50
OAC (%)	8.00
Foam capacity (%)	10.00
Foam stability (%)	90.90
Emulsification capacity (%)	6.25
Gelation capacity (wt%)	0.25
Gelation temperature (°C)	95.00

Table 2: Result of mineral composition of the thickener

S. N.	Sample	Mineral element (mg/100 g, mg/g, or ppm)				
		Ca	K	Na	Mg	Zn
1	JFS/OS	34.00	303.00	3.0	37.00	0.42

OS: Ofor seed flour, JFS: Jackfruit seed flour

Ash content

The percent ash content is the organic residue remaining after the organic matter has been burnt away.

Crude protein

The percent crude protein of the flour was 19.25%. The value obtained was, however, lower than that obtained by Sing *et al.*[23]
Bobbio *et al.* (1978) reported the value of 31.9%. The differences observed may be contributed by varietal differences, maturation of the seeds, and environmental conditions.

Crude fiber

The percent crude fiber content of the flour was 2.75%.
This value is comparable to the value of 3.06% reported by Singh *et al.*[23] Crude fiber value of 2.36% was also reported by Tulyathan *et al.* (2002).[25] The disparity may be due to varietal differences and locality.

Carbohydrate

The major component of the flour was carbohydrate. The value obtained from the study was 54.66%. This value obtained is lower than that reported by (66.2%). The disparities may be due to maturity and growing condition.
Table 4 summarizes the phytochemical screening of jackfruit seed flour and OFS blend. Phytochemicals, in general, are natural bioactive compounds found in plant that works with nutrients and fiber to act as a defense system against disease or more accurately to protect against disease.[6]
Plants are considered as biosynthetic laboratory for a multitude of secondary metabolites such as alkaloids, tannins, polyphenols, and carotenoids.[12]
The presence of carotenoid in higher quantities was observed in the sample seed, and it has been known for their medical uses.[8]
Alkaloids are known to show medicinal activity as well as physiological activity.[24] The presence of alkaloid in the seed suggests its usefulness in pharmaceuticals since they can serve as potent starting materials in the synthesis of sex hormones.[17]
Phenols and flavonoids are reported to have antibacterial, antifungal, and antioxidant properties.[5]
Table 5 summarizes the sensory attribute of jackfruit seed flour/ofor seed flour blends and cocoyam flour. The sensory attribute of jackfruit seed flour/ofor seed flour blends and cocoyam flour was presented in Table 5.
Both were used as thickener and 10 untrained panelists of food science and technology department were evaluated for color, taste, aroma, thickness, and overall acceptability.
From the result gotten, colors (8.19 ± 0.57 and 7.60 ± 0.52) were gotten for jack seed flour/OFS and cocoyam flour, respectively. This shows that there is a significant difference ($P \leq 0.05$) between them. Taste was also evaluated to be 7.70 ± 0.48 and 7.40 ± 0.52 for jack seed flour/OFS and cocoyam flour, respectively. This shows that there is no significance ($P \geq 0.05$) between the two samples.
Furthermore, aroma was also evaluated as 7.50 ± 0.53 and 7.90 ± 0.32 for jackfruit/ofor flour and cocoyam flour, respectively, and the result shows that there is a significant difference ($P \leq 0.05$) between them.
Thickness of the soup was also evaluated to be 7.70 ± 0.48 and 7.90 ± 0.32 for both jackfruit/OFS and cocoyam flour, respectively. The result shows that there is no significant difference ($P \geq 0.05$) between the samples.
Overall acceptability of the samples was also evaluated to be 8.20 ± 0.63 and 7.60 ± 0.52 for jack/OFS and cocoyam flour, respectively. The

Table 3: Result of proximate composition of the thickener

Result	Parameters
9.78	Moisture content (%)
19.25	Crude protein (%)
6.50	Fats and oil (%)
2.72	Crude fiber (%)
7.06	Ash content (%)
54.66	CHO% by difference

Table 4: Result of phytochemical properties of the thickener

Parameters	Result
Flavonoid (%)	0.42
Tannin (%)	1.00
Alkaloid (%)	2.80
Saponin (%)	1.60
Phenol (mg/g GAE)	0.82
Carotenoid (µg/100 g)	23.00

Table 5: Result of sensory attribute on blends of jack seed flour/OFS and cocoyam flour

Attributes	Sample	Mean	P (2-tailed)
Color	Jack seed flour/OFS	8.10 ± 0.57	0.05
	Cocoyam flour	7.60 ± 0.52	0.05
Taste	Jack seed flour/OFS	7.70 ± 0.48	0.19
	Cocoyam flour	7.40 ± 0.52	0.19
Aroma	Jack seed flour/OFS	7.50 ± 0.53	0.05
	Cocoyam flour	7.90 ± 0.32	0.05
Thickness	Jack seed flour/OFS	7.70 ± 0.48	0.29
	Cocoyam flour	7.90 ± 0.32	0.29
Overall acceptability	Jack seed flour/OFS	8.20 ± 0.63	0.32
	Cocoyam flour	7.60 ± 0.52	0.32

$P \leq 0.05$, samples are significant different, OFS: Ofor seed flour

result shows that there is no significant difference ($P \geq 0.05\%$) between the two soups. This means that jack seed flour/OFS can be used as a substitute for cocoyam.

CONCLUSION

The results from the study show that jackfruit seed flour *(A. heterophyllus)* and ofor seed flour *(D. microcarpum)* has a lot of potential in the food industry, especially its use as thickener and binding agent in the food systems.

RECOMMENDATION

From the conducted analysis carried out on the functional, mineral, proximate, and phytochemical analysis on jackfruit seed flour *(A. heterophyllus)* and ofor seed flour *(D. microcarpum)*, it is recommended that these seeds, more especially jackfruit seed that people normally throw away be included in the family nutritional scale of preference to aid boost the body immunity.

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