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Physico-chemical and functional characteristics of palmyrah (*Borassus flabellifer* L) tuber flour

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The search for lesser known and under-utilized crops, many of which are potentially valuable as human and animal food has been the focus for research in recent years. India stands first in the world in terms of its wealth of palmyrah (*Borassus flabellifer* L) palms with a population nearly 122 million palms (Vengaiah *et al*., 2012). The palm is found growing in Andhra Pradesh, Tamil Nadu, Bihar and Orissa and more number of palms are found in southern states of India. Palmyrah palm has great economic potential and every part of the palm is useful in one way or the other. Tuber is an important edible shoot grown in loose soil from the seed of ripe fruit after 120 days. Tuber is eaten by many people directly by cooking in open fire after peeling of outer layer. The aim of this study was to determine the physico-chemical and functional properties of palmyrah tuber flour which is commonly used as value added product from palmyrah. Palmyrah products has been reported to contain high levels of protein, starch, calcium and thiamine. The tubers may be cooked in open fire, boiled, or roasted and eaten or boiled and preserved in dried form. Roasted, dried tubers are ground to make flour which is blended with wheat flour for baking. Though the composition of tubers has been reported, the physico-chemical and functional properties of tuber flour have not been studied. Hence, the study was initiated under AICRP on Palms (palmyrah) with the aim to determine the physico-chemical and functional properties of palmyrah tuber flour in order to explore its potentials as a nutritional food.

Mature palmyrah tubers were collected and stored at low temperature (4 °C). The tubers (apocolon) remaining the outer layer were sliced and dried at 60 °C for 24 hrs. The dried tubers were finally milled using pulveriser to pass through a 250 μm sieve. The samples were then packaged in polyethylene bag and stored in a refrigerator (4 °C) until use.

Moisture content, crude fat, ash, protein, fibre contents in the crude sample, pH and titratable acidity were determined using standard methods of analysis (AOAC, 1990). Carbohydrate content was determined by subtracting the total protein, fibre, ash and fat from the total dry matter. The energy (calorific value) estimation was done by summing the multiplied values for protein, fat and carbohydrate (excluding fibre). Water absorption capacity was determined using methods described by Beuchat (1977) and expressed as per cent water absorption based on the original sample weight. Oil absorption capacity was determined using methods described by Beuchat (1977). Bulk Density was determined by the method of Narayana and Narasinga Rao (1984). A graduated cylinder tube was weighed and flour sample filled to 5 ml by constant tapping until there was no further change in volume. The contents were weighed and the difference in weight determined. The bulk density was computed as grams per milliliter of the sample. Swelling power was determined with the method described by Leach *et al.* (1959) with modification for small samples. One gram of the sample was mixed with 10 ml distilled water in a centrifuge tube and heated at 80 °C for 30 min.

and continually shaken during the heating period. The suspension was centrifuged at 1000 x g for 15 min after attaining room temperature. The supernatant was decanted and the weight of the paste taken. The swelling power was calculated as weight of the paste/weight of dry sample. Foam capacity (FC) and foam stability (FS) was determined after Narayana and Narasinga Rao (1982). Two grams of flour sample was added to 50 ml distilled water at 30 ± 2 °C in a 100 ml measuring cylinder. The suspension was mixed and properly shaken to foam and the volume of the foam after 30 s was recorded. The FC was expressed as a percentage increase in volume. The foam volume was recorded in 1 hr after whipping to determine the FS as a percentage of the initial foam volume.

The moisture content of the tuber flour was 5.19 per cent (Table 1). Moisture provides a measure of the water content of the tuber flour and for that matter its total solid content. It is also an index of storage stability of the flour. The fat content of the palmyrah tuber flour was 0.7 per cent. This value is relatively low when compared to pigeon pea flour (1.8%) (Okpala and Mammah, 2001) and wheat flour (3.1%) (Akubor and Badifu, 2004) and similar to that reported by Sankaralingam *et al.*, 1999. The per cent ash content of the flour was 2.6 per cent. The ash content is the organic residue remaining after the organic matter has been burnt away. It is not necessarily of exactly the same composition as the mineral matter present in the original flour as there may be losses due to volatilization or some interactions between constituents. Ash content of 2.8 to 3.3 per cent (dry matter basis) has been reported for palmyrah tubers (Sankaralingam *et al.*, 1999). The disparity may be due to varietal differences and the locality. The per cent crude protein of the flour was 3.2 per cent. The value obtained was however lower than that obtained by Sankaralingam *et al.* (1999). The difference observed may be contributed by varietal differences, maturation of the seeds and environmental conditions. The per cent crude fibre of the flour was 10.2 per cent (Table 1). This value is comparable to value of 3.1 per cent reported by Sankaralingam *et al.* (1999). The major component of the flour was carbohydrate. The value obtained from the study was 69.4 per cent. The calorific value (energy) of the palmyrah tuber flour was 282.2 kcal 100 g^{-1}. The pH and titratable acidity (as lactic acid) of the tuber flour were 5.8 and 1.1 per cent respectively. pH value gives a measure of the acidity or alkalinity of the flour, while the titrable acidity gives a measure of the amount of acid present in the fruit. The levels of these indices are used to estimate the quality of the flour. The water absorption capacity for the palmyrah tuber flour was 18 per cent (2.5 ml g^{-1}) (Table 2). The value is lower than 1.7 ml g^{-1} reported for African yam bean (Eke and Akobundu, 1993). Values of 3 to 4 ml g^{-1} have also been reported for tiger nut flour (Oladele and Aina, 2007). Water absorption capacity describes flour - water association ability under limited water supply. The result obtained shows that the flour has a good ability to bind water. This result suggests that palmyrah tuber flour could be used in bakery industry. The fat absorption capacity was found to be 14 per cent (1.7 ml g^{-1}) (Table 2). Fat absorption is an important property in food formulations because fats improve the flavour and mouth feel of foods (Kinsella, 1976).

Table 1. Physico-chemical properties of palmyrah tuber flour

Parameter	Values
Moisture (% w.b)	5.2 ± 0.01
Crude fat (%)	0.7 ± 0.01
Ash (%)	2.6 ± 0.02
Protein (%)	3.2 ± 0.06
Fibre (%)	10.8 ± 0.01
Carbohydrate	69.4 ± 0.06
Energy (Kcal 100 g^{-1})	282.2 ± 1.20
pH	5.8 ± 0.01
Titratable acidity	1.1 ± 0.03

Values were recorded in triplicates (n=3)

Table 2. Functional properties of palmyrah tuber flour

Parameter	Values
Water absorption capacity (%)	18.0 ± 1.67
Fat absorption capacity (%)	14.0 ± 1.37
Bulk density (g cm-3)	0.7 ± 0.02
Foaming capacity (%)	4.6 ± 0.02
Foam stability (%)	21.3 ± 0.01
Swelling power (g g^{-1})	4.6 ± 0.10

Values were recorded in triplicates (n=3)

Fat absorption values of 1.1 to 1.1 ml g^{-1} were reported for tiger nut flour (Oladele and Aina, 2007). Narayana and Narasinga Rao (1982) reported values of 1.2 to 1.4 ml g^{-1} for raw winged bean. Eke and Akobundu (1993) also reported value of 1.42 ml g^{-1} for African yam bean. The result obtained shows that palmyrah tuber flour is a high flavour retainer and may therefore find useful application in food systems such as ground meat formulations. Bulk density depends upon the particle size of the samples. The value obtained from the study was 0.7 g cm^3 (Table 2). Bulk density is a measure of heaviness of a flour sample. It is important for determining packaging requirements, material handling and application in wet processing in the food industry. Oladele and Aina (2007) reported values of 0.6 g cm^{-3} for tiger nut flour. Values of 0.5 g cm^{-3} for African breadfruit kernel flour and 0.7 g cm^{-3} for wheat flour have also been reported (Akubor and Badifu, 2004). Since flours with high bulk densities are used as thickeners in food products, the palmyrah tuber flour studied could be used as a thickener. The foam capacity of the palmyrah tuber flour is shown in Table 2. The per cent foam capacity is about 4.5 per cent which is lower than values reported for pearl millet flour and quinoa flour (11.3 and 9% respectively) (Oshodi and Ekperigin, 1989). Foamability is reported to be related to the amount of solubilized protein (Narayana and Narasinga Rao, 1982) and the amount of polar and non-polar lipids in a sample (Nwokolo, 1985). The per cent foam stability is about 21.32 per cent which is higher than that reported for soyflour (14.6%) and pigen pea flour (20.0%) (Oshodi and Ekperigin, 1989). However, it is comparatively lower than 50.6 to 59 per cent reported for tiger nut flour (Oladele and Aina, 2007). Values of 60 and 80 per cent have been reported for wheat flour and African breadfruit kernel flour, respectively (Akubor and Badifu, 2004). The palmyrah tuber flour has swelling power value of 4.5. Swelling power is a measure of hydration capacity, because the determination is a weight measure of swollen starch granules and their occluded water. Food eating quality is often connected with retention of water in the swollen starch granules (Rickard *et al.*, 1992).

Results from the study show that palmyrah tuber flour has a lot of potential in the food industry, especially as fibre enrichment and thickener in the food systems.

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References

A.O.A.C. 1990. *Official Methods of Analysis*. 15th edn. Washington, D.C. *Association of Official Analytical Chemists.*

Akubor, P.I., and Badifu, G.I.O. 2004. Chemical composition, functional properties and baking potential of African breadfruit kernel and wheat flour blends. *International Journal of Food Science and Technology* **39**: 223-229.

Beuchat, L.R. 1977. Functional and electrophoretic characteristics of succinylated peanut flour protein. *Journal of Agricultural Food Chemistry* **25**: 258-261.

Eke, O.S. and Akobundu, E.N.T. 1993. Functional properties of African yam bean (*Sphenostylis stenocarpa*) seed flour as affected by processing. *Food Chemistry* **48**: 337-340.

Kinsella, J.E. 1976. Functional properties of protein foods. *Critical Reviews in Science and Nutrition* **1**: 219-229.

Leach, H.W., McCowen, L.D. and Schoch, T.J. 1959. Structure of the starch granules. In: *Swelling and solubility patterns of various starches*. *Cereal Chemistry* **36**: 534-544.

Narayana, K. and Rao, M.S.N. 1982. Functional properties of raw and heat processed winged bean flour. *Journal of Food Science* **47**: 1534-1538.

Narayana, K. and Rao, M.S.N. 1984. Effect of partialproteolysis on the functional properties of winged pea (*Psophocarpus tetragonolobus*) flour. *Journal of Food Science* **49**: 944- 947.

Nwokolo, E. 1985. Nutritional quality of the seeds of the African breadfruit (*Treculia Africana Decne*). *Tropical Science* **27**: 39-47.

Okpala, L.C. and Mammah, E.N. 2001. Functional properties of raw and processed pigeonpea (*Cajanus cajan*) flour. *International Journal of Food Science and Technology* **52**: 343-346.

Oladele, A.K. and Aina, J.O. 2007. Chemical composition and functional properties of flour produced from two varieties of tigernut (*Cyperusesculentus*). *African Journal of Biotechnology* **6**(2): 2473-2476.

Oshodi, A.A. and Ekperigin, M.M. 1989. Functional properties of pigeon pea *(Cajanus cajan*) flour. *Food Chemistry* **34**: 187-191.

Rickard, J.E., Blanshard, J.M.V. and Asaoka, M. 1992. Effects of cultivar and growth season on the gelatinization properties of cassava (*Manihot esculenta*) starch. *Journal of the Science of Food and Agriculture* **59**: 53-58.

Sankaralingam, A., Hemalatha, G. and Ali, A.M. 1999. *A Treatise on Palmyrah.* ICAR, All India Co-ordinated Research Project (Palms), Killikulam, Tamil Nadu and Central Plantation Crop Research Institute, Kasaragod, Kerala, India.

Vengaiah, P.C., Murthy, G.N., Prasad, K.R. and Kumari, K.U. 2012. Post harvest technology of Palmyrah (*Borassus flabellifer* L) Present practises and scope. International conference on food processing by omics group 22-24, November, 2012, Hyderabad, India.

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