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Full Length Research Paper

Proximate composition and functional properties of pra (*Elateriospermun tapos* Blume) seed flour

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The proximate composition and functional properties of flour produced from pra (*Elateriospermum tapos* Blume) seed were investigated using standard method. The whole seeds were sorted, de-shelled, dried, milled and sieved to produce flour. The flour contained considerable amounts of protein (16.10%), carbohydrate (25.36%) and fat (36.49%). The fatty acid composition showed that the flour was high in unsaturated fatty acids (29.83%) of which oleic acid (12.54%), linoleic acid (12.01%) and α-linolenic acid (3.44%) were dominant. The water absorption capacity, oil absorption capacity, emulsion capacity, foaming capacity and foaming stability (after 2 h) were 187.5, 130.4, 39.6, 32.6 and 28.2%, respectively. Based on these results, pra seed flour is nutritious and has a potential for use as a functional agent in food formulations.

Key words: *Elateriospermum tapos* Blume, pra, functional properties, flour.

INTRODUCTION

Pra or kra (*Elateriospermum tapos* Blume) is an edible native nut found in southern Thailand especially at Khao Luang and Khao Nan National Park, Nakhon Si Thammarat province, Thailand. Pra, also known as perah tree of the family Euphorbiaceae, is a monoecious canopy species that responds to a deciduous life cycle in the short period of the dry season (Jantarit et al., 2009). In Malaysia, it is abundant in lowland forests in the northern parts of Peninsula Malaysia and throughout the country. The tree is cultivated as an ornamental plant because of its reddish pink foliage during a leaf flush. Its flowers appear simultaneously with the new leaves each year at the beginning of summer, while its fruits mature between August and September. The timber from the tree is hard and heavy, and is used for construction and firewood. The seeds can be eaten cooked, roasted or fermented but too much of it at one time may cause dizziness (Van Sam and Van Welzen, 2004). Not much is known about the chemical constituents except for the presence of hydrocyanic acid in the leaves and seeds (Ling et al., 2006). However, cooked (boiled) and fermented seeds has considerably less amygdalin, a type of cyanogenic glycoside, than the fresh ones (Ngamriabsakul and Kommen, 2009). Also, the oil which is seldomly pressed from the seed, is pale yellow in colour, nearly odorless and with a nice taste, used for cooking or as lamp oil. The fatty acid composition of extracted oil was determined using gas chromatography (GC) method. Unlike most seed oils, perah seed oil contained α-linolenic acid as part of its five major fatty acids. Result showed that perah seed oil is a potential nutritive seed oil to be developed in the future (Yong and Salimon, 2006).

The utilization of a seed or plant generally depends on the available information and data on such plant. Although, many researchers have worked on pra or perah (*E. tapos* Blume) (Ling et al., 2006; Yong and Salimon, 2006; Jantarit et al., 2009; Ngamriabsakul and Kommen, 2009), the nutritional property of the whole seed has not yet been reported. This work therefore aimed to investigate the proximate composition of the whole seeds of pra and some functional properties of the seed flour in order to be able to explore its potential in various food applications.

Abbreviations: GC, Gas chromatography; **FC,** foam capacity; **FS,** foam stability; **WAC,** water absorption capacity; **OAC,** oil absorption capacity; **EC,** emulsion capacity.

MATERIALS AND METHODS

Preparation of pra seed flour

Pra seeds were obtained from a local market in Nakhon Si Thammarat

Table 1. Proximate composition of pra seed flour.

Constituent	Percentage (%)
Moisture	2.47 ± 0.2
Protein (N×6.25)	16.10 ± 0.5
Fat	36.49 ± 0.6
Ash	2.15 ± 0.2
Crude fiber	17.43 ± 0.4
Carbohydrate (by difference)	25.36 ± 1.0

* Values are mean ± standard deviation of triplicate determinations.

province, southern Thailand. Whole seeds were sorted, cleaned and de-shelled. The seeds were heated to a medium roast measured as an average Hunter color lightness (L*) value of 40 ± 1.0. Pra seed flour was made from seeds which were roasted at 140°C in an oven for 2 h and milled to pass through a 0.5 mm mesh size sieve. Samples were stored in capped plastic boxes kept at room temperature until required for use.

Proximate analysis

The seed flour was analyzed for moisture, crude protein (N×6.25), fat, ash and crude fiber contents according to standard method (AOAC, 1995). The carbohydrate was calculated by differences. All proximate analyses were carried out in triplicate and reported in percentages. Fatty acid composition was determined by gas chromatography (GCI-02) equipped with a flame ionization detector. Fatty acid methylesters were prepared as described by AOAC (1995).

Functional properties

Water and oil absorption capacities

Water and oil absorption capacities of the flour samples were carried out as described by Abbey and Ibey (1988) using 1 g of flour and 10 ml distilled water or refined vegetable oil (density 0.98 g ml^{-1}). The determinations were carried out in triplicate at room temperature and the values were expressed as percentage of water or oil bound.

Emulsion capacity

Emulsion capacity was determined in triplicate according to the procedure of Beuchat et al. (1975) at room temperature. The value can be calculated as:

$$EC = \frac{(\text{Initial vol. of oil} - \text{Final vol. of oil})}{(\text{Wt of sample} \times \text{Density of oil})} \times 100$$

Foam capacity and foam stability

The method described by Lawhon et al. (1972) was used for the determination of foam capacity (FC) and foam stability (FS). The FC was expressed as a percentage increase in volume using the following equation:

$$FC = \frac{(\text{Vol. after whipping} - \text{Vol. before whipping})}{\text{Volume before whipping}} \times 100$$

The foam volume was recorded 2 h after whipping to determine the FS as a percentage of the initial foam volume as follows:

$$FS = \frac{\text{Foam volume after 2 h}}{\text{Initial foam volume}} \times 100$$

Measurements were made in triplicate and averaged.

RESULTS AND DISCUSSION

Proximate composition

Pra seed flour contained high amounts of protein (16.10%), carbohydrate (25.36%) and fat (36.49%) (Table 1). The protein content is relatively high when compared to those reported for hazelnut (14%), pecan (9%) and walnut (6%) but lower than the value reported for almond (21%). The high protein content of pra seed flour suggests that it may find use in food formulations. However, availability and quality of amino acids present in flour has to be determined before a conclusion on its suitability or otherwise.

The fatty acid composition of pra seed flour is presented in Table 2. The flour contains 6.66% saturated fatty acids, 29.83% unsaturated fatty acids but trans fat was not detected. Palmitic acid (4.85%) was the major saturated fatty acid, while oleic acid (12.54%) followed by linoleic acid (12.01%) were the major unsaturated fatty acid. Additionally, the flour has considerable amount of alpha linolenic acid (3.44%), the principal omega-3 essential fatty acid, which is higher than that of other nuts such as hazelnut (0.09%), macadamia (0.21%) and almond (none) but comparatively lower than walnut (9.08%). It is known that omega-6 and omega-3 imbalance is linked with serious health condition; the ideal intake ratio of omega-6/omega-3 is between 1:1 and 4:1. The value of omega-6/omega-3 ratio for pra seed flour is approximately 3.5:1; pra seed makes an important contribution to the human diet for their nutritional benefits to consumers in this aspect.

Functional properties

Table 3 shows some functional properties of pra seed flour. The water absorption capacity (WAC) value, 187.5% is comparatively lower than 512% for full fat *Cassia fistula* seed flour (Akinyede and Amoo, 2009), 243% for karkade seed product (Hamza et al., 1997) and 230% for jackfruit seed flour (Odoemelan, 2005) but higher than 137% for the yellow tigernut flour (Oladele and Aina, 2007). The WAC described flour-water association ability under limited water supply. The degree of water retention is useful as an indication of performance in several food formulations (Circle and Smith, 1972) in which the value ranging from 149.1 to 471.5% is considered critical in viscous food (AOAC, 1990). Thus, pra seed flour may

Table 2. Fatty acid composition of pra seed flour.

Fatty acid	Percentage (%)
Saturated fat	6.66
Palmitic acid (C16:0)	4.85
Stearic acid (C18:0)	1.63
Arachidic acid (C20:0)	0.08
Others	0.10
Unsaturated fat	29.83
Monounsaturated fatty acid	14.34
Palmitoleic acid (C16:1)	0.09
Cis-9-Oleic acid (C18:1)	12.54
Cis-11-Eicosenoic acid (C20:1)	1.71
Polyunsaturated fatty acid	15.49
Cis-9,12-linoleic acid (C18:2)	12.01
γ-Linolenic acid (C18:3)	0.03
α-Linolenic acid (C18:3)	3.44
Arachidonic acid (C20:4)	0.01
Trans fat	Not detected

* Values are means of duplicate samples.

Table 3. Functional properties of pra seed flour.

Property	Percentage (%)
Water absorption capacity (WAC)	187.5 ± 2.0
Oil absorption capacity (OAC)	130.4 ± 3.0
Emulsion capacity (EC)	39.6 ± 1.5
Foam capacity (FC)	32.6 ± 2.5
Foam stability (FS)	28.2 ± 2.0

* Values are mean ± standard deviation of triplicate determinations.

find use as functional ingredients in soups, gravies and baked products. Oil absorption capacity (OAC) is another important functional property since it plays an important role in enhancing the mouthfeel while retaining the flavor of food products (Kinsella, 1976). The OAC of pra seed flour (130.4%) was higher than that of the yellow tigernut flour (107%) (Oladele and Aina, 2007), while it was lower than the reported value for full fat *C. fistula* seed flour (216.2%) (Akinyede and Amoo, 2009) and defatted karkade seed flour (206%) (Hamza et al., 1997). The result showed that pra seed flour may be a better flavor retainer than the yellow tigernut flour but lower than *C. fistula* seed flour and karkade seed flour. It has been reported that variations in the presence of non-polar side chains, which might bind the hydrocarbon side chains of oil among the flour, explain differences in the oil binding capacity of the flour (Adebowale and Lawal, 2004). It might be concluded that the lower OAC of pra seed flour is due to the lower extent of hydrophobic proteins when compared to *C. fistula* seed flour and karkade seed flour. The emulsion capacity (EC) of pra seed flour (39.6%) is greater than that of soybean flour (18.0%) and wheat flour (11.0%) (Lin et al., 1974). Proteins constitute an important group of emulsifiers because they reduce interfacial tension, form rigid interfacial films and posses charged groups (McWatters and Cherry, 1981). Proteins with high emulsifying and foaming capacity are desirable for salad dressing, sausage, cake and frozen desserts (Ahmedna et al., 1999). This suggests that pra seed flour may be useful as an additive for stabilization of fat emulsions in such food formulations. The FC of pra seed flour (32.6%) was higher than that of yellow tigernut seed flour (10.3%) (Oladele and Aina, 2007). The value is in line with that of full fat *C. fistula* seed flour (33.3%), but comparatively lower than that of wheat flour (40.0%) (Akubor and Badifu, 2004). The foamability is 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 FS of pra seed flour (28.2%) is lower than 50.6 and 60.0% reported for yellow tigernut seed flour and wheat flour, respectively.

Conclusions

The results of this work indicate that pra seed flour under investigation may prove useful as a functional ingredient in food formulations. Pra (*E. tapos* Blume) could be ranked as one of the nutritious nuts because in addition to being a good source of omega-3 essential fatty acid, it contains considerable amount of protein. This study encourages further investigation of its nutritional properties. This would add some economic value to the existing uses of the plant and expand its cultivation.

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