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Short paper

Comparative study of the nutritional, phytochemical and mineral compositions of the nuts of tropical almond (*Terminalia catappa*) and sweet almond (*Prunus amygdalus*)

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Abstract. The study was conducted to compare the nutritional, phytochemical and mineral compositions of Tropical almond with Sweet almond. Sample of *Terminalia catappa* nuts were collected within the premises of Nigerian Stored Products Research Institute (NSPRI), Ilorin, Nigeria while *Prunus amygdalus* was purchased from Shoprite Palms Mall Ilorin, Nigeria. Proximate, phytochemical and mineral analyses were carried out using standard procedures. Results showed that *T. catappa* was significantly ($p<0.05$) high in ash (4.84%), crude fibre (15.54%), carbohydrates (2.91%) and some mineral elements such as potassium, zinc, iron, magnesium and copper. *Prunus Amygdalus* was significantly ($p<0.05$) high in ether extract (50.96%) while no significant difference ($p>0.05$) was recorded in their protein contents (33.00 and 32.89% respectively). *P. amygdalus* was significantly ($p<0.05$) high in phytochemicals such as tannin (748.49µg/g), phenols (1,781.50 µg/g), flavonoids (456.38 µg/g), saponin (158.70 µg/g) and alkaloids (240.11µg/g) while *T. catappa* was significantly ($p<0.05$) high in glycosides (220.27µg/g).The differences in phytochemicals might be due to the differences in drying and other processing methods. *T. catappa* can well compete with *P. amygdalus* if the value chain is improved upon by proper packaging and storage for commercial purposes.

Keywords. Almond, nuts, nutrition, Ilorin, Nigeria

1 Introduction

Plants continue to revolutionize the face of the earth through distinctive benefits they provide across the world (AgroNigeria 2017). Plant seeds form an important part of human diet and their significance especially in the diet of the population of developing countries is increasing for several reasons (Alozie and Udofia 2015). Almond seeds are a good source of proteins, edible oils and fats in the diets as well as potential raw materials for local industries.

This seed is also used by many rural dwellers in southern Nigeria to fortify the local complimentary foods, which are usually low in protein (Christian 2007). Almond is a large tree that grows mainly in the tropical regions of Asia, Africa and Australia (Pankaj and Robert 2008). This is also identified by common English names such as; Country-almond, Indian-almond, Malabar-almond, Sea-almond, Tropical almond (USDA 2016). *Terminalia catappa L.* (Tropical almond) belonging to the family *Combretaceae* is one of the underutilized tree species found in tropics including Nigeria. It is planted extensively in the tropics for shade and ornamental purposes, esp. in parks, along avenues, as well as home gardens (Mbah *et al*. 2013). The fruit of the tree is a drupe 5-7 cm long and 3-5.5 cm broad, green at first, then yellow and/red when ripe. The fruit contains a single seed, with sweet edible fibrous pulp which is eaten by children as forage snacks and there has been no report of associated toxicity with its consumption (Mbah *et al*. 2013, Arumugam *et al*. 2015). Sweet Almond (*Prunus amygdalus var. dulcis*) is another variety which belongs to the family *Roseceae*. It is also a drupe with a thick leathery grey-green exocarp called the hull. It has been shown to be a nutritious food providing more than 20% of daily value of riboflavin, niacin, Vitamin E, calcium, iron, magnesium, manganese, phosphorus and zinc in each 100 g (Berryman *et al*. 2011).

Literature has revealed the nutritional composition of tropical almond nuts which is predominant in Nigeria. Mbah *et al*. (2013) published some data on nutrient potential of almond seeds (*T. catappa L.*) sourced from three eastern states of Nigeria. They reported *T. catappa* seeds to be rich in protein and could reduce the level of malnutrition in most impoverished countries of Africa and hence encouraged its use in food supplements either in raw or roasted form to improve the food nutrient content. Ezeokonkwo and Dodson (2007) reported the potential of *T. catappa* seed as a source of dietary protein. Olatidoye *et al*. (2011) examined the chemical composition and physicochemical characteristics of Tropical Almond nuts (*T. catappa L.*) cultivated in south western Nigeria and reported that the physicochemical properties of the almond seed oil indicated that it is edible, drying and suggested its suitability for industrial purposes as well as the nutritional potentials of the nut, which could serve as an alternative food ingredient for unsaturated vegetable oil. Christian and Mark (2006) also evaluated the nutritional potential of the nuts of Tropical Almond (*T. catappa L.*) and also reported that tropical almond nut can contribute useful amounts of essential nutrients to the diet of man. The variety of almond nuts sold in most of Nigerian supermarkets is Sweet Almond (*P. amygdalus dulcis*) which is native to the Middle East and South Asia (AgroNigeria 2016).

The objective of the present study is to compare the nutritional, phytochemical and minerals composition of two varieties of almond with a view of revealing the potential of the local variety (*T. catappa*) of Almond,

and to provide information regarding the processing of Tropical Almond into a value added product that could be marketed worldwide, as a dietary supplement.

2 Materials and Methods

2.1 Sample collection and preparation

Mature almond nuts (*Terminalia catappa*) were collected within the premises of Nigerian Stored Products Research Institute (NSPRI), Ilorin, Nigeria. The fruits were sun dried and manually de-hulled to get the nuts in their whole form. The nuts were then stored in an air tight bag in a cool (20ºC) and dried place till usage. The foreign almond was purchased from Shoprite, Palms Mall, Ilorin, Nigeria under the Trade Name: Blue Diamond Almonds (Blue Diamond Growers: Sacramento, CA 95812 USA).

2.2 Determination of the proximate composition

The proximate analysis was carried out following the method of AOAC (2016) while carbohydrate content was determined by difference (Pearson, 1976). The moisture was determined by hot air oven (DHG-9055A Drying Oven, SearchTech Instruments) method at 105°C for 5 h. The micro kjeldahl method was used for the determination of protein content. The fat content or ether extract was determined by extracting 5g of sample with petroleum ether (boiling point of 40ºC to 60°C) using Soxhlet (Borosilicate glass, 45/50 KIMAX USA 24/40) solvent extraction method. Ash was determined by weighing 5 g of charred sample into a tarred porcelain crucible, which was incinerated at 600^0C for 6 h in an ash muffle furnace (SX-5-112 Box-Resistance Furnace, SearchTech Instruments) until ash was obtained. The crude fibre was determined by exhaustive extraction of soluble substances in the sample using 1.25% H_2SO_4 acid and 1.25% NaOH solution after the residue was ashed and the loss in weight was recorded as crude fibre.

2.3 Mineral analysis

The minerals; sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), copper (Cu) and zinc (Zn) were determined using the dry ash procedure in accordance with the method of Oshodi and Fagbemi (1991). Accordingly, 1 g of sample was weighed into a crucible and placed in a muffle furnace at 600^0C for 5 h to ash and then transferred into desiccators to cool to room temperature (23ºC). The ash was dissolved in 10% hydrochloric acid (10 ml), filtered and diluted to 100 ml volume with distilled water. From the digest, the required elements were determined; Na and K were measured

by the use of Jenway digital flame photometer, PFP7/C Analytical Flame Photometer as described by Bonire *et al*. (1990). Ca, Mg, Fe, Cu, and Zn were measured using atomic absorption spectrophotometer (AAS 969 Buck Scientific VGP 210, Buck Scientific Inc. 58 Fort Point St, East Norwalk, Ct. 06855) in accordance with AOAC (2000) and compared with absorption of standards of the elements.

2.4 Phytochemical screening

The qualitative phytochemical analysis was done to determine the presence of Alkaloids, Flavonoids, Saponin, Tannin, Phenols, Glycosides, Steroids and Phlobatannin in the nuts using the methods described by Dey *et al*. (2003), Mehta *et al*. (2013) and Ifemeje *et al*. (2014).The quantitative analyses to determine the amount of Alkaloids, Glycosides and Saponin in the nuts were carried out using the methods described by Obdoni and Ochuko (2001) and Ifemeje *et al.* (2014) while the concentration of Tannin, Phenols and Flavonoids were determined by the method described by Vijay and Rajendra (2014).

2.5 Statistical analysis

Data on proximate, minerals and phytochemical analyses were reported as mean ± SD of triplicate (n=3) determinations. All data were pooled together and analysed by using Student's t-test. Means were considered significant at probability level of 5 % ($p<0.05$).

3 Results and Discussion

3.1 Proximate composition

The results presented in Fig. 1 are the proximate analysis of *Terminalia catappa* and *Prunus amygdalus*. It showed that *T. catappa* was significantly ($p<0.05$) high in moisture (30.47%), crude fibre (15.54%), ash (4.84%) and in nitrogen free extract (NFE) or carbohydrates content (2.91%) compared to *P. amygdalus*; low in moisture (8.55%), crude fibre (11.08%), ash (4.13%) and NFE (0.96%) respectively. In contrast, *P. amygdalus* was significantly ($p<0.05$) high in crude fats (50.96%) compared to *T. catappa* (43.71%) while there was no significant difference ($p>0.05$) between the protein contents of *T. catappa* (33.00%) and *P. amygdalus* (32.87%).The protein content of *T. catappa* (33.00%) in this study was higher than some data available in literature. The protein contents of *T. catappa* (33.00%) and *P. amygdalus* (32.89%) compared well and were even higher than the protein contents of most conventional oil seeds; for instance, groundnut (25.00%), black-eyed

beans (27.13%), brown beans (28.00%), cowpea (27.80%), bambara nuts (23.41%) and pigeon pea (21.88%), (Ezeokonkwo and Dodson 2007). According to Ezeoknkwo and Dodson (2007) the protein content of *T. catappa* was 25.81%. Similarly, Mbah *et al*. (2013) reported the nutritional composition of *T. catappa* as; protein (23.40%), fats (22.0%), ash (4.1%), fibre (6.4%) and carbohydrates (34.6%). Also the proximate composition results in the present study are higher than those report by Agunbiade and Olanlokun (2006); protein (11.52%), ash (6.76%), fibre (5.09%) and carbohydrates (54.87%) and those reported by Olatidoye *et al.* (2011); protein (32.6%), fats (3.3%), ash (4.8%), fibre (0.4%) and carbohydrates (49.9%). The differences in protein contents may be due to varietal and other environmental differences such as soil, water, climate etc.

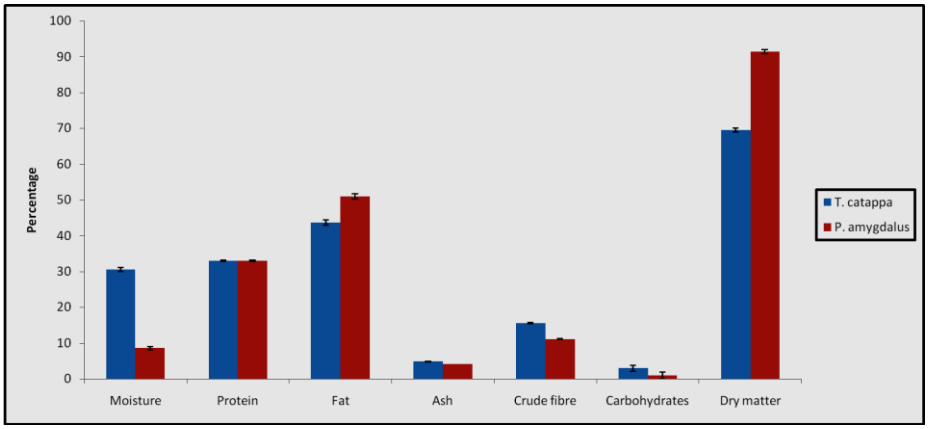

Fig. 1. Nutritional composition of *Terminalia catappa* and *Prunus amygdalus* (dry matter basis). Bar represents mean of triplicate readings (n=3) while error bar represents standard deviation. Bars with unshared alphabets are significantly different ($p<0.05$).

3.2 Phytochemical composition

Phytochemical screening of the two varieties of almond showed that all the parameters tested (in exception of steroids and phlobatannin) were present; these include, tannin, phenols, flavonoids, saponin, alkaloids and glycosides. The quantitative analysis of the phytochemicals (Fig. 2) showed that *P. amygdalus* was significantly ($p<0.05$) higher in tannin (748.49 µg/g), phenols (1,781.50 µg/g), flavonoids (456.38 µg/g), saponin (158.70 µg/g) and alkaloids (240.11 µg/g) as against *T. catappa* which are; tannin (388.95 µg/g), phenols (410.83 µg/g), flavonoids (73.28 µg/g), saponin (86.32 µg/g) and

alkaloids (210.65 µg/g) respectively. Conversely, *T. catappa* was significantly ($p<0.05$) higher in glycosides (220.27 µg/g) compared to *P. amygdalus* (181.65 µg/g). The reason for higher concentrations of tannin, phenols, flavonoids, saponin and alkaloids in *P. amydgladus* may be due to differences in varietal differences, soil and other environmental factors as it was also reported by Mbah *et al*. (2013). The tannin contents of *T. catappa* and *P. amygdalus* in the present study are higher than some literature reports. Agunbiade and Olanlokun (2006) reported the tannin content of Indian almond to be 18.2 microgram per gram while Mbah *et al*. (2013) reported the tannin content of *T. catappa* to be 0.03 microgram per gram. This may be linked with vegetative loss during processing.

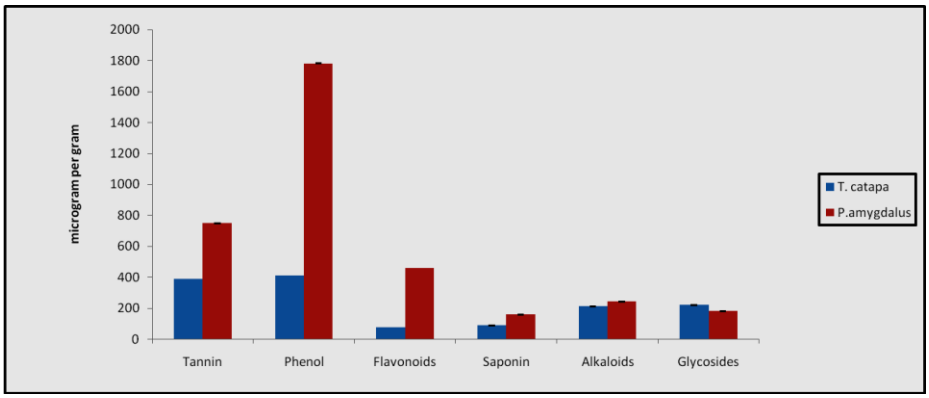

Fig. 2 Quantitative phytochemical composition of *Terminalia catappa* and *Prunus amygdalus*. Bar represents mean of triplicate readings (n=3) while error bar represents standard deviation. Bars with unshared alphabets are significantly different ($p<0.05$).

3.3 Mineral content

The mineral elements tested for in *T. catappa* and *P. amygdalus* were Sodium (Na), Potassium (K), Calcium (Ca), Zinc (Zn), Iron (Fe), Magnesium (Mg) and Copper (Cu). Sodium and Calcium were not detected in both samples. The results of the mineral analysis (Fig. 3) revealed that *T. catappa* was significantly ($p<0.05$) high in K (4.80 mg/ 100g), Zn (0.0075 mg/ 100g), Fe (0.0035 mg/ 100g), Mg (0.064 mg/ 100g) and Cu (0.0020 mg/ 100g) compared to *P. amygdalus* K (3.80 mg/ 100g), Zn (0.0025 mg/ 100g), Fe (0.0030 mg/ 100g), Mg (0.0615 mg/ 100g) and Cu (0.0015 mg/ 100g) respectively. The presence of macro and micro elements in *T. catappa* from the present study showed that this seed has some beneficial nutritional potential (Mbah *et al*., 2013).

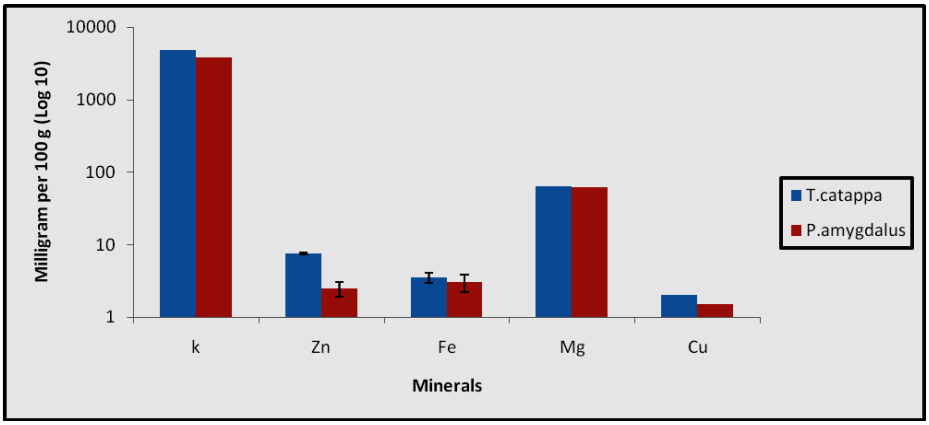

Fig. 3 Mineral composition of *Terminalia catappa* and *Prunus amygdalus.* Bar represents mean of triplicate readings (n=3) while error bar represents standard deviation.

4 Conclusions

The study has shown that *T. catappa* compares well with *P. amygdalus* in terms of nutritional, phytochemical and mineral compositions. This research work would serve as a source of information for processors or stakeholders regarding the value addition of the indigenous variety of almond.

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