Available online at www.elixirpublishers.com (Elixir International Journal)

Food Science

Elixir Food Sci. 84 (2015) 33882-33885

ISSN: 2229-712X

Effect of Moist Heat on the Nutritional and Phytochemical Profile of the Nuts of *Tetracarpidium Conophorum*

Awe A.B, Awofadeju O.F, Oluwatoke F.O, Amadi B.O Adewumi O.J and Akinlabi F.M
Forestry Research Institute of Nigeria, Ibadan, Nigeria.

ARTICLE INFO

Article history:
Received: 21 May 2015;
Received in revised form: 15 July 2015;
Accepted: 22 July 2015;

Keywords
Moist, Nutritional,
Anti-nutritional,
Phytochemical,
Tetracarpidium conophorum.

ABSTRACT

The study was designed to evaluate the effects of moist heat on the nutritional, anti-nutritional and phytochemical composition of the nuts of *Tetracarpidium conophorum* (African walnut). African walnut was subjected to cooking at 100^{o}C. The raw and boiled nuts were chopped and air-dried. The nutritional composition of *Tetracarpidium conophorum* investigated on shows: protein(%) 26.83, 25.90 and 26.23; crude fibre (%) 1.50, 1.20 and 1.10; fat(%) 16.36, 16.43 and 16.43; carbohydrate (%) 42.33, 43.60 and 44.63; moisture (%) 9.17, 9.33 and 8.92; ash (%) 3.80, 3.53 and 3.33 for all the samples of raw air dried, boiled air dried and boiled oven dried respectively. Evaluation of anti-nutritional factors (mg/100) revealed, phytates 31.67, 16.67 and 13.33; oxalates 12.17, 7.83 and 5.33 for raw air dried, boiled air dried and boiled oven dried respectively. Analysis on the phytochemical composition of the walnut (mg/100) revealed, alkaloid 12.32, 7.33 and 6.67; saponin 21.67, 13.33 and 8.33; flavonoids 2.33, 2.47 and 2.50; terpenoids 7.67, 9.23 and 6.40; steroids 12.30, 12.37 and 12.10; phenolics (GAEG) 35.10, 28.37 and 20.17; ORAC (% inhibition) 46.30, 32.50 and 25.10 respectively on the raw air dried, boiled air dried and boileded oven dried. With respect to the findings, there were significant ($p>0.05$) decrease in all the samples on the nutritional, anti-nutritional and phytochemical compositions of the samples except the fat and carbohydrates that showed increment on the compositions through raw air dried, boiled air dried and boiled oven dried processing. The moisture content of boiled air dried recorded highest among the samples, while the phytochemical compositions revealed the steroids to be stable in all the samples.

© 2015 Elixir All rights reserved.

Introduction

Nuts (including walnuts) are commonly eaten by man, rodents, domestic and wild animals. Though they are of plant origin, there have been wealth of fascinating information about many varieties which reveal their amazing health giving potentials as major sources of fat, minerals, proteins and vitamins (vitamins (Okoye and Okobi, 1984).). *Tetracarpidium conophorum* is a climbing shrub 10-20ft long, it is known in Western Nigeria as awusa or asala (Yoruba). This plant is cultivated principally for the nuts which are cooked and consumed as snacks (Ayoola et al., 2003). A bitter taste is usually observed upon drinking water immediately after eating the nuts. This could be attributed to the presence of chemical substances such as alkaloids. Ayodele (2003) reported the presence of oxalate, phytate and tannin in the raw *Tetracarpidium conophorum* nuts. Edem (2009) reported on the proximate composition, ascorbic acid and heavy metal contents of the nut. Oyenuga (1997) reported on the amino acid and fatty acid components of the nut and on the use of its leaf juice for the treatment of prolonged and constant hiccups. Ihemeje et al also reported on the effect of processing methods on the nutritional and functional and constituents of the nut. The lipid content of these nuts has also been reported by Ekpo and Eddy (2005). Previous studies focused on the nutritive value, chemical and functional characteristics of conophor nuts (Enujiugha, 2003), antimicrobial activity of the extracts and fractions of the nut (Ajaiyeoba and Fadare, 2006). Recently, physicochemical Walnuts are considered to be herb in Traditional Chinese medicine. They are said to tonify kidneys, strengthen the back and knees, moisten the intestines and move stool. It is believed to stop asthma and is prescribed to be taken between bouts of asthma, but not for acute asthma. It is used for the elderly as a constipation cure. (Wikipedia, 2009). The bark is used in tea as laxative and chewed for toothache. It helps to prevent and control high blood pressure. The leaves are used as male fertility agent and in the treatment of dysentery in southern Nigeria. Generally, nuts are far richer in minerals than meat. Diets containing walnuts have also been shown to lower serum cholesterol. Daily intake of nuts (28g) can decrease serum level and LDL cholesterol by 4% and 6% respectively (Sibbett, 1994). Ros (2006) added that olive oil and the walnuts help reduce the onset of dangerous inflammation and oxidation on the arteries after consuming unhealthy or saturated fats. However, unlike olive oil, the walnuts also help the arteries maintain their elasticity and flexibility even in people with high cholesterol. He inferred that walnut's protective effects could be because the nuts are high in antioxidants and Omega-3 fatty acid. Walnuts also contain arginine, which is an amino acid that the body uses to produce nitric oxide necessary for keeping blood vessels flexible. Ajaiyeoba and Fadare (2006) carried out an investigation that showed that *T. conophorum* has a high potential as an antimicrobial medical plant.

Tannins, hydrocyanic acid (HCN) and oxalate have been found as anti-nutritional factors in T.conophorum. The anti-nutritional factors (ANFS) may be defined as those substances generated in natural food stuffs by the normal metabolism of

Tele:
E-mail addresses: adede235@yahoo.com

© 2015 Elixir All rights reserved

species and by different mechanisms (e.g. inactivation of some nutrients, diminution of the digestive process, or metabolic utilization of feed which exert effects contrary to optimum nutrition (Kumar, 1992). Tannins reduce the bioavailability of proteins and protein value of foods (Soetan and Oyewole, 2009). Oxalate is known to form insoluble salts with calcium and magnesium in the digestive system, rendering them unavailable to the body (Soetan and Oyewole, 2009). Trace amount of alkaloid was found in African walnut (Osagie et al., 1996). Enujiugha and Ayodele-oni (2003) discovered some significant concentrations of phytates (in addition to oxalate) which according to Ayodele-oni (2003) chelate certain mineral elements especially calcium, magnesium, iron and zinc, rendering them metabolically unavailable. The oil in the nut is suggested to be a suitable material for soap making and as a substitute for linseed oil in the varnish and lacquer industries. (Ajaiyeoba and Fadare, 2006). T. conophorum kernels which have high lipid content are often eaten as nibbles in Cameroon (Tchiégang et al., 2001). The liquor from walnut is used to flavor ice creams and other confections). Recently, physicochemical characteristics of the nut oil revealed that the oil is edible and a good candidate for conventional oil (Oladiji et al., 2007). African walnut till date is classified among "lesser-known" plants and with increased interest in the exploitation of less-common oilseeds, it is very necessary to investigate the quality characteristics of raw and processed *Tetracarpidium conophorum* nut in order to ascertain its status. Therefore, the objective of this work was to ascertain the effects of moist heat (boiling) on the nutritional, anti-nutritional and phytochemical constituents of African walnut.

Materials and Methods

African walnuts were purchased from Oje market in Ibadan, Oyo State, Nigeria.

Preparation of Walnut Flour

The walnut sample (1,500g) was cleaned, sorted to remove dirt and immature ones. The cleaned sample was divided into two portions. A portion (1000g) was boiled in water in an aluminium pot at 100^0C for 45 minutes. The second portion (500g) was untreated and used as control. The boiled portion was further divided into two: one was air dried for 3 days while the other was oven dried at 50^0c for 6 hours. The three different portions were separately milled into flour using Malex blender. The flours were sieved using 1mm sieve size to obtain fine flour which is packaged separately in three different air-tight polyethylene bags.

Nutritional Analysis

The standard method described by A.O.A.C (1995) was used in the determination of crude protein, crude fibre and moisture content while carbohydrate content was obtained by difference.

Analysis of Anti-nutritional Constituents

The procedure described by Holoway et al. (1989) was used in the determination of total oxalate, while phytate analysis was according to Vaintraub and Lapteva (1988).

Analysis of Phytochemicals

The phytochemical screening was done on the samples using methods as described (Sofowara, 1993). The total phenolic content of the extract was determined according to the method described by Hung et al; 2001

Statistical Analysis

Data collected was subjected to ANOVA to determine the levels of significant differences (if any) among the samples.

Results and Discussions

Table 1. Nutritional Composition of the Nuts of Tetracarpidium conophorum

	Raw (Air-dried)	Cooked (Air-dried)	Cooked (Oven-dried)
Protein (%)	26.83±0.57	25.90±0.20[a]	26.23±0.42[a]
Crude fibre (%)	1.50±0.10	1.20±0.10[a]	1.10±0.10[a]
Fat (%)	16.36±0.15	16.43±0.25	16.43±0.11
Carbohydrates (%)	42.33±0.30	43.60±0.26[a]	44.63±0.37[a]
Moisture (%)	9.17±0.05	9.33±0.15[a]	8.92±0.50[a]
Ash (%)	3.80±0.10	3.53±0.15[a]	3.33±0.15[a]

[a] = values significant compared to control (raw)

Table 2. Anti-nutritional Composition of the Nuts of T. conophorum

	Raw (Air-dried)	Cooked (Air-dried)	Cooked (Oven-dried)
Phytates (mg/100g)	31.67±2.89	16.67±2.89[a]	13.33±2.89[a]
Oxalates (mg/100g)	12.17±0.29	7.83±0.58[a]	5.33±0.58[a]
Protease Inhibitors (mg/100g)	ND	ND	ND

[a] = values significant compared to control (raw)

Table 3. Phytochemical Composition of the Nuts of T. conophorum

	Raw (Air-dried)	Cooked (Air-dried)	Cooked (Oven-dried)
Alkaloids (mg/100g)	12.33±2.51	7.33±1.15[a]	6.67±1.52[a]
Saponins (mg/100g)	21.67±2.89	13.33±2.89[a]	8.33±2.89[a]
Flavonoids (mg/100g)	2.33±0.28	2.47±0.31	2.50±0.10
Terpenoids (mg/100g)	7.67±0.76	9.23±0.25[a]	6.40±0.26[a]
Tannins (mg/100g)	23.33±0.29	11.67±0.58[a]	10.00±0.00[a]
Steroids (mg/100g)	12.30±0.26	12.37±0.32	12.10±0.36
Phenolics (GAE/g)	35.10±0.45	28.37±0.32[a]	20.17±0.29[a]
ORAC (% Inhibition)	46.30±0.30	32.50±0.25[a]	25.10±0.36[a]

[a] = values significant compared to control (raw)

Discussion

The proximate composition of raw African walnut (T. conophorum) showed the following on percentage dry basis; protein (26.83), oil (16.36), fibre (1.50); ash (3.80), carbohydrate (42.33) and moisture (9.17). The significant reduction observed with respect to boiling in the result justified the inclusion of T. conophorum with a high percentage of oil as an oil rich nut on their different works on lesser known and under utilized tropical oil seed (Alabi et al., 2005) The oil has far back been ascertained suitable for industrial and domestic uses especially in vegetable oil production (Ajayeoba and Fadare. 2006).The protein content is comparable with those obtained in legumes. The low ash content indicated its low mineral content and the fibre content is similar to those of other oil seeds (Enujuigha 2003; Enujiugha and Ayodele-Oni, 2003). The carbohydrate content of T. conophorum is on the high side.

Furthermore, there is overwhelming evidence that heat reduces the anti-nutrients and some phytochemicals present in the nuts of Tetracarpidium conophorum. Phytates and oxalates were significantly reduced by boiling.

Phytates/Phytic forms stable complexes with Cu^2+, Zn^2+, Co^2+, Mn^2+, Fe^2+ and Ca^2+. calcium, iron, zinc and other minerals, thereby reducing their availability in the body (FAO), It also inhibits protein digestion by forming complexes with them. On the contrary, recent research has shown that phytic acid has many health benefits. Phytic acid has antioxidant, anticancer, hypocholesterolemic and hypolipidemic effects. Phytic acid may be used as a safe preservative and antioxidant in food products. Oxalates bind minerals like calcium and magnesium and interfere with their metabolism. They also cause muscular weakness and paralysis. Oxalates also cause gastrointestinal tract irritation, blockage of the renal tubules by calcium oxalate crystals, development of urinary calculi and hypocalcaemia (Soetan and Oyewole, 2009). Oxalate, phytate and tannins are anti-nutrients, which could be toxic when consumed in an unprocessed food (Ojiako and Igwe, 2008). The bioavailability of the essential nutrients in plant foods could be reduced by the presence in these plants of some anti-nutritional factors such as oxalates (Akindahunsi and Salawu, 2005). Too much of soluble oxalate in the body prevents the absorption of soluble calcium ions as the oxalate binds the calcium ions to form insoluble calcium oxalate complexes. As a result of this, people with the tendency to form kidney stones are advised to avoid oxalate-rich foods (Adeniyi et al., 2009).

Protease /trypsin inhibitors have the ability to inhibit the activity of proteolytic enzymes within the gastrointestinal tract of animals [13]. Protease inhibitors are the most commonly encountered class of anti-nutritional factors of plant origin. Trypsin (protese inhibitors) cause pancreatic enlargement and growth depression (Akande et al., 2010). Trypsin/protease inhibitors are polypeptides that form well characterized stable complexes with trypsin on a one-to-one molar ratio, obstructing the enzymatic action. Protease inhibitors are inactivated by heat especially moist heat, because of even distribution of heat(Soetan and Oyewole, 2009). It has been reported that the presence of bioactive substances in plants play a role in preventing colorectal carcinoma, hyperchloestrolcamia and renal calculi (Soetan and Oyewole, 2009). Polyphenols have been shown to have antibacterial, anti-inflammatory, antiallergic, antiviral and antineoplastic activity (Alabi et al., 2005). Phenolic compounds could be a major determinant of antioxidant potentials of food plants and could therefore be a natural source of antioxidants and because phenolic compounds have been associated with the health benefits derived from consuming high levels of fruits and vegetables.

Alkaloids cause gastrointestinal and neurological disorders (Aletor, 1993). Tannins causes decreased feed consumption in animals, bind dietary protein and digestive enzymes to form complexes that are not readily digestible (Aletor, 1993). They also cause decreased palatability and reduced growth rate (Roeder, 1995). Saponins reduce the uptake of certain nutrients including glucose and cholesterol at the gut through intra-lumenal physicochemical interaction. Saponins cause hypocholesterolaemia by binding cholesterol, making it unavailable for absorption. They also cause haemolysis of red blood cells. Saponins from *Bulbostermma paniculatum* and *Pentapamax leschenaultii* have also been demonstrated to have anti-spermal effects on human spermatozoa (Soetan and Oyewole, 2009).

Conclusion

The work showed that the nuts of T. conophorum are a rich source of oil which could be useful in the food, confectioneries, cosmetics, paints etc industries. Heat (boiling) reduced the anti-nutrients present in the nuts of *T. conophorum* considerably lending credence to the importance of the traditional processing of boiling the nuts before eating. It is note worthy that eating the nuts raw could be dangerous owing to the high levels of anti-nutrients like oxalates and phytates.

The present study has also shown the phytochemicals present in the *Tetracarpidium conophorum* . This partly shows the use of this plant in herbal medicine. As a rich source of phytochemicals, *T. conophorum* can be seen as a potential source of useful food and drugs. The presence of saponins supports its anti-inflamatory property. This also proves that the plant may be helpful in asthma, rheumatoid and arthritis. Further studies have to be carried out to isolate, characterize and elucidate the structure of the bioactive compounds from the plant for industrial drug formulation.

References

Adeniyi SA, Orjiekwe CL, Ehiagbonare JE (2009). Determination of alkaloids and oxalates in some selected food samples in Nigeria. Afri. J. Biotechnol. 8(1): 110-112.

Ajaiyeoba, E. O. and Fadare, D. A. (2006). Antimicrobial Potential of Extracts and fractions of the African Walnut (*Tetracarpidum conophorum*). Africa Journal of Biotechnology. 5 (22): 2322 -2326.

Akindahunsi A A, Salawu S O (2005). Phytochemical screening and nutrient and anti- nutrient composition of selected tropical green leafy vegetables. Afr. J. Biotechnol. 4: 497-501.

Alabi, D.A., O.R. Akinsulire and M.A. Sanyaolu, 2005. Qualitative determination of chemical and nutritional composition of *Parkia biglobosa* (jacq.) Benth. Afr.J. Biotechnol., 4: 812-815

Aletor VA (1993). Allelochemicals in plant foods and feeding Stuffs. Part I. Nutritional, Biochemical and Physiopathological aspects in animal production. Vet. Human Toxicol. 35(1): 57-67.

Aletor VA. (2005). Anti-nutritional factors as nature's paradox in food and nutrition securities. Inaugural lecture series 15, delivered at The Federal University of Technology, Akure (FUTA

AOAC, 1995. Official Methods of Analysis of AOAC International, 16th ed. Method

Ayodele, O.B., 2003. Nutrition in Nigeria Ibadan,, Catoon Publishers

Ayoola P.B, Adeyeye A,Onawumi O.O & Faboya. O.O (2011) IJRRAS 7 (2)

characteristics of the oil from Tetracarpidium conophorum (Mull. Arg.) Hutch.

Dalz nut. Nig. J. Biochem. Mol. Biol. 22 (2), 93–98.

Edem, Christopher A. Dosunmu, Miranda,I., Bassey Francesca, I. (2009). Determination of Proximate Composition,Ascorbic Acid and Heavy Metal Content of African Walnut (*Tetracarpidium conophorum*).*Pak .J. Nutrit*., 8: 225-226.

Ekpo, A. S., Eddy, N. O.(2005).Comparative Studies of The Level of Toxicant in the Seeds of Terminalia Catappa(india almond) and Coula edulis (African walnut).*ChemClass Journal* Vol.2 .pp: 74

Enujiugha VN, Ayodele-Oni O, 2003. Evaluation of oil nutrient and anti-nutrients in lesser known under utilized oil seeds .Int. J.Food Sci and Technol 38:525-528.

Enujiugha, V.N., 2003. Chemical and functional characteristics of conophor nut. Pak. J. Nutr. 2, 335–338

FAO/WHO/UNU. "Energy and Protein Requirements: Report of a Joint FAO/WHO/UNU Expert Consultation". WHO Technical Report Series. 1991.p.724. fruits from Nigeria. Pak. J. 7(1): 85-89.f Food Science Vol. 3 (9), pp. 223-232, September, 2009

Ford, J. E. and Hewitt, J. W. (1979). Protein Quality of Cereal and Pulses. I. Application of Microbiological and other In-vitro Method in the evaluation of rice (Oryza sativa), Sorghum (Soighum vilgare), Barley and Field Bean (Vicia faba). British J. of Nutri.33:314 - 352. Giami, S. Y. (2003).

Holloway, W. D., Argall, M. E., Jealous, W. T., Lee, J. A. and Bradbury, J. H. (1989). Organic acid and Calcium Oxalate in Tropical Root Crops. J. of Agri. and Food Chem. 37:337 – 341

Hung Y, Sava V, Yang SM, Hong MY, Yang PC, Huang GC, 2001. Isolation and characterization of melanin pigments derived from tea and tea polyphenols. Food Chem. 73(2): 177-184

Ihemeje, A.; Okorie, S.U. and Ekwe Charles .C (2012) Effects of processing methods on the biochemical, functional and antinutritional properties of African walnut *Tetracarpidium conophorum*) Journal of Biological Science and Bioconservation 2012 55-64

K.E. Akande, U.D. Doma, H.O. Agu and H.M. Adamu (1987). Major Antinutrients Found in Plant Protein Sources: Their Effect on Nutrition Pakistan Journal of Nutrition 9 (8): 827-832, 2010

Loewus FA.(2002). Biosynthesis of phytate in food grains and seeds. In: Reddy NR, Sathe SK (Eds.). Food Phytates. CRC Press, Boca Raton Florida, pp 53–61.

Ojiako OA, Igwe CU (2008). The Nutritive, Anti-nutritive and Hepatotoxic properties of *Trichosanthes anguina* (Snake Tomato) fruits from Nigeria. Pak. J. 7(1): 85-89.f Food Science Vol. 3 (9), pp. 223-232

Oladiji, A.T., Abodunrin, T.P., Yakubu, M.T., 2007. Some physicochemical Phytochemical and nutrient evaluation of *Tetracarpidium conophorum* (Nigerian walnut) root.

Ros. E. (2006). Health Benefits of Walnuts. Journal of the American College of Cardiology. 2006 edition, p. 3.

Sibbett, S. G. (1994). Edible Tree Nuts, Walnuts. Encyclopedia of Agricultural Science. 2:9 -16.

Soetan K. and Oyewo O. (2009). The need for adequate processing to reduce the antinutritional factors in plants used as human foods and animal feeds: A review. African Journal of Food Science Vol. 3 (9), pp. 223-232.

Soetan KO (2008). Pharmacological and other beneficial effects of antinutriionalfactors in plants. –A Review. Afr. J. Biotechnol. 7(25):4713-4721

Sofowara, A., (1993). Medicinal Plants and Traditional Medicine in African. Spectrum book. 2ndEd, pp: 10-158

Tchiégang, C., Kapseu, C., Parmentier, M., 2001. Chemical composition of oil from

Tetracarpidium conophorum ((Müll Arg.) Hutchand Dalz.) nuts. J. Food Lipids 8, 95–102.

Vaintraub, I. A. and Lapteva, N. A. (1988). Colorimetric Determination of Phytate in Unpurified Extracts of Seed and the Products of Their Processing. Analytical Biochemistry 175:227 - 230.

Victor N. Enujiugha 2009 Isolation and preliminary characterization of conophor of the African walnut – *Tetracarpidium conophorum*. Afr. J. Biotechnol. 5, 2322–2325.