



ECONOMIC, NUTRITIONAL AND MEDICINAL VALUES OF AFRICAN WALNUT (*TETRACARPIDIUM CONOPHORUM*) IN NIGERIA (Hutch. & Dalziel): A REVIEW

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ABSTRACT

*The Nigeria Walnut (*Tetracarpidium conophorum*) is a climber crop species that help in poverty reduction through improvement of the purchasing power of families and their standard of living. African walnut has proven evidence that leads to general acceptability to its protective effects against certain diseases majorly the cardiovascular disease (CDV). It has many other medicinal values such as treatment of Diabetic, maintenance of healthy bone, Anti-malarial, diseases prevention, pregnancy protection and sperm improvement, weight management and so on. The consumption of this fruit is not only effective for the health of man but contributes to other lifestyles characteristics backed up by evidence from certain scientific investigations. However, the challenges facing its year round availability have not been fully documented and data related to its contributions to livelihoods of rural farmers and its nutritional value is not readily available to the populace, thereby places the plant in danger of genetic extinction and disappearance which have the potential to restrict its development options. Therefore, this paper reviewed the monetary contribution of African Walnut, its potential roles in poverty reduction, commitment to national advancement and value added exports from Nigeria, hence the investigation is expected to bridge some of this gap, giving an overview of the present information encompassing the economic commitment of Walnut, its nutritional and medicinal values in Nigeria.*

Key words: Economics, Nutrition, Medicinal Benefits, Chemical composition, Walnut

INTRODUCTION

Origin of African Walnut

The African Walnut, scientifically known as *Plukenetia conophora* or *Tetracarpidium conophorum*, is from *Euphorbiaceae* family and has a long history as occasional natural fruits. It is an incredible plant originated from the tropical West African nations of Sierra Leone to Angola; Nigeria and different nations in West Africa. The African Walnut is generally produced in the western and eastern parts of Nigeria and is additionally indigenous to Cameroon, Central African Republic, Congo, Gabon and Niger (Janick and Paul 2008). Its

range in Nigeria incorporates Uyo, Akamkpa, Akpabuyo, Lagos, Akure, Kogi, Ajaawa, Ogbomosho, Ibadan (Obianime and Uche, 2010; Oke 1995), Ife, Ekiti and Ijeshaland. African Walnut is known as *Asala* in Yoruba land, *Ekporo* by Efik and Ibibios of Cross River and Akwa Ibom, as *Ukpa* in Ibo, *Okwe* in Edo and Gwandi, *Bairi* in Hausa (Akupuaka and Nwanko, 2000). It is bounteous in all cocoa-producing states in Nigeria and in the southern part of Nigeria (Nwaichi *et al.* 2017; Udedi *et al.* 2014).

Lack of storage facilities has hampered the market value of the walnut due to this observation the nuts

must be consumed within 1–2 days when cooked or else they will become foul-smelling and unpleasant for sale and consumption (Kanu et al. 2015). The seeds are consumed as snacks and refreshments. It is a perennial cash crop and an economic tree that is widely grown for its edible seed nut (Chijoke et al. 2017; Edem et al. 2009; Enujiugha and Ayodele 2003).

Morphology of *Tetracarpidium conophorum*

African Walnut is a little tropical blooming plant, a woody perennial climber or climbing plant of around 6 m – 18 m long on fulfillment of the conceptive stage. Its stem can be up to 16 cm in size and it is dark grey when old, yet is it green and glabrous when young (Nwachoko and Jack 2015). The root is fasciculate and the leaf ranges between 10 cm long and 5 cm broad while the petiole might be up to 5 cm long (Ekwe and Ihemeje 2013; Janick and Paul 2008). Moreover, the leaf is simple, crenate and ovate with a serrated edge. They are rounded at the base with alternate leaf arrangement and suddenly taper (Ekwe and Ihemeje 2013; Janick and Paul 2008). For the most part, the Walnut stems twines around different trees for support, particularly the cocoa tree and kola nut tree (Oyekale *et al.*, 2015). The climber bears capsules which are greenish in colour when young and greenish/yellow when completely matured; they contain four to five shelled seeds with darker shell and white parts. African Walnut is a source of palatable nuts and is traditionally eaten as nut after boiling (Akpuaka and Nwankwo, 2000). The plant ascends to the tops to benefit from full daylight and it might tie trees together with the end goal that in the event that one of the trees dies, it is held in position until it decays (Bailey 2006). African Walnut usually blossoms around November and early January and fruits around February and September with high production in July (Oyekale *et al.*, 2015). The seed takes 4–6 months to develop (Akpuaka and Nwankwor, 2000). Figure 2 and 2 show African Walnut fruits and plant.



Figure 1: African Walnut Fruits



Figure 2: African Walnut Plant

Economic Importance of Walnut in Nigeria

It is apparent that the notoriety of African walnut is increasing as market request is expanding Nationwide; the potential benefits of nut are improving the purchasing power of families, their living condition and the battle against rural poverty, although Walnut has not been completely perceived and produced for industrial use in Nigeria. As indicated by Babalola (2012), neither the producers nor the marketers engaged in direct sale of the item. The town vendors move from town to town and market to market to purchase the available raw nuts (Babalola, 2009). Walnuts are majorly consumed in the city. Despite its present low industrial utilization, Onwualu (2013) stipulated that tiger nut and walnut can get Nigeria over ₦100 billion every year and create direct employment for over 5,000 individuals, if the value chain for production, handling, processing and marketing of the commodities are appropriately developed.

According to Onwualu (2013), there is high market for walnut as the Western and Southern Nigeria. For large scale production of Walnuts in Nigeria, the rural farmers should be encouraged through provision of adequate inputs, incentive and credit facilities. Despite the current low productivity however, the socio-economic contributions of African walnut to farmers and other stakeholders can be seen as an opportunity to conserve indigenous trees under which it grown (Babalola, 2012).

Dietary and phytochemical constituents of Africa Walnuts

Nwaoguikpe *et al.* (2012) investigated the phytochemical and biochemical composition of various walnuts (boiled and crushed wet nuts and dried powdered nuts). Saponins (8.37, 5.03 mg/kg) were the highest constituent of the pounded wet nuts and the dried powdered nuts, respectively. This proposed the role of the nuts in health and nutrition. Ekwe and IHEMEJE (2013) reported the proximate composition of the African walnut on wet basis, contained protein (14.92%), oil (45.84%), raw fibre (1.14%), debris (3.52%) and carbohydrate (15.38%), while the anti-dietary components contained tannins (0.89 mg/100 g), oxalate (1.28 mg/100 g), phytic acid (3.105 mg/100 g), trypsin inhibitors (1.84 mg/100 g), saponin (985.0 mg/100 g) and alkaloid (40.91 mg/100 g).

Arinola and Adesina (2014) stated that the nut is a good source of protein and fat but when boiled the protein, ash and raw fibre content of the nut continuously diminished. Additionally, Akpogheli *et al.* (2016) assessed the nutritional content of walnut seed (*P. conophora*) and reported that the crude seed contains ash (3.18%), moisture (39.27%), unrefined fiber (8.40%), fat (5.19%), protein (20.74%) and sugar (23.22%), while the mineral content revealed K (4029.14 mg/kg), Na (3480.00 mg/kg), Ca (3014.28 mg/kg), Mg (726.11 mg/kg), Fe (68.00 mg/kg), Zn (24.01 mg/kg), Mn (19.00 mg/kg) and Cu (14.00 mg/kg). Chijoke *et al.* (2015) reported the seed nut to contain alkaloids (2.29 mg/100 g), glycoside (2.19 mg/100 g), saponins (8.07 mg/100 g), flavonoids (0.02 mg/100 g), tannins (0.89 mg/100 g), reducing sugars (4.10

mg/100 g) and soluble carbohydrate (1.06 mg/100 g). The nut likewise revealed high moisture content (31.40%), debris (6.01%), fiber (8.66%), protein (28.85%), starch (21.30%) and high energy value (234.57 kcal). The mineral and nutrient constituents of the seed were likewise recorded by Nnorom, Enenwa and Ewuzie (2013). Udedi *et al.* (2013, 2014) revealed near proximate analyses of crude and cooked walnut and noticed that the nut is a great food material with potential in combating food insecurity in rural communities. They recommended the nut as a supplement to school children feeding programmes. The detailed major bioactive mixes found in *T. conophorum* incorporate phenols (7.44 mg/mL and 7.04 mg/mL), flavonoids (3.5 mg/mL and 1.66 mg/mL) and ascorbic acid (54.56 mg/kg and 44.00 mg/kg) for raw and cooked walnuts, respectively.

The outcomes demonstrated that the unrefined protein, starch and raw fiber contents of the crude seed were altogether higher than the cooked seed nuts however, the hydrogen cyanide and steroid content of crude seed nuts was higher than the cooked seed nuts. The hematological parameters in the rodents had a significant reduction in white blood cell (WBC) and lymphocytes when compared with the control group of rodents set for the experiment. Chikezie (2017) likewise analyzed the phytochemical and proximate composition of boiled walnut seeds and observed a high concentration of alkaloids, steroids and a moderate concentration of tannins without the presence of saponins, phlobatannins, flavonoids, phenols or glycosides. Barber and Obinna-Echem (2016) surveyed the nutritional composition, physical and tangible properties of wheat–African walnut cookies and prescribed that the African walnut flour could be utilized effectively as a partial substitute for wheat flour at a range of 5% – 15%. Onawumi *et al.* (2013) completed proximate analysis on the leaf *T. conophorum*, which contained moisture (29%), fat (5.63%), fiber (14.92%), protein (16.62%), ash (12.89%) and starch (20.94%).

The optional metabolites revealed high alkaloid content (2.670 mg/kg) and low tannin content (0.56 mg/kg). Ayoola *et al.* (2013) reported on a

comparative analysis of the phytochemical and supplement synthesis of the leaves and seeds of *T. conophorum* and noticed that the seeds have more nourishing and essential composition than the leaves. The phytochemical constituents present in the seeds are additionally present in the leaves. Suara *et al.* (2016) assessed the nutraceutical properties of the methanol concentrate of *P. conophora* leaves and reported some mineral components. The result showed that proximate analysis was 6.86% moisture content, 11.78% protein, 8.57% complete ash, 20.12% unrefined fiber, 1.56% total fat and 51.8% total carbohydrate. The study concluded that the leaves can served as an anti-venom agent because of its relatively high content of cardiac glycosides, alkaloids, saponins and phenols, which are active substances for detoxification of venoms in the human system (Bowsher, Steer & Tobin 2008). Uhunmwangho and Omoregie (2017) assessed the nutrition and anti-nutrition contents just as mineral content of walnut seed oil at various phases of fruit maturation. This investigation revealed the nourishing profile of the fruit-nut of walnut as a good source of plant protein, carbohydrate and fat, with a decrease in the degree of some anti-nutrients in matured fruits. Findings from –investigation by Isong *et al.* (2013) on Africa Walnuts proposes that it is a non-drying oil suitable for paint and soap making as well as other industrial purposes. The results revealed that the oil has potential as a source of biofuel when compared with commercial graded diesel. Also, the free fatty acid (9.47%) and ester (89.74 mg KOH g⁻¹) content suggests its suitability as edible oil while the high acid (87.22 mg KOH g⁻¹) and low peroxide (9.67 meq O₂ g⁻¹) content indicates high susceptibility to rancidity and low antioxidant levels.

Antimicrobial properties of Africa Walnuts

Akinwande (2015) reported the presence of antimicrobial activities in the leaves of *T. conophorum* to possess phytosterols (triterpenoids) – 3 β , 22E-stigmata-5, 22-dien-3-ol and 3 β -hydroxyolean-12-en-28-oic acid. Suara *et al.* (2016) further established antimicrobial properties in *P. conophora* methanol leaf extract which was active against *Bacillus subtilis* and *Proteus mirabilis* that

are causer agents of skin diseases. Ogbolu and Alli (2012) proposed that walnut has no in-vitro antibacterial activity on Gram-positive and Gram-negative microbes. These finding negates the reports of Ajaiyeoba and Fadare (2006) that methanol concentrate and its fractions displayed concentration-dependent antimicrobial properties, which were carried out in the same geographical locations.

Toxicological properties of Africa Walnuts

Akomolafe *et al.* (2017a) reported that the watery concentrate of *T. conophorum* leaves in rodents did not reveal any pathological changes even at 2000 mg/kg. Agbaje *et al.* (2016) studied the intense and sub- chronic toxicity studies of the aqueous concentrate of the new nuts of *T. conophorum* and reported that there was no mortality at a 2 g/kg dosage. It was presumed that the concentrate could be hepato-protective and perhaps fill in as an immunostimulant. In a study by Oladiji *et al.* (2010) on the poisonous quality of a *T. conophorum* nut oil-based diet in rodents, there was a decrease in the activity of Alkaline phosphatase ALP, glutamic oxaloacetic transaminase (GOT) and glutamic pyruvic transaminase (GPT) in the liver and heart of the animals fed the nut oil-based diet. Bello *et al.* (2014) evaluated the hematological and biochemical changes in African catfish fed a diet supplemented with *T. conophorum* leaf and onion bulb and reported no traces of infections of anaemia during the fish culture. It was recommended that the extract of the walnut leaf and onion bulb could be useful in stimulating immune responses.

Presence of Antioxidants in Africa Walnuts

A study reported by Akomolafe *et al.* (2015a) showed that anti peroxide activity of the leaves of *T. conophorum* was seen to diminish malondialdehyde (MDA) level in reproductive organs and accessory organs of rodents. Adult male rodents were managed orally with the watery leaf extract from *T. conophorum* at 50, 500 and 1000 mg/kg body weight for 21 continuous days while clomiphene citrate (1.04 mg/kg body weight), The results of the study indicated that there was increment in relative organ weight, body weight, average total food and water consumed by the treated groups of rodents.

Kanu and Okorie (2015), reported that extract from *T. conophorum* leaves had more capacity to diminish lipid peroxidation in conceptive organs and frill organs. In this way, the plant might be valuable in the treatment of reproductive cellular damage.

Disease Preventive properties of Africa Walnuts

Omega 3 and Omega 6 are two fundamental fatty acids required by the body for cell development, immune function, bloodclotting and disease prevention which the body can't make alone, (Gourmetguide,2014) These fatty acids are provided by walnuts. The body needs requires two basic Omega-3 fatty acids (eicosnpentaenic acid called EPA and docosa hexaenoic corrosive called DHA). Akpoghelie *et al.* (2016). Walnut contains an antecedent Omega-3, called apha-linoleic acid (ALA) which coverts EPA and DHA. About 28g of walnuts gives 18g of total fat of which 13g are PUFA and 2.5g are ALA (NW, 2014).

Anti-malarial properties of Africa Walnut

Dada and Ogundolie (2016) evaluated the in vivo anti-plasmodial activity of the raw seed concentrate of *T. conophorum* in Swiss albino mice infected with Plasmodium berghei, revealing portion dependent action on chemo- suppression. A portion of 600 mg/kg had the most at 47.22%, while chloroquine at 5 mg/kg produced 55.50% chemo-suppression. This recommended that the walnuts seed nut could be helpful in the treatment of malaria. A report by Ogundolie *et al.* (2017) on the impact of the ethanol seed extract of *T. conophorum* on the hematological and histopathological parameters of Swiss albino mice infected with *P. berghei* (NK65) proposed an increased in the hematological parameters, packed cell volume (PCV), red platelets (RBC), hemoglobin (HGB) and platelet (PLT) of every single treated groups of rats. The histology of the seed extract of Africa walnuts at 400 mg/kg demonstrated a restorative effect on the liver and kidney of the mice however at 600 mg/kg there was regenerative tissues on the kidney yet affected the liver. It was concluded that 400 mg/kg of the seed extract of *T. conophorum* might be viewed as suitable to treat human malaria infection.

Pregnancy Protection and Sperm Quality Improvement properties of Africa Walnuts

Walnut fights off sickness during pregnancy and boost brain development in the child, Akomolafe *et al.* (2015b). Harvard School of Public Health Nutritionists reported that utilization of peanuts and tree nuts during pregnancy may diminish the danger of hypersensitive sickness improvement in children (NW, 2014). Likewise, scientists from University of California, Los Angeles (UCLA) revealed that consumption of about 75g of walnut could help improve sperm quality due to the alinoleic acid and Omega-3 that it contains. These boosts sperm vitality, versatility and morphology. Nwauzoma and Dappa (2013) reported ethnobotanical uses of *T. conophorum* seed in the treatment of fibroids; the boiled seeds are also eaten to improve sperm count in men while the leaf juice is used to improve fertility in women and regulate menstrual flow.

Anti-cancer properties of Africa Walnuts

Tchiegang *et al.* (2001) reported that *T. conophorum* is a potential source of macro-minerals and trace elements to man because of its substance of calcium, sodium, potassium and phosphorus and so forth, Research has shown that walnut has anticancer activities. The cancer prevention properties of walnut helps to lower the danger of ceaseless oxidative pressure, and the anti-inflammatory properties help incessant oxidative pressure inflammation. Studies demonstrated that the hazard prostrate and breast cancer are reduce by walnut consumption Nwaoguikpe R.N, and Ujowundu C.O. (2016). Walnut contains polyphenol ellagitannins which certain microorganisms in the gut convert to urolithins. Urolithins is a property that has anti-inflammatory assist them with capacities that secure against colorectal disease. Urolithins also reduce the danger of hormone-related tumors like breast and prostate cancer. A research conducted in the Department of Chemistry, Ladoke Akintola University, Ogbomosho, indicated that the high ascorbic acid content found in the walnut seeds can be used to prevent or at least minimize the formation of carcinogenic substances from dietary material.

Weight Management properties of Africa Walnuts

An ounce of walnut contains 2.5g of Omega-3 fats, 4g of protein and 2g of fiber that give satiety, this aids weight management program as satiety is a significant factor in weight the management plan (NW, 2014). A scientific supplement database shows that 100 grams of shelled African walnuts contain 13.14g of carbs and zero cholesterol which makes it excellent for reducing overweight. (Finelib.com, 2016)

Energizing properties of Africa Walnuts

Aladeokin and Umukoro (2011) evaluated the psychopharmacological properties of a fluid concentrate of the *T. conophorum* nut in mice and with oral administration at 50 mg/kg – 200 mg/kg produced a significant dose-related decrease in the duration of immobility in the constrained swim test. The tested dosages did not delay the span of rest produced by thiopentone nor modify the pattern of the stereotyped actuated by the amphetamine. It was observed that the nut extract showed stimulant like activity.

Diabetic properties of Africa Walnuts

Onwuli *et al.* (2014); Ogunyinka *et al.* (2015) reported that the nuts can possibly reduce hyperglycaemia. The authors likewise reported that Africa Walnuts increased the hemoglobin level and decreased urine output in the experimental group when contrasted with controls and could forestall diabetes related with renal damage. Walnuts help to control excess weight by lines decreasing the danger of high glucose and diabetes. Ogbonna *et al.* (2015) confirmed that eating African walnuts on regular basis assists to reduce the danger of hyperglycemia, high glucose which is the significant reason for type-1 and type-2 diabetes mellitus. Ogbonna *et al.* (2013) indicated a significant decrease in blood glucose level and proposed that the leaf and the root extracts of *T. conophorum* are progressively active in bringing down blood glucose in alloxan- induced diabetic rodents when compared and oral hypoglycaemic agents. Experiments have shown that African walnut is outstanding amongst other natural products for individuals that need to keep up a

healthy blood sugar level and prevent the risk of obesity.

Anti-lipidemic properties of Africa Walnuts

Ezealisiji *et al.* (2016) provided details regarding the anti-cholesterol activity of the ethyl acetic acid derivation and n-hexane extracts of the *T. conophorum* seed and indicated that a 2.00 mg/kg portion of the two extracts decreased low density lipoprotein (LDL) and increased high density lipoprotein (HDL) cholesterol when contrasted and atorvastatin (a standard cholesterol- lowering agent), which could be credited to the oleic acid and α -linolenic acid. Analike *et al.* (2017) examined the effects of cooked walnuts on blood lipids, lipoprotein and glucose among adult Nigerians. There was a significant decrease in plasma cholesterol, triglycerides, LDL-C and the LDL-C/HDL-C proportion of the subjects when compared with their baseline values. It was concluded that the decrease could forestall hyperlipidaemia intricacies and furthermore improve lipid digestion and metabolism.

Usefulness of Africa Walnuts for healthy Bones

African walnut contains anti-inflammatory properties that help to forestall bone fiery sicknesses. Different supplements, for example, calcium and potassium are significant bone-density minerals that help to improve bones quality and limit the dangers of bone diseases, for example, osteoporosis, Kanu, *et al.* (2015)

Other Restorative and medical advantages of Africa Walnuts

Tetracarpidium conophorum promotes quality rest. Anosike *et al.* (2015) reported that Walnut can be utilized for treatment of the gastrointestinal tract, and helps reduce premature deliveries in pregnant women because it has culinary purposes, for example, soup preparation; it can boost cognitive function because of the presence of vitamin B6 and omega-3 unsaturated fats and furthermore helps as an anti-ageing agent (Global Food Book 2015). Walnuts have multitudinous health advantages. The seed has various utilizations ranging from weight management to prevention and slowing of various cancers. The plant has

innumerable advantages as phytochemical analysis of the nuts, leaves and roots demonstrated that it has bioactive compounds, for example, as oxalates, phytates, tannins, saponins, alkaloids, flavinoids and terpenoids Ayodele, 2003; Onawumi, 2013; Ayoola, 2013.

CONCLUSION AND RECOMMENDATIONS

An African walnut (*Tetracarpidium conophorum*) has demonstrated proof that prompts general acceptability to its defensive impacts against specific diseases significantly the cardiovascular diseases (CDV). The African walnut should be investigated for the production of walnut flour and

cake for diet-based (diabetes, hypertensive) patients in view of its extraordinary potential. It is advised to be incorporated as part of the daily diet since it has a scope of balanced nutrition such as vitamins, dietary fiber, basic minerals and vitamins just as some plant compounds. The production, propagation and cultivation should be stretched out to different parts of Nigeria and Africa, which could support food security and reduce poverty in Africa. Additionally, its separation, characterization and basic clarification of the chemical compounds in the leaf, stem bark and seed nut should be measured in perspective on producing drugs that could be useful in battling numerous maladies and diseases.

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