Specialty Journal of Pharmacognosy, Phytochemistry, and Biotechnology
ISSN: 3062-441X
2021, Volume 1, Page No: 28-34

Available online at: www.galaxypub.co/page/journals

Galaxy Publication

Health Benefits and Nutritional Profile of *Tetracarpidium conophorum* (Nigerian Walnut)

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Received: 01 March 2021; **Revised:** 19 May 2021; **Accepted:** 19 May 2021

ABSTRACT

The popularity of Nigerian walnuts (*Tetracarpidium conophorum*) for dietary and medicinal purposes has surged, leading to a scarcity in the markets where they are sold. This study explores the walnut's classification, characteristics, phytochemical composition, nutritional value, and therapeutic properties. There is an increasing trend in research focused on leveraging Nigerian walnuts for drug development. The walnut has shown potential in areas such as antioxidant, anti-inflammatory, anti-chelating, and blood pressure regulation. It also possesses anti-lipidemic, anti-diabetic, anti-malarial, antimicrobial, antibacterial, and anticancer qualities. Furthermore, it has been noted to enhance reproductive health by boosting sperm count and quality, promoting wound healing, and alleviating ulcers and stomach issues. The walnut's benefits extend to energy enhancement, weight management, disease prevention, and support for bone and tissue repair. This positions it as a valuable resource in alternative and complementary medicine. The striking similarities between Nigerian walnut and bitter kola in their dietary and medicinal properties call for more in-depth studies. Drug developers and researchers should continue to explore its potential in creating novel treatments for diseases that are difficult to manage globally.

Keywords: *Tetracarpidium conophorum*, Nutritional profile, Nigerian walnut, Health benefits

How to Cite This Article: Obeta U, Lawrence A, Akram M, Khan FS. Health Benefits and Nutritional Profile of *Tetracarpidium conophorum* (Nigerian Walnut). Spec J Pharmacogn Phytochem Biotechnol. 2021;1:28-34. https://doi.org/10.51847/PZn2siPatx

Introduction

The popularity of Nigerian walnuts (*Tetracarpidium conophorum*) for dietary and medicinal purposes has surged, leading to a scarcity in the markets where they are sold. This study explores the walnut's classification, characteristics, phytochemical composition, nutritional value, and therapeutic properties. A thorough literature review provided significant findings on the nutritional and medicinal uses of Nigerian walnuts [1-8]. These findings encompass aspects such as local names, phytochemical properties, physical and chemical characteristics, and visual representations, as shown in **Figures 1-3**.

Results and Discussion

Local names of walnuts in Nigeria

The walnut's scientific name is *Tetracarpidium conophorum*, and it is commonly known as Nigerian walnut or African walnut due to its origin in *Juglan nigra* in the Juglandaceae family. Despite its common name, different ethnic groups in Nigeria assign various names to the walnut based on their respective cultures and regions. For instance, it is called Ukpa in the Igbo language, Ukwa in the Igala and Idoma regions, Ekporo by the Efik and Ibibio, Okhue or Okwe by the Edo people, Gawadi bairi in Hausa, and Awusa or Asala among the Yoruba [5, 7, 8].

Description of the walnut

Tetracarpidium conophorum has a long history of cultivation as a food crop in West Africa, particularly in Guinea, as well as in West and Central Africa. The plant's capsules are initially green and turn greenish-yellow as they mature. The leaves are approximately 53 inches wide and 3 inches long, arranged in a rotational pattern. The taste of the walnut is described as a combination of hard fruit and eucalyptus. The seeds mature within 4 to 6 months and are typically available in local markets between June and September. It is believed to have originated in the southwestern part of Africa, and it is primarily cultivated on small-scale farms and gardens for local consumption. As a climbing plant, it grows between 6 to 18 meters tall and often climbs onto taller trees to access more sunlight. The walnut's stem can reach over 70 meters in height, thriving in warm climates. Its roots are strong, and its leaves are oval-shaped, measuring around 10 cm by 5 cm, with serrated edges and three prominent nerve lines. The petioles of the leaves can extend up to 5 cm long [9].

Research by Ndukwu and Ejirika [10] further described the physical properties of Nigerian walnuts, including their water content (28.2%), mass (5.5-6.5 g), shell thickness (0.135 ± 0.04 cm), core mass (4.22 ± 0.26 g), and core water content (28.9%). The walnut has a porosity of 45%, a grain density of 0.815 g/cm^3, and a grain area of 15.41 cm^2. These physical attributes impact the walnut's behavior, including its water content, growth area, and grain size variability. The fruits of the walnut tree are shown in **Figure 1**, with ripe and dried fruits displayed in **Figures 2 and 3**.

Figure 1. The African Walnut seed is in the process of maturation.

Figure 2. Ripped African Walnut seed showing the internal structure.

Wild berries are cultivated in traditional farming systems, primarily in the tropical lowland areas. These plants are adaptable, and capable of thriving in various soil types, provided the soil is well-drained and able to retain moisture. The tree is deciduous, usually with few branches, and sometimes appears in the shape of a candelabra. The seeds are encased in a capsule measuring 6-10 cm in length, which contains a small, subglobular seed that measures 1-1.5 cm. The seed has a thin brown shell, resembling that of a small nut, which is reflected in its English name [11].

The term "peanuts" is used for plants within the genus *Juglans* (family Juglandaceae), particularly the Persian or English walnut (*Juglans regia*). Technically, nuts are defined as fruits with hard shells or coverings, which distinguishes them from vegetables. Walnuts are commonly used in cooking either as immature green nuts or fully ripened fruits. *Juglans nigra* (black walnut) and *Juglans cinerea* (butternut) are known for their smaller kernels. Walnuts are a rich source of essential proteins and fatty acids.

In addition to the nuts themselves, research has highlighted the importance of other parts of the African walnut tree for their medicinal and therapeutic properties [12].

Figure 3. Displays a fully matured walnut seed encased in its shell.

Characteristics of Nigerian walnut

The walnut fruit is round with a single, thick wall, typically consumed when ripe. After proper cooking, the husk is removed, revealing the walnut shell, which is typically wrinkled and may show distinctive marks on both sides. As the walnut matures, the shell becomes rigid and cracks open, signaling its readiness for harvest. The core of the walnut is usually divided into two parts by a partition, and the internal cells resemble the structure of the shell. Walnuts are often dipped in brown beans, which contain antioxidants that help preserve the oils in the nuts by preventing oxidation and acidity [7].

Walnuts do not grow beyond mid-spring and contain natural chemicals in the soil that prevent weed growth. As a result, it is advised not to plant flowers or other crops near walnut trees. Walnuts consist of 14% carbohydrates, 15% protein, 4% water, and 65% fat, with 7% fiber content [8, 13].

Walnut storage

Proper storage is crucial for preserving the quality of walnuts, much like other fruits. When walnuts are not stored correctly, they become susceptible to insect infestations and fungal diseases, which may lead to the production of aflatoxins, known carcinogens. Therefore, the beans must be removed entirely to prevent such risks [5].

The optimal storage temperature for walnuts ranges from -3 to 0 °C (27-32 °F) in conditions of low humidity for both domestic and commercial purposes. However, in developing countries where walnuts are produced in large quantities, such cooling infrastructure is not always available. In these regions, the best storage temperature for walnuts is up to 25 °C (77 °F). High temperatures above 30 °C (86 °F) and humidity exceeding 70% can accelerate spoilage and cause severe damage. If the humidity exceeds 75%, it can foster the growth of fungi that produce aflatoxins [7, 14].

Phytochemical properties of Nigerian walnut

The *Tetracarpidium conophorum* plant, although not widely known, offers significant health benefits. Phytochemical analysis of its roots and leaves reveals compounds such as oxalates, phytates, tannins, alkaloids, flavonoids, and terpenoids. These compounds contribute to the medicinal value of the plant, making it useful in traditional herbal remedies [12].

Research by Nowajkbe *et al*. [15] found saponins in boiled and dried walnut nuts, with concentrations of 8.37 mg/kg and 5.03 mg/kg, respectively. The seeds contain 14.92% protein, 45.84% oil, 1.14% crude fiber, 3.52% micronutrients, 15.38% carbohydrates, and various other bioactive compounds such as 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), saponins (985.0 mg/100 g), and alkaloids (40.91 mg/100 g).

Arinola and Adesina [16] reported a reduction in protein, fat, ash, and intestinal contents in cooked Nigerian walnut seeds. Akpogheli *et al*. [17] identified 3.18% ash, 39.27% water, 8.40% fiber, 5.19% fat, 20.74% protein, and 23.22% sugar in the nuts. The mineral content includes 4029.14 mg of potassium per kg, 3480.00 mg of sodium per kg, 3014.28 mg of calcium per kg, 726.11 mg of magnesium per kg, 68.00 mg of iron per kg, 24.01 mg of zinc per kg, 19.00 mg of manganese per kg, and 14.00 mg of copper per kg. Chijioke *et al*. [18] also found that Nigerian walnuts contain alkaloids (2.29 mg/100 g), glycosides (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 carbohydrates

(1.06 mg/100 g). Additionally, the walnut has high water content (31.40%), nutrients (6.01%), fiber (8.66%), proteins (28.85%), starch (21.30%), and an energy value of 234.57 kcal [19].

According to Udedi *et al*. [20], phenols (7.44 mg/ml for raw and 7.04 mg/ml for ripe walnuts), flavonoids (3.5 mg/ml for raw and 1.66 mg/ml for ripe), and ascorbic acid (54.56 mg/kg for raw and 44.00 mg/kg for ripe) were also detected in Nigerian walnuts. Onawumi *et al*. [21] identified water (29%), fats (5.63%), fiber (14.92%), proteins (16.62%), ash (12.89%), starch (20.94%), alkaloids (2670 mg/kg), and microtannins (0.56 mg/kg) in the walnuts.

Nutritional and medicinal properties of Nigerian walnuts

Nigerian walnuts are available in two forms: shelled and unshelled. Depending on their preparation, walnuts may be whole, partially split, or entirely broken. While they are most commonly cooked, walnuts can also be used in a variety of recipes. For instance, pickled walnuts can be either sweet or salty, depending on the type of pickling solution used. Peanut butter, whether homemade or commercially available, can be made using raw or cooked walnuts. Walnuts are versatile and can be eaten by themselves (either raw, roasted, or pickled), added to muesli mixes, or served as a side dish, such as in peanut bread or soup, both of which benefit from the addition of walnuts [18].

According to Barber and Obinna-Echem [22], Nigerian walnut flour is a superior alternative to wheat flour due to its beneficial nutritional content. Walnuts are commonly used as ingredients in dishes like bean curd, ice cream toppings, and as garnishes in various meals. Additionally, Nicino, an alcoholic beverage, is created by fermenting green walnuts with alcohol. Walnut oil is also widely available, particularly for use in salad dressings, although its low smoke point limits its use for frying [5, 7].

When it comes to nutrition, 100 grams of walnuts provide 654 calories (2,700 kJ) along with a rich array of minerals and vitamins, including significant amounts of manganese, vitamins B1, B2, B3, B5, B6, B12, C, and E, as well as niacin, arginine, and selenium. Other notable nutrients found in walnuts include omega-3 fatty acids, polyphenols, zinc, calcium, phosphorus, potassium, sodium, carbohydrates, and proteins [5, 8].

Several studies have also highlighted the medicinal benefits of Nigerian walnuts. For instance, the plant has been found to play a role in wound healing, a process where tissues regenerate after injury. Research has shown that treatment with *T. conophorum* promotes faster healing of wounds when applied at concentrations of 5% or 10% for 8 days [23]. Additionally, the plant has demonstrated anti-ulcer and cytoprotective effects, with studies by Ezealisiji *et al*. [24] and Anosike *et al*. [25] supporting these findings.

Therapeutic uses and benefits of Nigerian walnuts

Ayoola *et al*. [26] discussed the application of Nigerian walnuts in treating gastrointestinal issues and managing high blood pressure. Nwachoko and Jack [27] also demonstrated that a hot aqueous extract of Nigerian walnuts helped shield rats from diarrhea caused by castor oil.

In terms of antimicrobial properties, Nigerian walnuts have shown potential, with both Akinwande [28] and Ajaiyeoba and Fadare [29] confirming their antimicrobial activities. A study on their chelating properties also revealed a dose-dependent reduction in chelation [30].

The anti-inflammatory properties of Nigerian walnuts have been further explored, with Olaniyi *et al*. [31] and Oladokun *et al*. [32] reporting significant inflammation reduction after walnut consumption.

Amaeze *et al*. [12] assessed the antioxidant activity of Nigerian walnut leaf extract and found that dried leaves have superior antioxidant effects compared to fresh leaves. Moreover, Akomolafe *et al*. [33] and Kanu and Okorie [8] reported a decrease in lipid peroxidation in the reproductive organs of rats, demonstrating the walnut's effectiveness in combating oxidative stress.

Walnuts help to reduce oxidative stress, which can damage red blood cells. They eliminate free radicals, support immune function, and protect against toxins from the environment and chemicals. This can also slow down aging [34].

The reproductive health benefits of Nigerian walnuts have also been examined. Akomolafe *et al*. [35] found that walnuts help prevent pregnancy complications and support the development of the fetal brain. Studies by Obianime *et al*. [36, 37] showed that Nigerian walnuts promote sperm production and quality in male guinea pigs, with similar results confirmed by Akomolafe *et al*. [38] and Ikpeme *et al*. [39]. Akomolafe and Oboh [33] noted significant improvements in biomarkers like lactate dehydrogenase (LDH) and glucose-6-phosphate dehydrogenase (G-6PDH) in the testes and epididymis. Additionally, they observed increases in serum

testosterone, LH, and FSH levels, as well as better sperm motility, count, and viability, indicating positive effects on spermatogenesis.

In contrast, Akomolafe *et al*. [40] found that alcohol consumption negatively affects male fertility, decreasing sperm count, viability, and fertility hormone levels, along with an increase in sperm abnormalities.

Nigerian walnuts are known for their disease-preventive qualities, primarily due to Omega-3 fatty acids like eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) [17]. Studies suggest that these walnuts may reduce the risk of prostate and breast cancer [15], and help manage diabetes by lowering blood glucose levels [41-43]. They also possess anti-lipidemic properties [44, 45] and contribute to bone health by promoting growth and strength [46].

The anti-malarial effects of walnut seeds have been explored, with findings indicating improved hematological parameters in malaria treatment [47, 48]. Furthermore, Nigerian walnuts are beneficial for energy and weight management due to their physiochemical composition [15-20, 46]. Additional research points to their potential in treating gastrointestinal disorders, reducing premature births, improving cognitive function, and offering anti-aging benefits, attributed to their vitamin B6 and Omega-3 content [26].

Conclusion

The Nigerian walnut is an emerging fruit with significant potential for both nutritional and medicinal use. It shares similarities with bitter kola in terms of its properties and applications. The incorporation of walnuts into the diet should be encouraged, benefiting both healthy individuals and those with health conditions. This fruit has demonstrated a range of medicinal benefits that could address various health issues.

The findings of this study reveal that Nigerian walnut exhibits antioxidant, anti-inflammatory, anti-chelating, and blood pressure-regulating properties. Furthermore, it shows anti-lipidemic, anti-diabetic, anti-malarial, antimicrobial, antibacterial, and anticancer effects. The walnut also supports reproductive health by enhancing sperm production and quality, aids in wound healing, and provides relief for ulcers and digestive disorders. Additionally, it promotes energy, weight management, and disease prevention, while contributing to bone health and tissue repair.

Ongoing research is recommended to further explore the potential of Nigerian walnuts in complementary and alternative medicine, with the hope of advancing its integration into modern medical practices.

Acknowledgments: None

Conflict of Interest: None

Financial Support: None

Ethics Statement: None

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