

## Phytochemical and Proximate Compositions of *Tetracarpidium Conophorum* [African Walnut] Seeds

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**Abstract:** A sample of boiled *Tetracarpidium conophorum* (African walnut) seeds was analyzed for the phytochemical and proximate compositions. The result of the phytochemical [qualitative] screening revealed the presence of high concentrations of Alkaloids and Steroids, and moderate concentration of Tannins. There were no traces of Saponins, Phlobotannins, Flavonoids, Phenols and Glycosides. The proximate analysis showed that the boiled seeds contained 5.5% moisture, 19.3% carbohydrate, 17.9% protein, 53.4% crude fat, 1.24% crude fiber and 2.67% ash. Data from this study showed that the boiled *Tetracarpidium conophorum* seeds contain some bioactive compounds and have good nutritional composition. They could be useful in pharmaceutical formulations and as food.

**Keywords:** Boiled *Tetracarpidium conophorum* seeds, Phytochemical screening, Proximate analysis, Bioactive compounds, Food nutrients.

### 1. INTRODUCTION

The plant, *Tetracarpidium conophorum* (Mull. Arg) Hutch & Dalziel Syn. *Plukenetia conophora*, commonly called African Walnut, belongs to the family Euphorbiaceae [GRIN, 2010] and the genus *Plukenetia*. It is also called Nigerian walnut, Black walnut or Conophor. *Tetracarpidium conophorum* is a perennial climbing shrub, 10 – 20 ft long, often found in most forest zones of sub – Saharan Africa. It is not related to the walnut, being so named because its nuts bear a superficial resemblance to the walnut. *Tetracarpidium conophorum* is native to tropical western and central Africa, from Togo to Congo and in Sierra Leone, and is abundant in Nigeria, Cameroon, Republic of the Congo and the Democratic Republic of Congo. It prefers rain forest hedge in half-shady places; low bush; secondary forest; plantations at elevations from 250–1,400 m (820–4,590 ft), and produces stems usually 3–15 m (9.8–49.2 ft) long, though they can be up to 30 m (98 ft) long [Wikipedia, 2016]. Black walnut grows best on moist, deep, fertile, well drained loamy soils, although it also grows quite well on silty clay, loam soils [Williams, 1990; Cogliastro *et al.*, 1997]. It is a light-demanding species, requiring full sun to grow well [Brinkman, 1974].

*Tetracarpidium conophorum* is known in southern Nigeria as “ukpa” [Igbo], in western Nigeria as “awusa” or “asala” [Yoruba] and is known as “kaso” or ngak” in the littoral and western Cameroon [Dalziel, 1937]. It is known in northern Nigeria as “gawudi bairi” [Hausa]. In Nigeria, *Tetracarpidium conophorum* is found in Lagos, Uyo, Akamkpa, Akpabuyo, Kogi, Ajawa –Ogbomoso and Ibadan [Ayoola *et al.*, 2011]. The plant is cultivated principally for the nuts which are cooked and consumed as snacks [Oke, 1995]. The nut is an excellent source of protein and provides high food energy value [Nwaoguikpe *et al.*, 2012; Ojobor *et al.*, 2015]. The seed/nut is thin-shelled and about 25 mm (0.98 in) long. It is contained in a pod which may house one-shelled nut [single], two-shelled nut [double] and three-shelled nut. The walnut shells could be black or brown from the plant. The nut is whitish upon cracking from the shell. The nut has a thin layer in between two halves. [Ayoola *et al.*, 2011]. The seeds take 4 –6 months to mature and are found in the local market between the months of June and September. In Nigeria, it is traditionally eaten as nut after boiling [Akpuaka and Nwankwo, 2000].

Walnuts are shown to decrease endothelial dysfunction associated with high fat diets [Anderson *et al.*, 2001]. A study has suggested that consumption of walnut increases fat oxidation and reduces carbohydrate oxidation without affecting total consumption, suggesting that walnut consumption may

improve the use of body lipids in overweight adults. Walnut is useful in treating Rheumatism, gout, cold, kidney pain, heavy menstrual bleeding, as a blood cleanser and to expel worms [Ekhuosuehi, 2008]. 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 young leaves and shoots are edible vegetable. The leaf is useful in the treatment of cancers that grow in the neck region. They are used as tea for diarrhea, gastro-intestinal system and inflammation of the gums, mouth and throat. The root is especially good in treating piles. The bark is used in tea as laxative and chewed for toothache. It helps to prevent and control high blood pressure [Ekhuosuehi, 2008]. The oil from the nut has been used in the formulation of wood varnish, stand oil, vulcanized oil for rubber and leather substitutes. [Babalola, 2011]. Walnut shell is compatible with other materials and work well as filler in dynamite. The shell is ideal as the gritty, rough agent in soap, cosmetics and dental cleaner [Ekhuosuehi, 2008]. The shells are used as fuel in co-generation power plants and in oil-well drilling, as well as in the paint industry for making paints and varnishes.

Nwokolo [1987] reported on the impact of traditional processing on the nutrient and sensory qualities of the nut. Oke and Fafunsho [1995] studied the high nutrient potentials of the nut. Oyenuga [1997] reported the amino acid and fatty acid components of the nuts, and the use of its leaf juice for the treatment of prolonged and constant hiccups. Okpero [2001] reported on the methods of processing the *Tetracarpidium conophorum* nuts. Ayodele [2003] reported the presence of oxalates, phylates and tannin in the raw *Tetracarpidium conophorum* nuts. The proximate composition, ascorbic acid and heavy metal content of the nut were reported by Edemet *et al.*, [2009]. The effects of different methods of extraction of the walnut seeds on phytochemical constituents and on antimicrobial activities was reported by Malu *et al.*, [2009]. Obianime and Uche [2010] reported the effects of aqueous extracts of the seeds of *Tetracarpidium conophorum* on hormonal parameters of male guinea pig. Oselebe *et al.*, [2010] studied the physiochemical and pasting characteristics of defatted and undefatted flours derived from African Walnut [*Tetracarpidium conoforum*]. Amaeze *et al.*, [2011] evaluated the antioxidant activity of *Tetracarpidium conophorum* (Mull. Arg) Hutch & Dalziel leaves. The root of *Tetracarpidium conophorum* was reported to be a potential source of useful drug formulation due to the fact that it contains important bioactive components [Ayoola *et al.* , 2011]. Bello *et al.*, [2013] screened for the antimicrobial qualities of walnut [*Tetracarpidium conophorum* Mull. Arg] leaf and onion bulb [*Allium cepa* Linn.] extracts against six pathogenic bacteria of fish.

Ayoola *et al.*, [2011] evaluated the chemical and nutritive values of *Tetracarpidium conophorum* seeds in their locality. As yet, not much studies has been carried out on the boiled *Tetracarpidium conophorum* seeds. This research studied the phytochemical and proximate compositions of boiled *Tetracarpidium conophorum* seeds found in the locality of this study, in order to evaluate its usefulness in pharmaceutical formulations and as food.

## 2. MATERIALS AND METHODS

### 2.1. Sample Preparation

The boiled nuts were purchased from Ekeonuwa market, Owerri, in Imo State, Nigeria. The shells were removed and the nuts air-dried for seven days before milling to a coarse powder. The coarse powder was stored in an air-tight container prior to analyses.

### 2.2. Phytochemical Analysis

Phytochemical screening was done using the methods described by Ogukweet *et al.*, [2004] and Yadav and Agarwala [2011].

### 2.3. Proximate Analysis

Protein content was determined by Kjeldahl method and ash content by ignition at 550<sup>0</sup>C in a muffle furnace for four hours. Moisture content was determined by drying to constant weight at 105<sup>0</sup>C in an oven. The crude fat content was determined by Soxhlet extraction with petroleum ether as solvent, and crude fibre content by the acid and alkaline digestive methods [AOAC, 1990]. The carbohydrate content was estimated by differences, subtracting the sum of water, protein, fat, crude fiber and ash percentages from one hundred.

## 3. RESULTS

The result of the phytochemical [qualitative] screening of the boiled *Tetracarpidium conophorum* seeds is presented in Table 1. It shows that the seeds contain high concentrations of alkaloids and

steroids, while tannins were present in moderate quantity. There were no traces of Saponins, Flavonoids, Phenols, Phlobatannins and Glycosides.

The result of the proximate analysis of boiled *Tetracarpidium conophorum* seeds, as presented in Table 2 shows that the boiled seeds have high crude fat content [53.4%] and moderate quantities of carbohydrate [19.28%] and crude protein [17.9%]. This result is within the range reported by Ogunsma and Ddeboma [1983] and Osogie *et al.*, [1986]. The seeds also contain crude fibre [1.24%], crude ash [2.66%], and moisture [5.46%] [Table 2].

**Table1.** *Phytochemical composition [qualitative] of boiled Tetracarpidium conophorum seeds*

Constituents.	Bioassay.
Saponins	-
Flavonoids	-
Steroids	++
Phenol	-
Alkaloids	++
Tannins	+
Phlobatannins	-
Glycosides	-

**Key:** + = Present in moderate amount.

++ = Present in high amount.

- = No trace/ not detected.

**Table2.** *Proximate composition of boiled Tetracarpidium conophorum seeds*

Constituents.	Composition [%].
Crude protein content	17.90
Crude fat content	53.74
Carbohydrate content	19.28
Moisture content	5.46
Crude fiber content	1.24
Ash content	2.66

#### 4. DISCUSSION

Phytochemicals are biologically active compounds, found in trace amounts, which are not established nutrients, but which nevertheless contribute significantly to protection against degenerative diseases [Dreosti, 2000]. The result of the phytochemical [qualitative] screening of the boiled *Tetracarpidium conophorum* seeds shows that the seeds contain high concentrations of alkaloids and steroids, and also contain moderate quantity of tannins. Nwaogukpe *et al.*, [2012] and Ojobor *et al.*, [2015] also reported the presence of alkaloids and tannins in the phytochemical analysis of raw *Tetracarpidium conophorum* seed samples.

Alkaloids have been associated with medicinal uses for centuries, and one of their common biological properties is their cytotoxicity [Nabori, *et al.*, 1994]. Several workers have reported the analgesic [Antherden, 1969], antispasmodic and antibacterial [Stray, 1998] properties of alkaloids. This is why the seed is believed to stop asthma and is prescribed to be taken between bouts of asthma, but not for acute asthma. It is also used for the elderly as a constipation cure [Wikipedia, 2009]. Alkaloids have been implicated for its detoxifying and antihypertensive properties [Trease and Evans, 1989].

The presence of tannins in the boiled seeds of *Tetracarpidium conophorum* supports its anti-inflammatory properties and its use for healing haemorrhoids, frost bite and varicose ulcers in herbal medicine [Igboko, 1983; Maduyi, 1983]. The presence of tannins suggest the ability of this plant to play a role as antidiarrhoeic and antihaemorrhagic agent. [Asquith and Butler, 1986]. Parekh and Chanda [2007] reported that tannins are known to react with proteins to provide the typical tanning effect which is important for the treatment of inflamed or ulcerated tissues. Tannins bind to proline-rich protein and interfere with protein synthesis. Herbs that have tannins as their main components are astringent in nature and are used for treating intestinal disorders such as diarrhea and dysentery [Dharmananda, 2003].

The result also shows that the boiled seeds contain high quantities of steroids. Steroids have been reported to have antibacterial properties [Raquel, 2007], and they are very important compounds especially due to their relationship with compounds such as sex hormones [Okwu, 2001]. Ajaiyeoba and Fadare [2006] reported that the nut has been shown to cure male infertility problems. Some plant steroids are also useful for their effects when consumed by human beings, because their presence decreases the amount of cholesterol in the blood stream. [Wisegeeek, 2013].

In all, the result of phytochemical screening obtained suggests that the identified phytochemical compounds present in the boiled *Tetracarpidium conophorum* seeds could be the bioactive compounds that confer medicinal qualities to the seeds. These observations support the use of *Tetracarpidium conophorum* seeds in herbal cure remedies or traditional medicines.

The proximate analysis of the boiled *Tetracarpidium conophorum* seeds shows that the seeds have moderate quantities of carbohydrate [19.28%] and crude protein [17.90%], and high crude fat [53.4%] content. The seeds also contain crude fiber [1.24%], crude ash [2.66%], and moisture [5.46%]. Therefore the seeds have good nutritional value. The main nutritional value of legumes lies in their supply of cheap, dietary protein and calories in the developing countries of the world [USNAs, 1980]. Therefore, *Tetracarpidium conophorum* seeds could play a role, considering its crude protein [17.9%] and carbohydrate [19.28%] contents. The high crude fat content [53.74%] of the boiled seed suggests its exploitation as an oil seed. In this regard, it has been used for the generation of dry oil. [Akpuaka and Nwankwo, 2000; Tchiegang, 2001].

Ayoola *et al.*, [2011] reported the presence of vitamins, such as ascorbic acid [4.15mg/100g], tocopherol [122.57mg/100mg], and trace amounts of Vitamins B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, and B<sub>12</sub>, on a dry weight basis in the raw seeds of *Tetracarpidium conophorum* seeds.

Ascorbic acid [Vitamin C] is an antioxidant and helps to protect healthy cells from damage caused by free radicals. It helps in absorption of iron, promotes wound healing and also helps the body's immune system. The presence of ascorbic acid in the seed supports the use of the plant in herbal medicine for the treatment of skin conditions, including eczema, pruritus, psoriasis and parasitic conditions [D'Amelio, 1999]. This vitamin can also be used for the treatment of common cold and other diseases like prostate cancer [Okwu and Okwu, 2004; Okwu and Okeke, 2003]. There is also an interesting ability of ascorbic acid as an antioxidant to prevent, or at least minimize the formation of carcinogenic substances from dietary material [Hunt *et al.*, 1980].

Tocopherol [Vitamin E], also an antioxidant, protects the body from the damage of oxidation. It is important in the formation of red blood cells and the use of vitamin K [blood-clotting vitamin]. Deficiency of tocopherol causes sterility in animals e.g. rats. The presence of tocopherol in appreciable amount in the *Tetracarpidium conophorum* seeds supports its use to cure male infertility problems [Ajaiyeoba and Fadare, 2006].

Previous reports [Ayoola *et al.*, 2011], have also shown that the *Tetracarpidium conophorum* seed contain rich sources of mineral elements, such as; Calcium [4337.5mg/kg], Magnesium [1711.25mg/kg], Potassium [6250.00mg/kg], Sodium [4830.00mg/kg], Iron [110.00mg/kg], Zinc [40.10mg/kg], Manganese [22.00mg/kg], and Copper [15.45mg/kg], which are very useful in the body. The sodium and potassium content of *Tetracarpidium conophorum* seed is an added advantage, because of the direct relationship of sodium [Na] intake with hypertension in human [Dahl, 1972]. This may be the reason why the plant is used to prevent and control high blood pressure [James, 2009]. The manganese content shows that the plant can be used to protect bone disease [James, 2000]. Manganese is necessary for the functioning of the pituitary gland, the pineal gland and the brain, it promotes hepatorenal function, combats anemia and is also essential for growth [Claude and Paule, 1979]. Manganese is used in the management of diabetes [Edemet *et al.*, 2009]. The copper content is important for cellular defence and protection of the mucous membrane, is anti-anaemic and is essential for the formation of haemoglobin from iron. The presence of copper maybe responsible for the absorption of iron, it is therefore often seen with iron naturally [Claude and Paule, 1979]. The presence of zinc suggests that the seed may have some effect on the nerve function and male sterility. This supports the use of *Tetracarpidium conophorum* seeds to cure male infertility problems [Ajaiyeoba and Fadare, 2006]. Zinc is important for normal sexual development, especially for the development of testis and ovaries. It is also essential for reproduction. Zinc stimulates the activity of vitamins, formation of red and white corpuscles [Claude and Paule, 1979]; healthy functioning of the heart and normal growth [Elizabeth, 1994].

## 5. CONCLUSION

This study has shown the phytochemical [qualitative], and proximate compositions of boiled *Tetracarpidium conophorum* seeds. It revealed that the boiled seeds contain high concentrations of alkaloids and steroids, and also contain moderate quantities of tannins. These bioactive compounds could be responsible for the reported medicinal properties of *Tetracarpidium conophorum* seeds. The study has also shown that the boiled *Tetracarpidium conophorum* seeds contain moderate quantities of crude protein and carbohydrate, and a high crude fat content. Thus, the seed is a source of cheap dietary protein and calories. The *Tetracarpidium conophorum* seed also contains some essential vitamins and is a rich source of mineral elements. Therefore, this study reveals that the boiled *Tetracarpidium conophorum* seeds contain some bioactive compounds and have good nutritional value. They could be useful in pharmaceutical formulations and as food. Its high crude fat content suggests exploitation as an oil seed. Further studies should be carried out to isolate, characterize and elucidate the structures of the bioactive compounds contained in the boiled *Tetracarpidium conophorum* seeds, to elucidate their mechanism of action and use in pharmaceutical formulations.

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