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Assessment of Phytochemical, Mineral and Proximate contents of African Black Night Shade (*Solanum nigrum*) Used for Bone Fracture Treatment by Traditional Bone Healers in Ogodo, Ankpa Kogi State, Nigeria

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ABSTRACT: The objective of this paper was to assess the phytochemical, mineral and proximate contents of leaves of African black night shade (*Solanum nigrum*) using appropriate standard methods. The phytochemical constituents evaluated are flavonoid (22.05 ± 0.04), steroids (17.56 mg/100g), phenol (14.11 mg/100g), tannins (5.22 mg/100g), terpenoids (3.62 mg/100g), alkaloids (3.10 mg/100g) and saponins (1.70 mg/100g). Also, the proximate constituents evaluated are moisture (8.05 %), ash (42.00 %), crude fat (7.15 %), crude fibre (17.40 %), crude protein (22.06 %) and carbohydrate (28.54 %). Furthermore, the mineral evaluation showed potassium (424.01 mg/100g), calcium (258.00 mg/100g), sodium (179.81 mg/100g), magnesium (278.23 mg/100g), phosphorous (381.27 mg/100g), iron (14.43 mg/100g), zinc (0.81 mg/100g), copper (0.56 mg/100g), sulphur (10.73 mg/100g) and manganese (19.22 mg/100g). The high content of calcium, potassium, phosphorous and magnesium could be responsible for its bone healing potential as acclaimed by the traditional healers. Thus, the outcome of this work supports the validity of it's use in the treatment of bone fracture by traditional bone healers in Ogodo, Ankpa LGA of Kogi State. It has also unveiled its potentials for dietary supplements in our daily food intake. Thus a new theory on bone fracture treatment and management may be arrived at.

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Solanum nigrum (African black night shade) belongs to the family Solanaceae. It has received attention as a vegetable worthy of domestication to supplement the nutritional demand of both rural and central African communities. *S. nigrum* has a long history of medicinal usage, dating back to ancient times (Barnea *et al.*, 2000; Bassett and Munro, 2005). The high patronage received by traditional bone-setters has been documented in some researches. For instance, Olaolorun *et al*. (2001) revealed that eighty-five percent of patients who were presented with femoral fractures to an Orthopedic Hospital had been to traditional bonesetters (TBS) prior to going to the hospital. Also, as far as fracture and dislocation treatment in the developing countries is concern, the use of herbs has proven to be more effective especially

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in the rural areas where the available hospitals are very poor. In Ogodo Ankpa Local Government Area of Kogi State, there is no orthopedic hospital. As a result of this, people find it difficult to access orthopedic hospitals for the treatment of bone fracture and even where it is available in the neighboring states, the cost of treatment is very high. Hence, local village herbalists treat bone fracture locally using plants. Traditional medicine practitioners remains the only hope of the rural dwellers.

In spite of this popularity, the practice of traditional bone setting has been associated with unacceptable outcomes in many cases. In some instances, incantations are made on the affected area as a way of invoking the spirit of the ancestors for divine intervention and healing (Chris and Kwaja, 2011). This adds to the conflicts between traditional medicine and western medicine and thus cannot help western medicine to overcome its limitations. Even though the use of *S. nigrum* is ever increasing, very little is known about its use patterns. It is very important to document, analyze and evaluate this knowledge not only for their scientific reasons, but also for their commercial value, as ethno-medicinal uses of plants is one of the most successful criteria used by the pharmaceutical industry in finding new therapeutic agents. *Solanum nigrum* is one of the major plants involved in the healing of bone fracture by villagers of Ankpa Local Government Area of Kogi State, Nigeria**.** Therefore, the objective of this paper is to assess the phytochemical, mineral and proximate contents of leaves of African black night shade (*Solanum nigrum*) used for bone fracture treatment by traditional bone healers in Ogodo, Ankpa Kogi State, Nigeria.

MATERIALS AND METHODS

Sample collection and preparation: The leaves of *Solanum nigrum* was collected from the derived savannah vegetation of Ogodo, Ankpa LGA of Kogi State. The plant specimen was identified botanically by Mr. Momoh, T. B. at the Department of Plant Science and Biotechnology, Kogi State University, Anyigba. Fresh leaves were washed with distilled water to avoid dirt and microbial contamination. The samples were dried at room temperature. The dried leaves was grounded into powder and was used for analysis.

Qualitative Phytochemical screening: The test for alkaloids, glycosides, tannin, saponins, flavonoids, total phenol, steroids and terpenoids were carried out according to the method of Trease and Evans (2002).

Quantitative Phytochemical screening: Alkaloid, phenol, tannin, saponins, flavonoid, steroids and terpenoids were determined using standard methods of AOAC (2000) and Afolabi and Afolabi, (2013).

Evaluation of the Mineral Composition: Phosphorous, calcium, magnesium, potassium, manganese, sodium, iron, copper, sulphur and zinc were determined using absorption spectrometry as described by Dhellot *et al*. (2006) and Tatiya *et al*. (2007).

Proximate analysis: Moisture, ash, crude fibre, crude protein, lipids and carbohydrates were determined using standard methods of AOAC (2000).

Data analysis: This was carried out using SPSS version 20. Values were considered significant at $P \leq 0.05$.

RESULTS AND DISCUSSION

The results of the qualitative phytochemical composition of the ethanolic leaf extract of *Solanum nigrum* is shown in table 1. Flavonoids, phenols and steroids were highly present, tannins and alkaloids were moderately present, terpenoids and saponins were slightly present while glycosides was not detected. The phytochemical result showed that the extract was rich in phenols, saponins, flavonoids, glycosides and alkaloids. The results in this study are in consonance with earlier reports of Pronob and Islam (2012), Chinedu *et al*. (2011) and Dougnon *et al*. (2012) who noted the presence of alkaloids, saponins, tannins, terpenoids, phenols, glycosides and flavonoids in the leaves of *Solanum myricanthus, S. microcapon* and *S. nigrum*.

Table 1: qualitative phytochemical compositions of ethanol leaf extract of *Solanum nigrum*

Phytochemicals	Relative Presence
Flavonoid	+++
Phenols	+++
Saponins	+
Steroids	+++
Glycosides	ND
Terpenoids	+
Tannins	++
Alkaloids	++

Key: + slightly present, ++ moderately present, +++ highly present, ND= not detected

The results of the quantitative phytochemical composition of the ethanolic leaf extract of Solanum nigrum is shown in table 2. The highest phytochemical constituents was recorded in flavonoid (22.05 ± 0.04). This was followed by steroids (17.56 ± 0.03), phenols (14.11 ± 0.02), tannins (5.22 ± 0.02), terpenoids (3.62 ± 0.00), alkaloids (3.10 ± 0.03) while saponins showed the least phytochemical constituent (1.70 ± 0.01). In the present study, flavonoid recorded the highest phytochemical constituent. Flavonoids have been found to have a positive action on skin and bone repair. Collagen is a fundamental component of the bone matrix. Flavonoids can enhance the synthesis of collagen, contributing to the structural frame work necessary for new bone formation. Flavonoids can also influence various signalling pathways involved in bone remodelling (Estai *et al*., 2011; Burim *et al*., 2016). Alkaloids are widely exploited as pharmaceuticals, stimulants, narcotics, due to their potent biological activities. Alkaloids have pharmacological applications as anesthetics and CNS stimulants (Madziga *et al.,* 2010).

Saponins are anti-nutrient factors which interfere with metabolism of key nutrients and negatively influence their bioavailability. Saponins have also been shown to promote angiogenesis as a robust blood supply is necessary to deliver nutrients to the site of repair. This attribute is however useful in their roles as medicinal and therapeutic uses against a large number of illnesses (Okwu and Emenike, 2006). The presence of tannins in *S. nigrum* leaves accounts for their astringents properties and their physiological role in treating wounds (Sodipo *et al*., 2008) as well as curbing hemorrhages and restrict bare swellings. Tannins are known to possess antioxidant and antibacterial, as well as anti-inflammatory properties (Mensah *et al*., 2013). The leaves of *S. nigrum* also contained phenols and they have been shown to possess antibacterial, antiviral, anti-mutagenic and anti-carcinogenic properties (Monach *et al*., 2004).
Phenols have the ability to retard lipid oxidation in oils and fatty foods thereby reducing cardiovascular diseases (Rumbaoa *et al*., 2009). Steroids regulate carbohydrate and protein metabolism, and possess anti-inflammatory properties. Steroids (anabolic steroids) have been observed to promote nitrogen retention in osteoporosis and in animals with wasting illness (Maurya *et al.*, 2008; Madziga *et al.*, 2010). Terpenoids are known to possess antibacterial and antineoplastic properties (Oduro *et al*., 2009). Terpenoids have anti-hepatoxic properties thus helping to prevent liver damage. This study verified the presence of phytochemical constituents in *S. nigrum* leaves which could partly explain the use of the plant for the treatment of bone fracture in the study area.

Table 2: quantitative phytochemical compositions of ethanol leaf extract of *Solanum nigrum* leaves (mg/100g)

Phytochemicals	Relative Presence
Flavonoid	22.05 ± 0.04
Phenols	14.11 ± 0.02
Saponins	1.70 ± 0.01
Steroids	17.56 ± 0.03
Terpenoids	3.62 ± 0.00
Tannins	5.22 ± 0.02
Alkaloids	3.10 ± 0.03

Mean ± SD, n= 3

The results of the proximate composition of the ethanolic leaf extract of *Solanum nigrum* is shown in table 4. The ash content recorded the highest constituent (42.00 ± 4.21), followed by carbohydrate (28.54 ± 1.01), crude protein (22.06 ± 0.22), crude fibre (17.40 ± 1.15), moisture content (8.05 ± 0.11) while crude fat recorded the least (27.15 ± 3.22). The proximate analysis of *S. nigrum* leaves extracts revealed a diverse amount of moisture content, crude fat, crude fibre, crude protein and carbohydrate content. These findings are summarized in Table 4. The leaves extract of *S. nigrum* showed low moisture content. This moisture content was lower than those reported for *S. gilo*, *S. aethiopicum* and *S. anguivi* (Oyeyemi *et al*., 2015). Low moisture content hampers the growth of microorganism and promote longer shelf-life (Chinedu *et al*., 2011).

The value for ash in this study was higher than that of *S. aethiopicum* and *S. macrocarpon* as reported by (Chinedu *et al*., 2011). The high ash content is a reflection that the leaves are rich in mineral elements. The ash content in a food material determines the consistency of the material, identifying it as carbon-free and showing the organic, inorganic, and impurity content found in the sample (Ilodibia *et al.*, 2016). The value of crude fat in this study was higher compared to *Solanum nigrum* L. Var *virginicum* from Afikpo-Nigeria as reported by Akubugwo *et al.* (2007). The low crude fat content in *S. nigrum* would favour prevention of constipation and colon-cancer (Lee and Lim, 2003).
The estimated value for crude protein for *S.nigrum* in this study was lower than that of *S. anguivi* as reported by Adeyeye and Fagbohun (2006) but similar to that of Chinedu *et al*. (2011). Proteins are the building blocks of cells, fats, which provide energy and assist in the absorption of fat-soluble vitamins, and crude fiber, which helps in digestion (Aberoumand, 2011).

The crude fibre content for *S. nigrum* leaves in this study corresponds to that of *S. anguivi* as reported by (Adeyeye and Fagbohun 2006) but lower than that of *Solanum nigrum* L. Var *virginicum* from Afikpo-Nigeria as reported by Akubugwo *et al.* (2007). Plants that are rich in dietary fiber are usually employed in the treatment of diseases such as obesity, diabetes, cancer and abdominal disorder (Dhellot *et al*., 2006).
The carbohydrate content reported in this study is similar to that of Oyeyemi *et al*. (2015) on *S. anguivi* but lower than the earlier reports of Akubugwo *et al.* (2007) on *S. nigrum*. Carbohydrates provide energy

(calories) for muscles, nerves, and the brain (Glew *et al*., 2005).

Table 3: proximate composition of the ethanol extract of *Solanum nigrum* leaves

Parameters (%)	Compositions
Moisture	8.05 ± 0.11
Ash Content	42.00 ± 4.21
Crude Fat	7.15 ± 3.22
Crude Fibre	17.40 ± 1.15
Crude Protein	22.06 ± 0.22
Carbohydrate	28.54 ± 1.01

Mean ± SD, n= 3

The results of the mineral composition of the ethanol leaf extract of *Solanum nigrum* is shown in table 4. Potassium recorded the highest mineral constituent (424.01 ± 200.11), followed by phosphorous (381.27 ± 14.62), magnesium (278.23 ± 10.21), calcium (258.00 ± 10.25), sodium (179.81 ± 12.41), manganese (19.22 ± 0.10), iron (14.43 ± 0.55), sulphur (10.73 ± 0.64), zinc (0.81 ± 0.01) and copper (0.56 ± 0.06).

The results of the mineral composition revealed that *S. nigrum* leaf is a good source of minerals. These findings are summarized in Table 5. The values for the mineral elements in this study were higher than the recorded values in *S. anguivi* investigated by other researchers (Adeyeye and Fagbohun, 2006). Other essential minerals detected in the leaf of *S. nigrum* that play very indispensable role in normal human metabolism are, Zinc, Iron, Manganese and Copper. This result differs from the work of Adeyeye and Fagbohun (2006), who reported absence of Copper and Manganese in *S. gilo*, *S. aethiopicum* and *S. anguivi*.

Calcium is required for the maintenance of healthy bones, teeth as well as for structural rigidity to the body, and helps in blood clotting (Hussain *et al*., 2009). Iron is required for the making of new cells of amino acids, of hormones and of neurotransmitter, growth, reproduction, healing and immune function (Whitney and Hamilton, 2007). Potassium is an essential dietary mineral and body's principal intracellular electrolyte. Normal body function depends on tight regulation of potassium concentrations both inside and outside of cells (Peterson, 2007).

Sodium helps to maintain the body's fluid balance. It is also essential for nerve transmission, muscle contraction and cardiac function (Whitney *et al.*, 2001).

Manganese activates several important enzyme systems and in this capacity it is required for the synthesis of acid mucopolysaccharides, such as chondroitin sulphate, to form the matrices of bones and egg shells (Gordon, 2007). Copper forms part of enzymes which are essential for the formation of strong and flexible connective tissue. This maintains the integrity of connective tissue in the heart and blood vessels and also plays a role in bone formation (Turnlund, 2006). Magnesium is important for energy metabolism, bone formation, and enzymatic action (Smith, 2007). Zinc is is necessary for tissue repair and wound healing (Grodner *et al.,* 2000). Phosphorous functions as a constituent of bones, teeth, adenosine triphosphate (ATP), phosphorylated metabolic intermediates and nucleic acids. (Murray *et al*., 2000). Sulphur functions in cartilage, bone, tendons and blood vessel walls (Murray *et al*., 2000).

Table 4: mineral composition of the ethanol extract of *Solanum nigrum* leaves

Minerals	Compositions (mg/100g)
Potassium (K)	424.01 ± 200.11
Calcium (Ca)	258.00 ± 10.25
Sodium (Na)	179.81 ± 12.41
Magnesium (Mg)	278.23 ± 10.21
Phosphorous (P)	381.27 ± 14.62
Iron (Fe)	14.43 ± 0.55
Zinc (Zn)	0.81 ± 0.01
Copper (Cu)	0.56 ± 0.06
Sulphur (S)	10.73 ± 0.64
Manganese (Mn)	19.22 ± 0.10

Mean ± SD, n= 3

Conclusion: Ethanolic leaf extract of *S. nigrum* was rich in phenols, saponins, flavonoids, terpenoids, steroids, tannin and alkaloids. It also contain high proximate constituents such as moisture, fat, fibre, protein and carbohydrate. More so, it was rich in minerals such as phosphorous, calcium, magnesium, potassium, manganese, sodium, iron, copper, sulphur and zinc. Thus, the outcome of this work validates its use in the treatment of bone fracture in the study area. It has also unveiled the nutritional potentials of the plant. Thus a new theory on bone fracture treatment is arrived at.

Declaration of Conflict of Interest: The authors declare no conflict of interest

Data Availability Statement: Data are available upon request from the corresponding author.

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