**Chemical composition of *Siegesbeckia orientalis*: A valuable, but less known ethnomedicinal plant**

Linus A. Nwaogu¹*, Chidi U. Igwe², Cosmas O. Ujowundu³, Kingsley U. Obasi⁴ and Ujunwu L. Okeke⁵

Department of Biochemistry, Federal University of Technology, Owerri, Nigeria.

**Correspondence:** Linus A. Nwaogu; nwogulinus@gmail.com.

**ABSTRACT:** The chemical (phytochemical, vitamin, elemental and proximate) compositions of the leaves of *Siegesbeckia orientalis* was determined using standard methods. The results of the phytochemical composition in mg/100g indicated that saponins appeared to be highest followed by alkaloids, flavonoids, tannins, oxalates, cynogenic glycosides and phytate. The leaf contains appreciable concentration in mg/100g of vitamins A and C. The leaves contain vital concentration in mg/100mg of minerals which include calcium, magnesium, phosphorus, iron and zinc. It also contain trace amount of potassium, sodium, manganese and cobalt. The moisture content of the leaf was 75.50±1.00 %, ash 4.77 ± 0.03%, proteins 10.73 ± 0.03%, fiber 6.38 ± 0.11%, fats 2.27±0.07% and carbohydrate 0.35±0.02% respectively. The study revealed that *Siegesbeckia orientalis* leaf is a good source of vital vitamins and minerals. It also contains important phytochemicals which have been reported to have various biochemical and physiological effects that confer its medicinal benefits to users.

**KEYWORDS:** Ethnomedicinal plant, phytochemical, proximate, mineral, *Siegesbeckia orientalis*.
INTRODUCTION

Medicinal plants have been used for decades before the advent of orthodox medicine for the treatment of many illnesses. Various plants parts such as leaves, flowers, stem barks, roots, seeds and fruits have all been used as constituents of herbal medicines. The medicinal values of these plant parts lie in their phytochemical compositions, which produce definite physiological action on human body (Afolabi et al., 2007). Medicinal plants contain substances that could be used for therapeutic purposes and precursors for the synthesis of useful drugs. Each medicinal plant species has its own nutrient composition besides housing pharmaceutically important phytochemicals (Apiamu et al., 2013). Plants are very vital because they are a fundamental part of life on earth, which generate the oxygen, food, fuel and medicine that allow humans and other higher life forms to exist. It is no small wonder then that green leaves make excellent natural medicine (Nwala et al., 2013).

Plants are rich in variety of compounds. Many are secondary metabolites and include aromatic substances, most of which are phenols or their oxygen substituted derivatives such as tannins (Hartmann, 2007; Jenke-Kodama et al., 2004), they are also rich in amino acids, vitamins and minerals that are necessary for life’s survivals. Many of these compounds have therapeutic properties. Ethnobotanicals are important for pharmacological research and drug development, not only when plant constituents are used directly as therapeutic agents, but also starting materials for the synthesis of drugs or as models for pharmacological active compounds (Li and Veradas, 2009). About 200 years ago, the first pharmacological active pure compound, morphine, was produced from opium extracted from seed pods of the poppy Papaver somniferum. This discovery showed that drugs from plants can be purified and administered in precise dosages regardless of the source or the age of the material (Rousseaux and Schachter, 2003; Hartmann, 2007). Plants produce various phytochemicals such as terpenoids, phenolic acids, lignin, stilbenes, alkaloids and other metabolites which are rich in antioxidant activity (Zheng and Weng, 2001).

Studies have shown that many of these antioxidant compounds possess anti-inflammatory, anti-atherosclerotic, antitumor, anti-mutagenic, anti-carcinogenic, antibacterial and antiviral activities. The ingestion of natural antioxidants has been associated with reduced risk of cancer, cardiovascular diseases, diabetes and other diseases associated with ageing and in recent years there has been a worldwide trend towards the use of natural phytochemicals present in herbs, fruits and vegetables. There is interest in potential pharmacological activities of secondary plant metabolites (phytochemicals).

According to WHO, a medicinal plant is any plant which in one or more of its parts contains substances that can be used for therapeutic purposes or which are precursors for pharmaceuticals semi-synthesis. Parts including stem bark, leaf, seed, flower, fruit, grain, rhizome or root are used in the control or treatment of disease conditions and therefore contain chemical components that are medically active. These non-nutritive plant chemical compounds or bioactive compounds are often referred to as phytochemicals or phyto constituents and are responsible for protecting the plant against the microbial infections or infestations by pests (Doughari et al., 2009; Nweze et al., 2004).

In Nigeria, effective medicinal plants used in the management of various diseases have been documented (Sofowora 1993; Fasola, 2001; Obute, 2005) including those used for the treatment of opportunistic infections associated with HIV/AIDS (Enwereji, 2008). Weintritt, (2007) identified at least 522 medicinal species used in the management of numerous ailments in Nigeria.

Sigesbeckia orientalis is a medicinal plant of Asteraceae family. It is commonly called “St Paul’s wort”. The plant is a large annual herb with yellow flowers and large ovate triangular deeply cut leaves (Fig. 1). It is erect, hairy about 60cm in height, with spreading branches below. The leaves are opposite, somewhat arrow-shaped, 3 to 10cm long, 1-7cm wide and pointed at the tip, the base running down on the petioles small, rounded and 5-6mm in diameter. The ray flowers are red beneath, very short, curved and 3-toothed. The achenes are each enclosed in a boat-shaped bractlet which is hairless but slightly rough (Ashish and Amnlpal, 2010).

The whole of S. orientalis is salve and stimulates blood circulation (Chopra et al., 1996; Manadhar, 2002). The juice and tincture of the plant is used externally in the treatment of ring worm, other parasitic infections and as a protective cover for wound (Kirtikar and Basu, 1989). In Europe, a mixture of equal parts of the tincture and glycerin is used externally as an antifungal agent (Ashish and Amnlpal, 2010). A paste of the plant is applied to wounds between the toes that have been caused by prolonged walking barefoot in muddy water (Stuart, 1960). A decoction of the plant is also used in the treatment of rheumatoid, arthritis, pains and aches in the legs and sides, hemiplegia, hypertension, sciatica, weeping dermatitis and mastitis. A paste of the root is used in the treatment of indigestion. The juice of the roots is applied to wounds (Stuarts, 1960). Given the varied ethnomedicinal uses of the plant, this study was aimed to determine the phytochemical, vitamin, elemental and proximate composition of S. orientalis leaves.
MATERIALS AND METHODS

Collection and identification of the plants
Fresh green leaves of *S. orientalis* used for the study were obtained from the farm behind the Department of Biochemistry complex, Federal University of Owerri, Imo State. The leaves were identified by Mr. Francis Iwueze of the Department of Forestry and Wildlife, School of Agricultural Technology, Federal University of Technology, Owerri, Nigeria.

Sample Preparation
Apparently healthy leaves of *S. orientalis* were carefully selected, washed, air-dried and ground into fine powder using a mechanical homogenizer. Portions of the ground sample were extracted. The extract of the ground leaves was made as follows: A 100g portion of ground leaves of *S. orientalis* was soaked in 500ml of water for 24 hours, filtered and then exhaustively extracted with the aid of soxhlet extractor. The solvent from each extract was then distilled off in a distillatory and evaporated to dryness at 40 °C. The solid extract was each placed in a sterile container, labeled and stored at 4 °C in a refrigerator from where portions were taken and used for the analyses.

Phytochemical Determination
Phytochemical screening for alkaloids, tannins, cyanogenic glycosides, oxalates, saponins, flavonoids, phenols and phytates in aqueous extracts were investigated by the methods described by Harborne (1973) and Trease and Evans (1989). The quantitative determination of alkaloids was carried out by the alkaline precipitation using the gravimetric method as described by Harborne (1973). Determination of the concentration of cyanogenic glycosides (HCN) was carried out by the procedure described by AOAC (1990). Quantitative determination of flavonoids was carried out by the method as described by Harborne (1973) and Trease and Evans (1989). The saponin content of the extract was determined by double solvent extraction gravimetric method (Harborne, 1973). The spectrophotometric method of Griffiths and Thomas (1981) was used for the determination of phytates. The content of oxalate of the extract was determined by the method as described by Harbone, (1973). The Follin-Dennis spectrophotometric method of Pearson (1976) was used to determine the tannin contents of the extract.

Proximate analyses
The moisture content of the aqueous extracts was determined by the methods described by Pearson (1976) and James (1995). The crude lipid was determined by the continuous solvent extraction method in a solvent apparatus as described by James (1995). The crude fiber was determined by the Weende method (Pearson, 1976; James, 1995).

The protein content of the aqueous extract was determined by the Kjedhal method reported by James (1995). The total nitrogen was determined and multiplied by the factor, 6.25 to obtain the protein content.

The carbohydrate content of the extracts were determined by estimation using arithmetical difference method described by Pearson (1976) and James (1995). The carbohydrate content was calculated and express as nitrogen free extract.

The content of ash was determined by placing a clean empty crucible in a muffle furnace at 600°C for an hour, cooled in desiccators and then the weight of empty crucible recorded (W1). Four (4) grams of each of sample was taken in the crucible (W2). The sample was ignited over a burner with a help of blow pipe, until it was charred. Then the crucible was placed in muffle furnace at 55°C for 4 hours. The appearance of gray white ash indicated complete oxidation of all organic matter in the sample. After ashing, the furnace was switched off. The crucible was cooled and weighed (W3).

Figure 1: The leaves of *Sigesbeckia orientalis*
The Percentage ash was calculated using the following formula:

\[
\%\ Ash = \frac{\text{Difference in Wt. of Ash}}{\text{Wt. of sample}} \times 100
\]

Where:

\[
\text{Difference in Wt. of Ash} = W_3 - W_1
\]

**Vitamin and Mineral Analyses**

Vitamins A and E in the leaf extract were determined by High Performance Liquid Chromatography (HPLC, Model CO30). The minerals: sodium and potassium contents of the extract were determined with a Digital flame photometer (Model 2665-00). The other minerals; magnesium (Mg), calcium (Ca), phosphorus (P), iron (Fe), zinc (Zn), manganese (Mn), cobalt (Co) and copper (Cu) were determined with the aid of Atomic Absorption Spectrophotometer (AAS-Model-alpha 4).

**Statistical Analysis**

The results obtained are presented as mean ± standard deviation of triplicate determinations and were analyzed by simple percentages.

**RESULTS AND DISCUSSION**

The summary of the results of phytochemical, elemental, vitamins and proximate compositions of the leaves extract of *S. orientalis* are presented in Tables 1 to 5.

Tables 1 and 2 show the screening test and quantitative composition of the leaf extract. The results revealed that *S. orientalis* leaves posses high content of saponins, alkaloids and flavonoids. Oxalates, tannins, phytates and phenols were also found to be present, but at moderate levels.

Table 2 shows the phytochemical compositions of the leaf extract. It revealed that the leaf extract was found to be very rich in alkaloids (3200 ±12.01 mg/100g). This observation grees with the reports of Russo *et al.*, (2013), that the leaf has unique pharmacological activities including anti-malarial, antiasthma, anticancer, also as cholinometric vasodilator, analgesic, Cushnie *et al.*, (2014) as antibacterial and Qius *et al.*, (2014) for its anti-hyperglycemic activities.

Cynogenic glycosides were found to be present (160.00 ±2.04 mg/100g) in the plant extract which indicates that it may demonstrate antimicrobial properties particularly against fungi (Heinrich *et al.*, 2004). Cyanogenic glycosides are known to pose some toxicological effects in the body of consumers, but the concentration is unlikely to pose toxicity problem since it is below the toxic levels of 2-5g recommended by WHO (Munro and Bassir, 1969).

<table>
<thead>
<tr>
<th>Phytochemical</th>
<th>Mean ± S. D. (mg/100g)*</th>
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</thead>
<tbody>
<tr>
<td>Alkaloids</td>
<td>3200.00 ± 12.01</td>
</tr>
<tr>
<td>Cyanogenic glycosides</td>
<td>160.00 ± 2.04</td>
</tr>
<tr>
<td>Flavonoids</td>
<td>2300.00 ± 14.08</td>
</tr>
<tr>
<td>Saponins</td>
<td>4150.00 ± 12.01</td>
</tr>
<tr>
<td>Phytates</td>
<td>185.30 ± 2.03</td>
</tr>
<tr>
<td>Oxalates</td>
<td>413.60 ± 5.04</td>
</tr>
<tr>
<td>Tannins</td>
<td>300.20 ± 3.01</td>
</tr>
</tbody>
</table>

*Values are mean ± S. D. of triplicate determinations.

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**Table 1: Phytochemical Contents of *S. orientalis* leaf.**

<table>
<thead>
<tr>
<th>Phytochemical</th>
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<tbody>
<tr>
<td>Alkaloids</td>
<td>++ +</td>
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<tr>
<td>Flavonoids</td>
<td>++ +</td>
</tr>
<tr>
<td>Saponins</td>
<td>++ +</td>
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<tr>
<td>Phytates</td>
<td>++</td>
</tr>
<tr>
<td>Oxalates</td>
<td>++</td>
</tr>
<tr>
<td>Tannins</td>
<td>++</td>
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<tr>
<td>Phenols</td>
<td>++</td>
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</table>

Keys: ++ + = Highly present; ++ = moderately present
The leaf was also found to be very rich in flavonoids (2300.00 ± 14.08 mg/100g), which shows that the leaf has antioxidant activity, (Lotito et al., 2011). The leaf also possess anti-inflammatory, anti-diabetic, anticancer and neuroprotective activities. The neuroprotective activity might be related to its ability to modulate cell-signaling pathways (William et al., 2014).

The leaf of *S. orientalis* was found to be very rich in saponins (4150.00 ± 12.01 mg/100g). Saponins possess a carbohydrate moiety attached to a triterpenoid or steroidal aglycone. Saponins form a group of compounds, which on consumption cause deleterious effects such as haemolysis (Price et al., 1987). Saponins have also been shown to have hypocholesterolaemic as well as anti-carcinogenic effects (Price et al., 1987). This indicates that judicious use of this leaf extract could help in the protection of the heart against coronary heart disease. Phytate was found to be present (185.30 ± 2.03 mg/100g) in the plant leaf sample. The knowledge of phytate presence in any food substance is necessary because high concentration can cause adverse effects on digestibility. Phytate forms complexes with ions of copper, zinc, cobalt, manganese, iron and calcium but the mechanism of action has not been fully established (Lee et al., 2007).

The presence of oxalate in the leaf (413.6± 5.04 mg/100g) indicates that the leaf may be harmful when consumed at high concentration. The leaf extract contains some macro and micronutrients capable of complexing with some anti-nutrient factors. Calcium complexes with oxalate to form calcium oxalate, thus reducing the availability of calcium. Tannins were also found to be present (300± 3.01 mg/100g). Tannins are polyphenols that have antimicrobial properties. The presence of tannins in the extract may confer their chemoprotective benefits to users (Jean-Mare et al., 2013).

The result of vitamin composition of the leaf extract is presented in Table 3. The result indicates that the leaf extract has appreciable concentration of vitamin A (12.46±0.06 mg/100g) which shows that it is important for mammalian eye development (See and Clagett, 2009). Its intake can also influence the transcription of a broad range of genes.

Similarly, vitamin C was found to be present (8.45 ±0.03 mg/100g) in the plant extract indicates that the extract when used, could act as an antioxidant by donating electrons to various anti-oxidative enzymatic and a few non-enzymatic reactions thereby reducing the effects of free radicals (Grapper et al., 2005). Lack of vitamin C impairs the normal formation of certain intracellular substances throughout the body, including the collagen, bone matrix and tooth dentine. A striking pathological change resulting from this defect is the weakening of the endothelial wall of the capillaries due to reduction in the amount of these intracellular substances. Consequently, the clinical manifestation of scurvy in the mucous membrane of the mouth and gastrointestinal tract, anemia, pains in the joints and defect in skeletal calcification can be related to the association of ascorbic acid and normal connective tissue metabolism (Hunt et al., 1980). These functions of ascorbic acid also accounts for its requirement for normal wound healing. It is also essential to prevent diseases associated with connective tissue and to improve the immune functions (Zhao, 2007). Thus, intake of the leaf may help to alleviate vitamins A and C deficiencies to users.

<table>
<thead>
<tr>
<th>Vitamin composition</th>
<th>Values (mg/100g)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>12.46 ± 0.06</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>8.45 ± 0.03</td>
</tr>
</tbody>
</table>

*Values are mean ± S. D. of triplicate determinations.

Table 4: Elemental composition (mg/100g) of *S. orientalis* leaves.

<table>
<thead>
<tr>
<th>Elemental Composition</th>
<th>Mean ± S.D. (mg/100g)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td>142.20 ± 0.40</td>
</tr>
<tr>
<td>Fe</td>
<td>45.72 ± 2.02</td>
</tr>
<tr>
<td>Mg</td>
<td>142.89 ± 4.10</td>
</tr>
<tr>
<td>P</td>
<td>63.00 ± 2.50</td>
</tr>
<tr>
<td>Zn</td>
<td>19.14 ± 1.01</td>
</tr>
<tr>
<td>Co</td>
<td>0.02 ± 0.01</td>
</tr>
<tr>
<td>Cu</td>
<td>0.03 ± 0.02</td>
</tr>
<tr>
<td>Mn</td>
<td>0.57 ± 0.02</td>
</tr>
<tr>
<td>K</td>
<td>32.97 ± 0.04</td>
</tr>
<tr>
<td>Na</td>
<td>25.58 ± 0.02</td>
</tr>
</tbody>
</table>

*Values are mean ± S. D. of triplicate determinations
The proximate composition of *S. orientalis* leaf (Table 5) shows the presence of protein (10.73 ± 0.03%), lipid (2.27 ± 0.07%), moisture (75.50 ± 1.00%) and crude fibre (6.38 ± 0.11%). Protein is an important nutrient that is needed for the repair of worn out tissues in the body. The leaf can serve as a good source of nutrients when taken as medicinal plant. Also, the high moisture content found in the leaf indicates that the leaf when harvested has a short shelf life and as such should be used immediately for herbal decoction by soaking in a desired solvent which may be water or alcohol after harvest for the treatment of arthritis, pains and aches of the body, sciatica, hemiplegia and hypertension. The leaf contains appreciable quantity of crude fibre. Fibre in diet is known to enhance digestibility, decrease serum cholesterol and reduce the risk of large bowel cancers (Anderson et al., 1995). The results indicate that the leaf, in addition to its potential medicinal properties contains useful nutrients.

### Table 5: Proximate composition (%) of *S. orientalis* leaves.

<table>
<thead>
<tr>
<th>Proximate Composition (%)</th>
<th>Mean ± S.D*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture content</td>
<td>75.50 ±1.00</td>
</tr>
<tr>
<td>Ash</td>
<td>4.77 ±0.03</td>
</tr>
<tr>
<td>Fibre</td>
<td>6.38 ±0.11</td>
</tr>
<tr>
<td>Protein</td>
<td>10.73 ±0.03</td>
</tr>
<tr>
<td>Fat</td>
<td>2.27 ±0.07</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>0.35 ±0.02</td>
</tr>
</tbody>
</table>

*Values are mean ± S. D. of triplicate determinations

Table 4 shows the mineral composition of the *S. orientalis* leaf extract. The leaf contains among other minerals: calcium, magnesium, sodium, potassium, iron, phosphorus and zinc at high concentrations (mg/100g), while cobalt, copper and manganese were found at very low concentrations. It is known that iron, zinc and manganese help to strengthen the immune system, while zinc and manganese are components of cellular enzymes (Schwarz et al., 2013). Iron is also an important component of haemoglobin necessary for oxygen transport. Zinc is known to prevent muscle degeneration, gonadal atrophy and impaired spermatogenesis (Talwar et al., 1989; Chaturvedi et al., 2004).

The proximate composition of *S. orientalis* leaf (Table 5) shows the presence of protein (10.73 ± 0.03%), lipid (2.27 ± 0.07%), moisture (75.50 ± 1.00%) and crude fibre (6.38 ± 0.11%). Protein is an important nutrient that is needed for the repair of worn out tissues in the body. The leaf can serve as a good source of nutrients when taken as medicinal plant. Also, the high moisture content found in the leaf indicates that the leaf when harvested has a short shelf life and as such should be used immediately for herbal decoction by soaking in a desired solvent which may be water or alcohol after harvest for the treatment of arthritis, pains and aches of the body, sciatica, hemiplegia and hypertension. The leaf contains appreciable quantity of crude fibre. Fibre in diet is known to enhance digestibility, decrease serum cholesterol and reduce the risk of large bowel cancers (Anderson et al., 1995). The results indicate that the leaf, in addition to its potential medicinal properties contains useful nutrients.

### Conclusion

The study revealed that *S. orientalis* leaves are good sources of important phytochemicals which have been reported to have various biochemical and physiological effects. The benefit of these phytochemicals can only be derived with proper preparation of the decoction and moderation of dosage. The plant leaves are apparently good sources of important vitamins and minerals. The study has also shown the chemical composition of this available but less known highly medicinal plant, which when used in herbal medical practice will offer nutritional as well as medicinal benefits to users.

### REFERENCES


