

A Comparative Nutritional Assessments of Leaf Extracts of *Ocimum gratissimum* and *Solanum aethiopicum*

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Received September 16, 2019; Revised October 18, 2019; Accepted November 05, 2019

Abstract Background: *Ocimum gratissimum* and *Solanum aethiopicum* are widely utilized medicinal plants employed in ethnomedicine for the treatment of myriads of health abnormalities including anaemia, constipation, inflammation and ulcers. The present study compared the nutritional compositions of these two medicinal plants. **Methods:** The leaf of these plants were destalked and air-dried differently for 8 days. The dried samples were milled into fine powder using an auto-milling machine. The homogenized samples were subjected to quantitative analysis and atomic absorption spectrophotometry for phytochemical and mineral determinations respectively, while proximate analysis was determined by the methods described by Association of Official Analytical Chemists (AOAC). **Results:** There were significant ($p < 0.05$) increase in the percentage compositions of alkaloid, saponin and phytate in *Solanum aethiopicum* when compared to *Ocimum gratissimum*. On the other hand; tannin, flavonoid and phenols significantly increased ($p < 0.05$) in *Ocimum gratissimum* more than *Solanum aethiopicum*. All the quantified proximate and mineral compositions (Ca^{2+} , Mg^{2+} , K^+ , Na^+ , P , Fe^{2+} , Zn^{2+}) were significantly higher ($p < 0.05$) in *O. gratissimum* compared to *S. aethiopicum*. Again, *S. aethiopicum* revealed higher moisture content (84.33 %) than *O. gratissimum* (8.99 %). **Conclusion:** The results revealed higher nutritional composition in *Ocimum gratissimum* than *Solanum aethiopicum*. Therefore, increase consumption of these nutritional and medicinal compliant plants will help in diet formulation and alleviate the scourges associated with malnutrition in the population.

Keywords: nutritional assessment, *Ocimum gratissimum* and *Solanum aethiopicum*

Cite This Article: Victor Okezie Ikpeazu, Okezie Emmanuel, Celestine Nwabu Ekweogu, Emmanuel Ugochukwu Akara, and Eziuche Amadike Ugbogu, "A Comparative Nutritional Assessments of Leaf Extracts of *Ocimum gratissimum* and *Solanum aethiopicum*." *American Journal of Biomedical Research*, vol. 7, no. 2 (2019): 27-31. doi: 10.12691/ajbr-7-2-1.

1. Introduction

In recent years, the desire to adopt a healthy dietary lifestyle has rekindled the interest of scientists all over the world into investigation of nutritional potentials of vegetables. Again, the importance of vegetables as valuable sources of nutrients has been reported [1,2], while some of them have medicinal properties [3]. Vegetables contribute significantly to food security offering nutritional supports to pregnant women, lactating mothers, children under the age of 5 and as remedy against health abnormalities especially in developing countries [4,5].

Ocimum gratissimum L (Labiataeg) is popularly known as scent leaf belonging to the family Lamiaceae. It is predominantly found in Asia, South America and Africa [6,7]. In Nigeria, *O. gratissimum* is commonly used as a spice in the preparation of soup, stew and its aqueous or ethanolic leaf extract is often employed in folklore medicine in treatment of some diseases [7]. For example, the leaf extract of *O. gratissimum* is used in ethnomedicine in

the treatment and management of bacterial infections, fever, diarrhea, respiratory-tract infections, pneumonia, coughs and diabetes [7]. The chemical characterization of *O. gratissimum* revealed the presence of the following bioactives; α -pinene, β -pinene, 1,8-cineole, Terpeneole, Eugenol, (E)- β -Caryophyllene, Muurolere, Sehirene and β -selinerele [8,9]. Essential oils including eugenol, 1, 8-cineole and linalool, thymol, citral, linalool, ethyl cinnamate and geraniol have been reported present in *O. gratissimum* [9]. Interestingly, these oils from *O. gratissimum* have been reported to possess bactericidal effects against *Escherichia coli*, *Staphylococcus aureus*, *Bacillus subtilis* [10] and fungicidal properties against *Aspergillus repens*, *Curvularia lunata*, *Fusarium moniliforme*, *Aspergillus niger*, *Mucor mucedo*, *Fusarium solani*, *Botryodiplodia theobromae* and *Rhizopus solani* [10,11]. Researchers have reported various biological activities of *O. gratissimum* including wound healing potential [12], antioxidant [10], anti-inflammatory [13], antihelmintic [14] and hepatoprotective properties [15].

Solanum aethiopicum L. is a seasonal plant which belongs to the family Solanaceae. It is popularly known as garden egg or scarlet eggplant. *Solanum aethiopicum* is

evenly distributed in Asia, Africa (Nigeria, Cameroon, Sierra Leone, Zimbabwe and Ethiopia), Brazil, and Southern Europe [16,17]. In a similar role as *O. gratissimum*, the leaves of *S. aethiopicum* are used to prepare yam porridge, soup and stew. Morphologically, the leaves are alternately arranged, oval shaped and wavy margined having about 10 to 30 cm long and a range value of 4 to 15 cm wide. Komlaga et al. [18] reported high contents of crude fibre, calcium, iron, zinc, protein, fat, vitamins and phytochemicals on the leaves of *Solanum aethiopicum*. In ethnomedicine, myriads of ailments such as anaemia, constipation, overweight, inflammation, swollen joints and ulcers have been treated using *S. aethiopicum* [17,19]. *Ocimum gratissimum* and *Solanum aethiopicum* are considered as nutritional plants, but there is no published work that compared their nutritional compositions. Therefore the aim of this study was to evaluate the phytochemical, proximate and mineral compositions of *Ocimum gratissimum* and *Solanum aethiopicum*.

2. Materials and Methods

2.1. Collection and Authentication of *Ocimum gratissimum*

Fresh leaves of *Ocimum gratissimum* and *Solanum aethiopicum* were purchased from Eke Okigwe, Okigwe Local Government Area of Imo State, Nigeria. The leaves were authenticated by a plant taxonomist at University of Nigeria Nsukka as *Ocimum gratissimum* with herbarium number UNH No 360 and *Solanum aethiopicum* with herbarium number UNH No 331.

2.2. Sample Preparation

The identified leaves were destalked and air-dried differently for eight (8) days. After this time, the dried samples were differently homogenized using an auto-milling machine.

2.3. Phytochemical Determination

The tested phytochemical parameters: Alkaloids, saponins, flavonoid, phenols, oxalate and phytate were quantified using the methods described by Harborne [20], while tannin was spectrophotometrically quantified by Folin-Denis methods described by Shabbir et al. [21]

2.4. Proximate Determination

The proximate compositions; crude protein, crude fibre, crude lipid, ash, moisture and carbohydrate contents were determined according to the methods of the Association of Official Analytical Chemists [22].

2.5. Mineral Determination

Mineral constituents including calcium (Ca^{2+}), magnesium (Mg^{2+}), potassium (K^+), iron (Fe^{2+}), and zinc (Zn^{2+}) were determined using Atomic Absorption Spectrophotometry, while sodium (Na^+) and phosphorus (P) were determined using a flame photometer [22].

2.6. Statistical Analysis

Data presented are triplicate values \pm SD. The mean and standard deviations were calculated using Excel package 2010. The values were subjected to Students' T-test using GraphPad prism statistical software at probability level of 0.05.

3. Results

The comparative phytochemical composition of leaf extract of *Ocimum gratissimum* and *Solanum aethiopicum* is shown in Table 1. There were significant ($p < 0.05$) increase in the percentage composition of alkaloid, saponin and phytate present in *Solanum aethiopicum* compared to *Ocimum gratissimum*. On the other hand; tannin, flavonoid and phenols were significantly more ($p < 0.05$) in *Ocimum gratissimum* than *Solanum aethiopicum*.

Table 2 shows the results obtained from the percentage proximate compositions of the dried leaf extract of *O. gratissimum* and *S. aethiopicum*. From the result, all the proximate parameters were significantly higher ($p < 0.05$) in *O. gratissimum* than in *S. aethiopicum*. The result also revealed higher moisture content (84.33 %) in *S. aethiopicum*.

Table 3 shows the results obtained from the percentage proximate compositions of the dried leaf extract of *O. gratissimum* and *S. aethiopicum*. From the result, all the tested mineral constituents (Ca^{2+} , Mg^{2+} , K^+ , Na^+ , P, Fe^{2+} , Zn^{2+}) were significantly higher ($p < 0.05$) in *O. gratissimum* than in *S. aethiopicum*.

Table 1. Phytochemical composition of leaf extract of *Ocimum gratissimum* and *Solanum aethiopicum*

Parameter	Phytochemical Composition (%)	
	<i>Ocimum gratissimum</i>	<i>Solanum aethiopicum</i>
Alkaloid	0.35 \pm 0.09*	0.98 \pm 0.13
Saponin	1.91 \pm 0.33	2.03 \pm 0.25
Tannin	3.39 \pm 0.86	1.68 \pm 0.18*
Flavonoid	1.91 \pm 0.18	1.05 \pm 0.13*
Phenols	1.53 \pm 0.15	0.42 \pm 0.07*
Oxalate	0.30 \pm 0.01*	0.61 \pm 0.07
Phytate	0.17 \pm 0.04*	0.37 \pm 0.03

Values are mean \pm SD for triplicate determination. Values marked with superscript asterisk (*) shows significant different at $P < 0.05$.

Table 2. Proximate composition of leaf extract of *Ocimum gratissimum* and *Solanum aethiopicum*

Parameter	Proximate Composition (%)	
	<i>Ocimum gratissimum</i>	<i>Solanum aethiopicum</i>
Crude protein	15.17 \pm 1.26*	6.92 \pm 1.04
Crude fibre	10.27 \pm 0.64*	1.82 \pm 0.37
Crude lipid	2.83 \pm 0.75*	0.79 \pm 0.14
Ash	4.37 \pm 0.81*	1.79 \pm 0.16
Moisture content	8.99 \pm 1.14	84.43 \pm 3.09*
Carbohydrate	58.37 \pm 4.80*	4.26 \pm 0.80

Values are mean \pm SD for triplicate determination. Values marked with superscript asterisk (*) shows significant different at $P < 0.05$.

Table 3. Mineral composition of leaf extract of *Ocimum gratissimum* and *Solanum aethiopicum*

Parameter	Mineral Composition (mg/100g)	
	<i>Ocimum gratissimum</i>	<i>Solanum aethiopicum</i>
Ca ²⁺	53.63±4.82*	25.81±1.86
Mg ²⁺	86.30±2.13*	2.92±0.62
K ⁺	85.94±4.27*	67.60±4.91
Na ⁺	10.49±0.79*	5.29±0.94
P	56.87±3.97*	7.23±0.60
Fe ²⁺	15.44±0.87	13.50±1.40
Zn ²⁺	6.17±1.11*	0.82±0.05

Values are mean ± SD for triplicate determination. Values marked with superscript asterisk (*) shows significant different at P <0.05.

4. Discussion

Various parts of *Ocimum gratissimum* and *Solanum aethiopicum* are employed in ethnomedicine in the management of different diseases including diabetes, pile, rheumatism and hypertension [23,24]. In addition, the leaves are recommended for people with anaemia and low iron especially during pregnancy and post-delivery. Therefore, this study evaluated the phytochemicals, proximate and mineral compositions of leaf extracts of *O. gratissimum* and *S. aethiopicum*.

Phytochemicals or plant secondary metabolites (PSMs) are chemicals associated with plants, which are not produced for the growth and development of plants. They are often synthesized for defence and protection. PSMs offer medicinal advantages to the cell due to their active ingredients [25]. The phytochemical compositions of *O. gratissimum* revealed a decreasing trend in tannin > saponin > phenol > oxalate > alkaloid > phytate. Comparatively, significant (p<0.05) increase were observed in the percentage compositions of alkaloid, saponin and phytate in *Solanum aethiopicum* compared to *Ocimum gratissimum*, while tannin, flavonoid and phenols were significantly greater (p<0.05) in *Ocimum gratissimum* than *Solanum aethiopicum*. Alkaloids are groups of plant secondary metabolites that have nitrogen as their elemental constituent. Traditionally, alkaloids act as anti-ulcer, anti-inflammatory and antibiotics agents [26,27]. No wonder several researchers have reported its bactericidal and analgesic potentials [28,29]. Saponins are glycosylated triterpenoids eliciting antifungal activities. This is owed to their detergent-like properties by distorting cell membranes of the fungal pathogens [30]. Again, they play significant role in the synthesis of steroid hormones [31]. Tannins have stringent characteristics with strong affinity for proline (imino acid) capable of interfering with protein synthesis [32]. Flavonoids have antioxidant properties. Thus, it prevents oxidative stress that may arise from reactive oxygen species (ROS) [29,33]. Phenols and flavonoids are free radical scavengers. Their presence in plant may lend credence on the use of such plant in the management of cancer, Alzheimer's disease and atherosclerosis [34]. The appreciable number of phytochemicals present in these plants suggested that *O. gratissimum* and *S. aethiopicum* have antioxidants, anti-cancer and antiallergic activities [33], fungi-static and fungicidal properties [30].

The results of proximate analysis revealed significant increase (p<0.05) in percentage proximate composition of *O. gratissimum* compared to *S. aethiopicum*. However, *S. aethiopicum* had higher moisture content (84.33 %) than *O. gratissimum* (8.99) (Table 2).. Proximate analysis is carried out to quantify the protein, crude fibre, lipid, ash, moistures and carbohydrate contents of a food sample [35]. Moisture content is used in evaluating the shelf life of food. Moisture availability is one of the factors that contribute to microbial growth [36]. The recorded higher moisture content in *S. aethiopicum* suggested a lower shelf-life than *O. gratissimum*. Carbohydrate in food offers nutritional support by providing energy, endurance, poor mental function and stamina [37]. The body system needs Adenosine Triphosphate (ATP) to drive cellular activity. This study suggested that ingestion of *O. gratissimum* and *S. aethiopicum* could act as source of ATP to the cell due to the presence of carbohydrate found in the plant samples. Proteins are macromolecules having several amino acid compositions. They help in repairing and replacing of worn out tissues [29]. Crude fibres are polysaccharides usually non-hydrolysable capable of increasing faecal bulk. When ingested, help in increasing gastro-motility and promoting a healthy digestive system [38]. Again, it also helps in alleviating the risk associated with colon cancer [29]. Ash content in food has a direct relationship with mineral constituents [39]. This implies the higher the ash content, the more nutritional the plant would be. The present result showed that *O. gratissimum* and *S. aethiopicum* are nutritionally sound and could solve the problems associated with constipation due to its high crude fibre.

The results of mineral compositions of the tested leaf samples revealed higher mineral compositions including Ca²⁺, Mg²⁺, K⁺, Na⁺, P, Fe²⁺, Zn²⁺ in *O. gratissimum* than *S. aethiopicum*. Calcium cation (Ca²⁺) helps in the maintenance of strong bones and teeth. It is significantly involved in muscular activity [40]. Magnesium cation (Mg²⁺) is a divalent inorganic ion found in the cell which has been implicated in cardiac rhythmical activity. It helps in the dilation of arteries and hence, decreases blood pressure [41,42]. Sodium ion (Na⁺) as well as potassium ion (K⁺) is responsible for co-transport and also play role in communication between neurons. Sodium ions (Na⁺) help molecules cross through the membrane (co-transport). It also plays a role in the absorption of glucose in the small intestine [43]. Iron (II) ion (Fe²⁺) plays role in carrying oxygen. It is a key for oxygen transport in haemoglobin, which is mainly found in red blood cell. Traditionally, *O. gratissimum* and *S. aethiopicum* have been used in the treatment of anaemia. This may be owed to the significant presence of iron (II) ion present in these plant samples. Oboh et al. [16] have reported the haemolytic activity of *Solanum macrocarpon*. Zinc ion (Zn²⁺) is a crucial micronutrient involves in human growth and immune cellular response. It also acts as cofactor [29]. Zinc deficiency manifests in a number of ways including thin brittle nails, low sense of taste and smell, alopecia, increased susceptibility to disease and infection, slow healing and recurring colds [29,42]. These results suggested that *O. gratissimum* and *S. aethiopicum* are enriched with mineral and could meet up with the required daily allowance of some of the investigated minerals when consumed adequately.

5. Conclusion

In conclusion, the study revealed that there is a significant increase ($p < 0.05$) in all the tested proximate and mineral compositions recorded in *O. gratissimum* when compared to *S. aethiopicum*. These suggested a higher nutritional composition in *O. gratissimum* than *S. aethiopicum*.

The study also showed that the leaf extracts of *O. gratissimum* and *S. aethiopicum* could be used in fortification and supplementation of other food samples. Therefore, increase consumption of these leaves will help alleviate the scourges associated with malnutrition in the population.

The result also justifies the use of *O. gratissimum* and *S. aethiopicum* in ethnomedicine as an anti-anaemic tonic in the treatment and management of anaemia condition due to its appreciable iron (II) ion (Fe^{2+}) values.

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