Biochemical Profiles of *Ocimum gratissimum* L. and soil characteristics in the Secondary Forest of Cross River State, Nigeria

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ABSTRACT

Background*: Ocimum gratissimum* L. is one the important leafy vegetables commonly utilized as spices, food nutrient supplements and medicinal herbs. This study was conducted to assess the mineral nutrients and proximate compositions in leaves of O. *gratissimum* in relation to soil characteristics in the secondary forest of Cross River State, Nigeria.

Methods*:* Leaf samples of *O. gratissimum* and soil samples were collected from two sampling locations (S1 and S2) at the study area. Standard methods were used to determine the mineral nutrients and proximate compositions in leaves samples of the test plant. Soil physico-chemical properties of the experimental soils were determined.

Results*:* Soil physico-chemical properties of the two sampling locations were characteristics of a typical tropical region. The contents of sodium, potassium, nitrogen, phosphorus, iron, manganese, zinc and lead in leaves of *O. gratissimum* at sampling location 1 were higher than that of sampling location 2, while the calcium, magnesium, and copper contents leaves of *O. gratissimum* at sampling location 2 were higher than that of sampling location 1. The moisture, crude fat, crude fiber and crude protein in leaves of *O. gratissimum* at sampling location 1 were higher than that of sampling location 2, while the ash and carbohydrate contents in leaves of *O. gratissimum* at sampling location 1 were higher than that of sampling location 2.

Conclusion*:* Variations in soil properties as indicated in this study play a significant role on the nutrient constituents of *O. gratissimum* grown in the two sampling locations. The nutrient contents of the test plant also prove that this plant could serve as a useful supplement in human and animal nutrition.

***Key words*— Biochemical, *Ocimum gratissimum*, Soil, Characteristics, Cross River State.**

1. INTRODUCTION

Ocimum gratissimum L. (Lamiaceae) is usually utilized as a spice, vegetable as well as medicinal plant [1,2]. It grows as an erect small plant with many barnacles usually within the range of 1m in height [1,2]. The plant is grown in the tropical and subtropical parts of the world, where it is utilized in preparation of salads, soup, vinegars and jerries. The leaves are used in the treatment of diarrhea, conjunctivitis, skin infections and bronchitis [3, 4]. It is usually a homegrown shrub used mainly as spices for cooking delicacies due to its unique aromatic taste. *O. gratissimum leaves* are high in calcium, phosphorus, iron, potassium, carbon and vitamin A. The *O. gratissimum* leaves have been reported to be rich in plant chemicals [3, 5]. Oil from the leaves has been shown to possess antiseptic, antibacterial, and antifungal activities [5]. Most indigenes of Cross River State, particularly inhabitants of Ogoja, do not know the nutritional benefit of O. *gratissimum* leaves. This is because researchers only focus on common leafy vegetables such as pumpkin leaves that are highly cherished and locally consumed by the people. Considering the importance of this species, it is sometimes cultivated for the purpose of availability and sustainability. Ogoja is characterized by areas of secondary forest and derived savanna vegetation, which occur in lowland parts with intensive forest degradation. The major source of livelihood in the area is subsistence agriculture [6, 7]. It is important to note that the nutritional composition of plant parts are affected by different locations as a result of varying soil as well as other environmental factors [8]. Therefore, the determination of the proximate and mineral nutrient contents in leaves of O. *gratissimum* in relation to soil locations becomes increasingly important in order to provide a baseline information for continuous domestication of the species in the area.

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2. MATERIALS AND METHODS

2.1 Materials

2.1.1 Equipment

The following equipment and apparatus were used; soxhlet apparatus, heating mantle, blender, autoclave, incubator, automatic weighing balance, refrigerator, and spectrophotometer. glasswares used include; test tubes, beaker, conical flask, reagents used include; distilled water, petroleum ether, sulphuric acid , sodium hydroxide, anhydrous sodium sulphate, ethyl acetate, ferrous sulphate, ferrous chloride, aluminum chloride, ammonia solution,. Other materials include; aluminum foil, spatula and spectrophotometer.

2.1.2 Biological Materials

The biological materials used for this research were mainly the leaf samples of *O. gratissimum* obtained in triplicates from the natural secondary forest in the study area.

2.2 Methods

2.2.1 Study Area

A plot was carefully selected on two locations SI and S2 at Ogoja, Cross River State. The research area is in the tropical climatic zone of Nigeria and characterized by rainforest, secondary forest vegetation and derived savanna as well as marshy terrain, eroded ridges and different sized hill slopes. The coordinates of Ogoja are 6°30′N and 8°40′E. Average precipitation of 3000mm occurs annually along the coastal areas of Cross River State with an ambient minimum and maximum temperature of 22.4°C and 33.2°C, respectively, and Altitude of 32m (105ft) [6,7].

2.2.2 Data Collection

A sampling plot of about 30m x 30m was mapped out and Leaf samples of *O. gratissimum* were collected within the marked plot. Two sampling locations (S1 and S2) with a total of 3 points for each location were used. At each location, soil sample was collected at the depth of 0-20cm for determination of physico-chemical properties of the experimental soil.

2.2.3 Analysis of soil samples

Soil samples (0-15cm depth) collected from the study site, Ogoja, Cross River State, were analysed using standard methods for physico-chemical properties [9].

2.2.4 Determination of Mineral Elements

Plant materials were rinsed with distilled water and dried. Pestle and mortar was used to grind the dried plant material of each sample into powder form. Sieving of the powdered sample to obtain a fine powdered form was carried out using a 0.002mm wire mesh. Each sample of the fine powdered plant material was kept in small bottles for analysis. The following mineral elements (magnesium, calcium, sodium, nitrogen, phosphorus, potassium, zinc, lead, iron, manganese, and copper) were determined using standard methods [9, 10]. Standard MicroKjedahl method was used to estimate the total nitrogen concentration in the plant dry matter. Phosphorus was determined spectrophotometrically by ammonium-vanadate-molybdate method, potassium by using a frame photometer and other elements by atomic absorption spectrophotometer.

2.2.5 Proximate composition

Leaf samples of *O. gratissimum were* washed several times with water and rinsed with distilled water. They were placed in polybags, thereafter dried in an oven maintained at 60° C to a constant weight, macerated to powder, and stored in sample bottles for analysis. The proximate compositions (moisture, lipid, crude protein, crude fibre, ash, carbohydrate) of plant material were determined using standard method [9].

2.3 Statistical Analysis

Standard errors of the mean values were calculated and data were subjected to analysis of variance (ANOVA) test to compare the means [11] at the probability level of ($P < 0.05$).

3. RESULTS

The physico-chemical properties of the experimental soils (S1 and S2) are shown in Table 1. The pH of soil at location 1 was higher than that of location 2. The contents of nitrogen, phosphorus, magnesium, sodium and potassium in the soil of location 1 were significantly ($P < 0.05$) higher than that of location 2. Conversely, the calcium, hydrogen and organic carbon in the soil of location 2 were significantly ($P < 0.05$) higher than that of location 1. (Table 1).

Table 1: Physico-chemical properties of experimental soils.

Soil parameters	Location I (S1)	Location 2 (S2)
pH	5.20±0.42	5.06±0.14
N (%)	0.72±0.05	0.12±0.04
P(mg/100g)	6.24±0.22	3.30±0.10
Ca (mg/100g)	2.10±0.12	2.66±0.54
Mg (mg/100g)	3.02±0.44	2.20±0.19
Na (mg/100g)	2.83±0.21	1.32±0.13
K (mg/100g)	1.48±0.62	0.57±0.36
H(mg/100g)	0.72±0.06	0.85±0.03
Org. C (%)	3.17±0.35	4.21±0.29

Mean ± standard error from 3 replicates.

The mineral nutrient contents in leaves of *Ocimum gratissimum* obtained from sampling location 1 and 2 are presented in Table 2. The contents of sodium, potassium, nitrogen, phosphorus, iron, manganese, zinc and lead in leaves of *O. gratissimum* at sampling location 1 were higher than that of sampling location 2, while the calcium, magnesium, and copper contents leaves of *O. gratissimum* at sampling location 2 were higher than that of sampling location 1(Table 2). Similarly, the moisture, crude fat, crude fiber and crude protein in leaves of *O. gratissimum* at sampling location 1 were higher than that of sampling location 2, while the ash and carbohydrate contents in leaves of *O. gratissimum* at sampling location 1 were higher than that of sampling location 2 (Table 3).

Table 2: Mineral nutrient contents in Leaves of ***Ocimum gratissimum*** from the experimental locations.

Mineral nutrients	Location I (S1)	Location 2 (S2)
Ca (mg/100g)	6.93±0.40	8.46±0.62
Mg (mg/100g)	12.04±0.28	15.30±0.27
Na (mg/100g)	20.41±0.45	18.10±0.23
K (mg/100g)	70.23±0.22	60.30±0.41
N (%)	2.46±0.34	1.33±0.14
P (mg/100g)	0.67±0.06	0.52±0.03
Fe (mg/100g)	1.24±0.22	0.90±0.02
Mn (mg/100g)	0.52±0.05	0.45±0.04
Cu (mg/100g)	0.26±0.04	0.31±0.07
Zn (mg/100g)	10.72±0.57	6.14±0.19
Pb (mg/100g)	0.18±0.06	0.10±0.04

Mean ± standard error from 3 replicates.

Table 3: Proximate composition of Leaves of ***Ocimum gratissimum*** from the experimental locations.

Proximate contents	Location I (S1)	Location 2 (S2)
Moisture (%)	13.07±0.32	10.21±0.41
Ash (%)	11.07±0.46	15.02±0.90
Crude Fat (%)	3.42±0.18	2.18±0.25
Crude Fiber (%)	12.30±0.33	9.40±0.28
Crude protein (%)	15.22±0.69	13.43±0.38
Carbohydrate (%)	44.92±0.22	49.76±0.50

Mean ± standard error from 3 replicates.

4. DISCUSSION

There were marked variations in the chemical properties of the two experimental soils. These variations could be as a result of differences in both cultural practices and ecological factors [12, 13]. Differences in location of plants could influence the properties of soil in different places, thus leading to variation in soil nutrient composition with the

overriding effects on the chemical constituents of plants grown on such soil [14, 15]. Variations in mineral nutrients and proximate compositions in leafy vegetables among various locations have been reported [8, 16]. The variations in mineral elements may be attributed to the contents of acidity and alkalinity of the soil locations, which are directly influenced by the pH value of such soil [12, 17]. The nutrient contents reported in this study indicate that this plant could serve as a useful supplements in human and animal nutrition. Carbohydrates, proteins, lipids, moisture and fiber are important components of the human food, which are required for specific metabolic functions in the body [18]. The study of quantitative and qualitative compositions of plant materials is of great importance in order to ascertain the nutritional benefits of specific plant parts [19, 20].

5. CONCLUSION

Environmental conditions in different areas could contribute to varying soil properties and varying compositions of the plants. Variations in soil properties as indicated in this study could have a profound influence on the nutrient constituents of *Ocimum gratissimum* grown in the two sampling locations.

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Conflict of Interest

There was no conflict of interest between the two Authors.

Contribution of the Authors

Dr. Mbosowo Etukudo was fully in charge of the plant parameters while Dr. Richard Ukpe was in charge of Soil Chemical characteristics. The Compilation of this paper was organized collectively by the two authors.

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