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Comparative chemical compositions of *Moringa oleifera L.* leaves from selected locations in South-Eastern Nigeria

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Abstract

Plants have been an important source of medicine and nutrition for decades due to the presence of a variety of phytochemicals and nutritional constituents. Comparative chemical compositions of dried samples of *Moringa oleifera L.* leaves from selected locations (Afikpo, Abakaliki, Owerri, Okigwe, Umuahia and Aba) in South-Eastern Nigeria were investigated using standard methods. A set of five samples of *Moringa oleifera L.* leaves from each of the geographical locations were randomly collected, cleaned, air-dried and pulverized. The phytochemical and proximate compositions of the dried *Moringa oleifera L.* leaves were analyzed. The results of the phytochemical and proximate compositions of *Moringa oleifera L.* leaves varied significantly ($P < 0.05$) from one source to another. The phytochemical analysis recorded the concentrations in mg/100 g with Alkaloid content ranged from 1.37±0.10 in Okigwe to 5.85±0.15 in Umuahia; flavonoid from 8.77±0.78 in Abakaliki to 15.37±0.55 in Umuahia; phenol from 10.00±0.56 in Okigwe to 16.90±1.33 in Umuahia; saponin from 1.05± 0.15 in Abakaliki to 1.20±0.10 in Aba and tannin ranged from 6.75±0.37 in Abakaliki to 8.45±1.24 in Aba. The proximate analysis recorded the concentrations in % with crude protein ranged from 10.20±0.31-29.21±0.28; moisture from 3.60±0.61-9.64±0.77; ash from 7.20±0.50-16.10±0.45; crude fat from 6.28±0.28-15.20±0.41; crude fibre from 10.75±0.35-30.90±1.17 and carbohydrate from 25.09±1.01-48.99±0.64 respectively. The phytochemical and proximate values obtained in samples from different locations indicate, that the samples have therapeutic, medicinal and nutritional potentials with Umuahia leading in value. These differences observed could be as a result of variations in soil nutrients from the various sources and seasonal variations. It could therefore be concluded that *Moringa oleifera L.* leaves obtained from Umuahia has more therapeutic, medicinal and nutritional values than those obtained from other locations and could be used to improve health and nutrition in South-Eastern Nigeria.

Keywords: *Moringa oleifera L.* leaves; Phytochemical; Proximate; Selected locations; South- Eastern Nigeria.

1. Introduction

For decades, shrubs and herbs have been an important source of nutrition in medicine. Trees and shrubs with medicinal and nutritional potentials are numerous in Nigeria [1]. According to the World Health Organization (WHO), many people now rely primarily on traditional remedies such as herbs for their nutritional supplement and medicines [2]. The presence of a variety of phytochemicals and nutritional constituents in these plants account for their medicinal values [3]. This explains why their levels in many plants both in Nigeria and elsewhere are been investigated [4]. The antioxidant properties of plant's constituents reveal their medicinal roles in disease prevention or control, usually associated with amphipathic molecules that are referred to as polyphenolic compounds [5]. There is an increase in the dietetic and medicinal uses of plants and vegetables in the society because of its use in the maintenance of health and disease prevention [6].

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Moringa oleifera l. is among those herbs that exhibit nutritional potentials and other uses. It originated from India, has been naturalized in many locations in the tropics and now widely cultivated in other countries [7]. Every part of *M. oleifera L.* is edible, has medicinal properties and is commercially exploitable for the development of medicinal and industrial by-products [6]. Locally, the leaves, fruits, flowers and pods of *Moringa oleifera L.* tree are used as nutritious vegetable in countries like India, Pakistan, the Philippines, Hawaii and some African nations [8, 9, 10]. *Moringa oleifera L.* tree is used as an alternative food supplement to imported one to treat and fight malnutrition because of the usefulness of its chemical constituents in developing countries[11]. Phytochemicals such as flavonoids, polyphenols vanillin, omega fatty acids, carotenoids, ascorbates, tocopherols, beta-sitosterol, moringine, kaempferol and quercetin have been reported in *Moringa oleifera L.* tree [12, 13, 14]; these compounds have various biological activities, including antioxidant, anticarcinogenic, immunomodutory, antidiabetic, antiatherogenic, anti-ulcerogenic, hypocholesterolemic, antimicrobial and hepatoprotective functions[15, 16, 17, 18, 19, 20]. Moreover, *Moringa oleifera L.* tree contain trace elements that are essential to human health. For instance, magnesium, iron, selenium and zinc play an important role in metabolism [21].

In some of the South-Eastern States of Nigeria, *M. oleifera L.* tree is widely cultivated and consumed as vegetable and medicinal plant. Despite the use of this plant for such a wide variety of purposes ranging from dietetic and medicinal values, to date, a detailed comparative studies on phytochemical and nutritional constituents of *M. oleifera L.* leaves from South-Eastern States of Nigeria has not been reported and as such, this study will generate baseline data to bridge this scientific gap.

2. Materials and methods

2.1. Collection and authentication of plant material

The leaves of *Moringa oleifera L.* were selectively obtained from Afikpo located on (553N 756E/5.883N 7.933E), Abakaliki located on (620N 806E/6.333N 8.100E), Aba located on (507N 722E/5.117N 7.367E), Umuahia located on (532N 729E/5.533N 7.483E), Okigwe located on (549 45N 721 2E), and Owerri located on (529 06N 702 06E/5.485N 7.035E), South- Eastern Nigeria, and were authenticated at the Botany Unit of Akanu Ibiam Federal Polytechnic, Unwana, Afikpo, Ebonyi State by Dr. Mrs. S. E. Obasi, the Polytechnic Taxonomist. The voucher specimen (No 120) was placed in a herbarium for future references. These locations are found in Ebonyi, Abia and Imo States of South-Eastern Nigeria.

2.2. Methods

2.2.1. Preparation of Plant Materials

A set of five samples of *Moringa oleifera L.* leaves from each of the geographical locations were randomly collected, cleaned, air-dried, pulverized using Blender/Miller 111, (Model MS-223, China) and the resulting powder were stocked in well labeled – dried black plastic containers inside the storeroom at room temperature of 25^0C for analysis.

2.2.2. Phytochemical Analysis

Alkaloid and phenol determinations were done by the method of [22], and [23]. Saponin Determination was carried out by the method of [23]. Tannin Determination was by [24] Method. Determination of Flavonoid was carried out using [25] Methods.

Proximate determination was carried out according to the method of [26] to quantify the moisture, ash, crude protein, crude fat, crude fibre and carbohydrate components of the sample.

2.2.3. Statistical analysis

One-way analysis of variance (ANOVA) followed by Duncan's multiple range test (DMRT) by Statistical Package for Social Sciences (SPSS) Window 16.0 were used for the statistical analysis of the results.

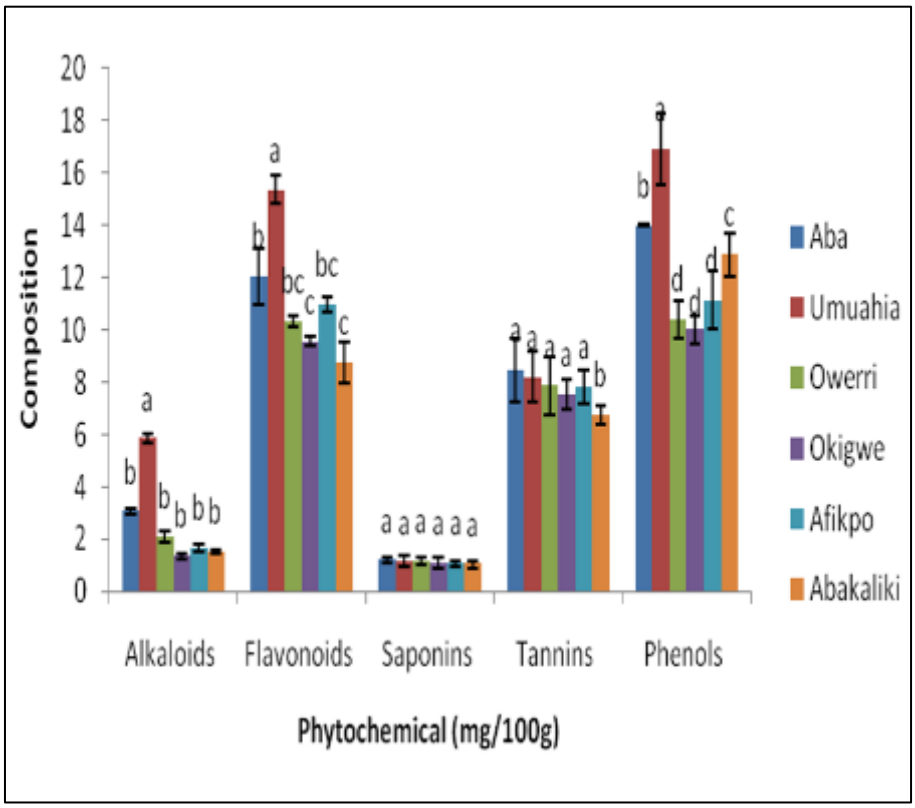
2.3. Results

Figure 1 shows the phytochemical composition of *Moringa oleifera L.* leaf samples.

The results of the phytochemical compositions are recorded in Figure 1 in mg/100g. Alkaloid content ranged from 1.37±0.10 in Okigwe to 5.85±0.15 in Umuahia; flavonoid from 8.77±0.78 in Abakaliki to 15.37±0.55 in Umuahia; phenol

from 10.00±0.56 in Okigwe to 16.90±1.33 in Umuahia; saponin from 1.05± 0.15 in Abakaliki to 1.20±0.10 in Aba and tannin ranged from 6.75±0.37 in Abakaliki to 8.45±1.24 in Aba.

The alkaloid, Flavonoid and phenol contents in samples obtained from Umuahia were significantly ($p < 0.05$) higher than in samples from other locations. Saponin content in samples from different locations were not significantly ($p > 0.05$) different from each other. Tannin contents obtained from Aba, Umuahia, Owerri, Okigwe and Afikpo samples were significantly ($p < 0.05$) higher than that from Abakaliki.



Values bearing different alphabets are significant at ($p < 0.05$).

Figure 1 Phytochemical Composition of *Moringa oleifera L.* Leaves Obtained from Different Locations of South-Eastern Nigeria.

Figure 2 shows the proximate composition of *Moringa oleifera L.* leaves samples.

Proximate compositions in percentage were recorded and the crude fat content ranged from 6.28±0.28 in Okigwe to 15.20±0.41 in Abakaliki; crude protein content from 10.20±0.31 in Abakaliki to 29.21±0.28 in Umuahia; carbohydrate ranged from 25.09±1.01 in Afikpo to 48.99±0.64 in Okigwe; moisture content from 3.60±0.61 in Abakaliki to 9.64±0.77 in Umuahia; ash content from 7.20±0.50 in Okigwe to 16.10±0.45 in Aba and crude fibre from 10.75±0.35 in Umuahia to 30.90±1.17 in Abakaliki.

The crude fat content obtained in samples from Abakaliki was significantly ($p < 0.05$) higher than samples from other locations. The samples from Umuahia contained crude protein content that was significantly ($p < 0.05$) higher than samples from other locations. The carbohydrate content in samples from Okigwe was significantly ($p < 0.05$) higher than samples from other locations The moisture content obtained in samples from Umuahia was significantly ($p < 0.05$) higher than those from other locations. Ash content in samples from Aba and Umuahia were significantly ($p < 0.05$) higher than samples from other locations. While the crude fibre content in samples from Abakaliki was significantly ($p < 0.05$) higher than samples from other location

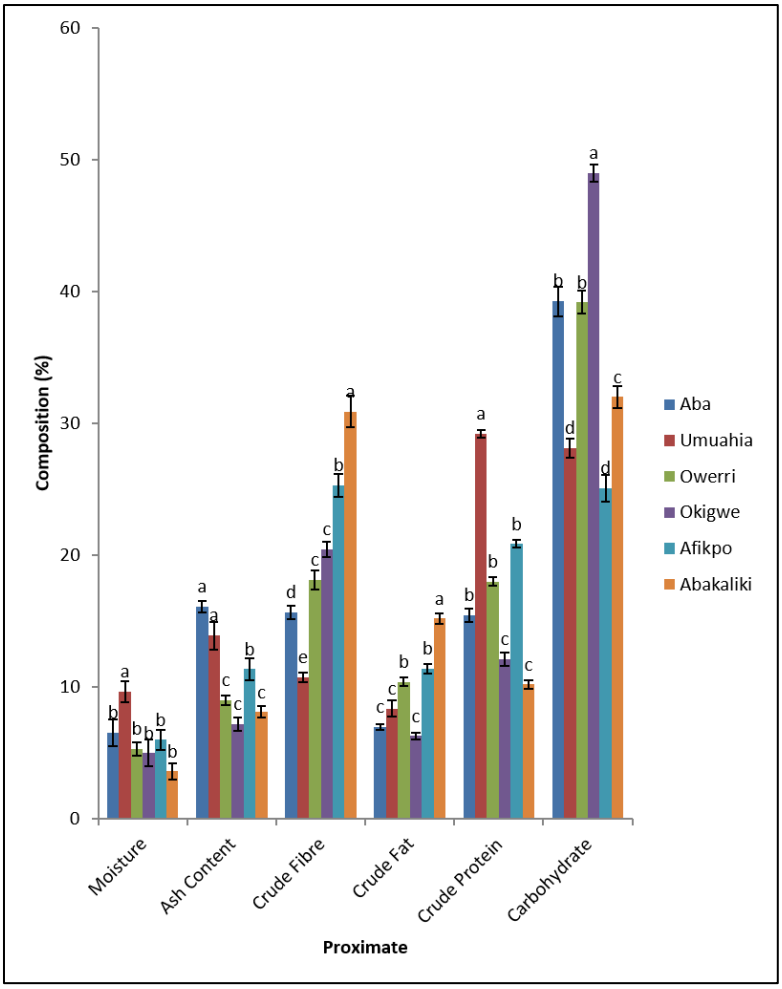


Figure 2 Proximate composition of the *Moringa oleifera L.* leaves obtained from different locations of South-Eastern Nigeria. Values bearing different alphabets are significant at ($p < 0.05$).

3. Discussion

3.1. Phytochemical constituents

Common varieties of plants based foods and herbs contain powerful bioactive chemical substances that can enhance the quality of our health and protect us against many diseases caused by diets [27]. The phytochemical compositions in this study are represented in Figure 1. The ranges of the phytochemical parameters are as follows: alkaloids (1.37-5.85 mg/100g), flavonoids (8.77-15.37 mg/100g), saponins (1.05-1.20mg/100g), tannins (6.75-8.45mg/100g) and phenols (10.00-16.90 mg/100g). The mean range alkaloid and saponin contents in this finding are in accordance with the values gotten by [28]: alkaloids (1.433 mg /100 g) and saponins (1.603 mg/100g). While the values of flavonoids, phenols and tannins in the present study disagreed with their findings: flavonoids (1.030mg/100g), phenols (2.010mg/100g) and tannins (0.127mg/100g). According to [29], low mean range tannin concentration (1.60-1.62mg/g) and saponin (0.83-0.84mg/g) were recorded when compared to this study.

3.2. Proximate compositions

The proximate analysis of *Moringa oleifera L.* leaves obtained from various parts of South-Eastern Nigeria is presented in Figure 2. The dried *Moringa oleifera L.* leaves studied revealed high levels of moisture and crude protein contents in Umuahia, carbohydrate content in Okigwe, crude fat and crude fibre contents in Abakaliki, and ash content in Aba. This present study observed mean range of proximate values: moisture; (3.60-9.64)%, ash; (7.20-16.10)%, crude fiber; (10.75-30.90)%, crude fat;(6.28-15.20)%, crude protein; (10.20-29.21)% and carbohydrate; (25.09-48.99)%. The results of this study suggest that the concentrations of mean moisture, crude protein and carbohydrate were in a close agreement with the ranges found in the work of [30]; (moisture=7.4%, crude protein=24% and carbohydrate=36%).

While the fiber, crude protein and carbohydrate contents observed in this work were not in accordance with the values obtained by [3] (crude fiber=9%, crude fat=6% and ash=7.6%).

Consequently, the findings were not co-related with the work of [31] in terms of protein=11.11%, fiber=8.37%, moisture=3,20% and carbohydrate=56.11%, but agrees in terms of lipid=10.26% and ash=10.90%. Moreover, the values observed by [32] in terms of moisture=9.53% and crude protein=30.29% were higher while ash (7.64%) and crude fat (6.50%) values were lower than the present findings. Besides, [33], in their findings, recorded low levels of crude protein (1.40%), carbohydrate (23.6%), ash (10.0%), high levels of crude fat (20.0%), moisture (10.0%) and crude fiber (35.0%) when compared to our findings. According to the work of [28], the carbohydrate (72.97%) value in their study was higher than our value, while every other parameter in the proximate composition was lower than our values. The high water content observed in the studied *Moringa oleifera L.* leaves (3.60-9.64%), makes it suitable for vegetable juicing as an alternative to whole vegetables. Besides, high moisture content tends to promote microbial contamination and chemical degradation in terms of natural product stability, as it provides a medium for many reactions to occur [34].

The mean range protein contents of *Moringa oleifera L.* leaves found in this study is comparable to that of other leafy vegetables, where the protein content ranged from 8 to 30% of dry weight basis [35]. This protein value makes the *Moringa oleifera L.* leaves to be a good potential source of supplementary protein in animal diets and it may be used to boost animal's protein and energy requirements and raise the immune system against diseases [32]. The appreciable amount of crude fiber is a clear indication that *Moringa oleifera L.* leaves could add bulk to the bowl. The ash content is generally recognized as a measure of quality for the assessment of the functional properties of foods [36]. The mean range ash contents observed in this study indicated that the leaves are rich in mineral elements like potassium, calcium, sodium and phosphorus.

4. Conclusion

The results of this study suggest that the concentrations of phytochemical and proximate composition of *Moringa oleifera L.* leaves collected from different parts of South-Eastern Nigeria exhibited slight changes among each other and their amounts were comparable to the concentration ranges found in other literatures. The differences observed in chemical and nutritional analysis of this studied *Moringa oleifera L.* leaves and other studies may depend on soil types, seasonal variations, the plant's stages of development. Despite these differences, the phytochemical and proximate values observed shows that *Moringa oleifera L.* is a good source of medicine and foods. The chemical and nutritional values of *Moringa oleifera L.* leaves indicate that it can be used as an excellent source of alternative medicine in human and source of food both in human nutrition and development of balanced diets for animal nutrition.

Statement of ethical approval

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Disclosure of conflict of interest

The author declares that no competing interests exist.

Statement of informed consent

I hereby authorize the publication of this study.

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