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Phytochemical, Proximate and Mineral Composition of Leaf Extracts of *Moringa oleifera* Lam. from Nsukka, South-Eastern Nigeria

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Abstract: *The phytochemical constituents aqueous and ethanolic leaf extracts of Moringa oleifera Lam. were assessed and compared. The mineral and proximate analyses were done on the whole leaf extract. The result of the qualitative phytochemical constituents of both leaf extracts of Moringa oleifera showed presence of all the tested phytochemicals (flavonoids, anthraquinone, alkaloids, saponins, steroids, terpenoids, cardiac glycosides, anthocyanin, tannins and carotenoids) with water extracting more of the phytochemicals. Results showed the presence of iron (0.03g/100g), calcium (2.09g/100g), magnesium (0.48g/100g), potassium (1.62g/100g), phosphorus (0.04g/100g), zinc (0.005g/100g), copper (0.01g/100g) and sulphur (0.85g/100g). Proximate analysis revealed the presence of carbohydrate (57.01%), protein (18.92%), fats (2.74%), fibre (9.31%), moisture (4.09%) and ash (7.95%). The results from this study prove the extensive use of the leaves of this plant in ethnomedicine and its potentials in drug formulation.*

Key words: *ethnomedicine, leaf extracts, Moringa, nutrients, phytochemicals*

I. Introduction

Moringa oleifera Lam., popularly called the "miracle tree" is a monogeneric plant in the family Moringaceae. It has long been cultivated and all its parts been consumed and used for a variety of purposes across the tropics (Jahn, 1984). This is because if its impressive range of nutritional and medicinal values (Bukar *et. al.,* 2010). Oluduro (2012) reported the presence the following minerals in the leaves: – sodium (11.86), potassium (25.83), calcium (98.67), magnesium (107.56), zinc (148.54), iron (103.75), manganese (13.55) among others in parts per million and nutrients such as carbohydrate (45.43%), protein (16.15%), fat (9.68%), crude fibre (9.68%), moisture (11.76%) and ash (10.64%). The leaves are edible and are commonly cooked and eaten like spinach or used to make soups and salads. The composition of the amino acids in the leaf protein is well balanced (Foild *et al*., 2001; Ogbe and Afikku, 2011). The leaves and pods are helpful in increasing breast milk in nursing mothers during breastfeeding (Oluduro, 2012) and the seeds have been found to contain a non-toxic natural polypeptide that sediments mineral particles and organics in the purification of drinking water, for cleaning vegetable oil, and for sedimenting fibers in the juice and beer industries (Muyibi and Evison, 1995; Ndabigengesere *et al*., 1995).

Nutritional analysis indicates that *Moringa* leaves contain a wealth of essential disease preventing nutrients which make it suitable to be included in diets as food supplement **(**Krishnaiah *et al*., 2009). *Moringa* leaves have been used to combat malnutrition, especially among infants and nursing mothers and hasten uterine contraction during child birth in pregnant women (Oluduro, 2012). It has also been found that extract obtained from the leaves of *Moringa* in 80 % ethanol contains growth enhancing principles for higher plants (Makkar and Becker, 1996).

In ethnomedicine, *Moringa oleifera* leaves have been used by local traditional healers in treatment of various ailments such as gastric discomfort, stomach ulcers, diarrhea, dysentery and skin infections. In certain case of diabetes, *Moringa* can also be used to stabilize sugar levels and can stabilize arterial tension (Bukar *et al*., 2010; Kasolo *et al*., 2010). The leaves have also been found to possess antitumour, antipyretic, antiepileptic, antinflammatory, antiulcer, antispasmodic, diuretic, antihypertensive and antioxidant properties (Bukar *et. al.,* 2010).

However, It has been reported that climatic factors and stages of maturity could cause variation in distribution of these phytochemicals in leaves of *M. oleifera* (Bamishaiye *et al*., 2011) as well as the choice of solvent as different solvents have different extraction capabilities and spectrum of solubility for phytoconstituents (Handa *et. al.,* 2008). In this view, the experiment was to evaluate the phytochemical constituents of the aqueous and ethanolic extracts and determine the nutritional values of the whole leaf of *Moringa oleifera* in Nsukka, South-Eastern Nigeria.

II. Materials And Methods

2.1 COLLECTION AND IDENTIFICATION OF PLANT MATERIAL

Young leaves of *Moringa oleifera* were collected from a *Moringa* tree growing at Ajuona Obukpa, in Nsukka Local Government of Enugu State, South Eastern Nigeria and was identified and authenticated in the Department of Plant Science and Biotechnology, University of Nigeria, Nsukka.

2.2 PREPARATION OF PLANT EXTRACTS

2.2.1 DRYING PROCESS

The fresh leaves of *Moringa oleifera* were harvested, washed and dried for seven days under shed, at room temperature, to avoid loss of active compounds. The dried leaves were ground to powder using a hand milling machine at the National Centre for Energy Research Development, University of Nigeria and weighed with a Mettler balance. The powdered sample was then stored in an air-tight bottle for further use.

2.2.2 EXTRACTION PROCESS

Aqueous extract: The extraction process used was hot-water method (decoction) following the procedure of Handa (2008). Fifty grammes of the powdered sample were soaked in 500 ml of distilled water and boiled for about ten minutes. After boiling, the sample was double-filtered using cheese cloth and collected in a conical flask and allowed to cool. The filtrate was dried in hot-air oven at temperature of 70^0C.

Ethanolic extract**:** Fifty grams of the powdered sample were soaked in 500 ml of absolute ethanol and allowed to stand for 24 hours. The mixture was stirred occasionally. After 24 hours, the sample was double-filtered using cheese cloth and collected in a conical flask. The filtrate was dried in hot-air oven at temperature of 45^0C (Handa, 2008).

2.3 PHYTOCHEMICAL, MINERAL AND PROXIMATE ANALYSES

Both the qualitative and quantitative phytochemical analyses of the *Moringa* leaf extracts (aqueous and ethanolic) were carried out for the presence of flavonoids, anthraquinone, alkaloids, saponins, steroids, terpenoids, cardiac glycoside, anthocyanin, tannins and carotenoids using the standard procedures as described by Edeoga *et al*. (2005) and Oluduro (2012). The mineral and proximate compositions of the whole leaf extracts were assessed following the methods of Oluduro (2012).

III. Results And Discussions

The result of the qualitative phytochemical analysis as shown in Table 1 showed the presence of flavonoid, anthraquinone, alkaloids, saponins, steroids, terpenoids, cardiac glycoside, anthocyanin, tannins and carotenoid in both the aqueous and ethanolic extracts. Quantitative analysis of phytochemical constituents showed that the aqueous extract had higher amounts of phytochemicals than the ethanolic extract. Aqueous extract had higher anthraquinone (11.68 ± 0.04), alkaloid (3.07 ± 0.00), steroids (3.21 ± 0.00), terpenoids (4.84 ± 0.05), cardiac glycoside (0.36 ± 0.03), tannins (9.36 ± 0.04) and carotenoids (1.16 ± 0.05) while ethanolic extract had higher flavonoid (3.56 ± 0.03) and saponins (1.46 ± 0.03) all in g/100g (Table 2).

The qualitative proximate composition of whole leaf extract of *Moringa oleifera* in g/100g showed presence of all the nutrients tested (Table 3) while the quantitative analysis result was presented as carbohydrate (57.01 ± 0.01), protein (18.92 ± 0.02), fats (2.74 ± 0.03), fibre (9.31 ± 0.02), moisture (4.09 ± 0.04) and ash (7.95 ± 0.04) in Table 4.

The qualitative analysis of minerals composition of *Moringa oleifera* leaf extract in g/100g showed presence of all the tested minerals (Table 5) while the quantitative analysis was presented as nitrogen (3.03 ± 0.02), calcium (2.09 ± 0.01), magnesium (0.48 ± 0.00), potassium (1.62 ± 0.02), phosphorous (0.44 ± 0.01), zinc (0.005 ± 0.00), iron (0.03 ± 0.00), copper (0.01 ± 0.00) and sulphur (0.85 ± 0.01) in Table 6.

The result of the qualitative phytochemical constituents of both leaf extracts of *Moringa oleifera* showed that all the tested phytochemicals (flavonoids, anthraquinone, alkaloids, saponins, steroids, terpenoids, cardiac glycosides, anthocyanin, tannins and carotenoids) were present. This corresponds with the report by Kasolo *et al*. (2010). However, Oluduro (2012) reported absence of steroids, terpenoids and cardiac glycoside while Bamishaiye *et al*. (2011) reported absence terpenoids and cardiac glycoside in the leaf extract. The observed values by Oluduro (2012) for calcium, potassium and zinc were lower but magnesium and iron higher than those observed in this investigation. This could be changes in climatic factors and stages of maturity as noted by Bamishaiye *et al*. (2011), in addition to edaphic factors.

It has been reported that different solvents have different extraction capabilities and spectrum of solubility for the phytoconstituents (Majorie, 1999). The quantitative analysis revealed that the aqueous extract constituted more phytochemicals than the ethanolic extract. This is in concurrence with the report of Oluduro (2012) on the evaluation of antimicrobial properties of leaves of *Moringa oleifera* where it was reported that the ethanolic extract did not exhibit antimicrobial activity on the tested orthopaedics' wound organisms but showed

insignificant effect on the enterpathogens while aqueous extract inhibited almost all in the test organisms, thus rendering water a good solvent for extraction for the leaves. It was also clearly noted that aqueous extract of *Moringa oleifera* leaf possessed significant antimicrobial activity against both Gram –ve and Gram +ve bacterial organism from wound (Oluduro, 2012). The antimicrobial activity of the aqueous extract was due to the ability of water to extract more quantity of antimicrobial phytochemicals than the ethanolic extract (Oluduro, 2012). The phytochemical screening of aqueous and ethanolic root peel extracts of *Moringa oleifera* revealed that water extracted more phytochemicals than ethanol with water having the strongest response to anthraquinone and alkaloids (Kasolo *et al*, 2010). However, Handa *et al*. (2008) recommended ethanol as a better solvent for extraction of alkaloids.

These antimicrobial phytochemicals (especially, alkaloids, tannins, anthraquinone and anthocyanin) act by binding with the cell walls and inactivate the enzymes (Tiwari *et al*., 2011).

Leaves of *M. oleifera*, which are rich in tannins, prove why it is used in treatment of urinary tract infection, diarrhea, healing of wounds and dysentery (Fahey, 2005; Akaneme, 2008).

The presence of terpenoids and saponins explains why *M. oleifera* is used for diabetes treatment (Fahey, 2005), because both constituents' ethno pharmacological uses are to treat diabetes and hyperglycaemia, a disorder often associated with diabetes (Krishnaiah *et al*., 2009).

The presence of alkaloids together with saponins is the reason why *M. oleifera* is used to treat hypertension because saponins prevent the excessive intestinal absorption of this cholesterol and thus reduce the risk of cardiovascular diseases such as hypertension (Fahey, 2005).

The flavonoids have long been recognized to possess anti-allergic, anti-inflammatory, antiviral, anti-proliferative and anti-carcinogenic activities as well as to affect some aspects of mammalian metabolism (Akaneme, 2008).

Table 1: Qualitative Phytochemical Result of the Aqueous and Ethanolic Leaf Extracts of *Moringa oleifera*

Phytochemical	Aqueous extract	Ethanolic extract
Flavonoid	+	+
Anthraquinone	+	+
Alkaloids	+	+
Saponins	+	+
Steroids	+	+
Terpenoids	+	+
Cardiac glycoside	+	+
Anthocyanin	+	+
Tannins	+	+
Carotenoids	+	+

+ = present

Table 2: Quantitative Phytochemical Result of the Aqueous and Ethanolic Leaf Extracts of *Moringa oleifera*

Phytochemical	Aqueous extract	Ethanolic extract
Flavonoid	3.56 ± 0.03	3.83±0.02*
Anthraquinone	11.68±0.04*	10.86±0.06
Alkaloids	3.07±0.00*	2.26±0.04
Saponins	1.46±0.03	1.72±0.05*
Steroids	3.21±0.00*	3.12±0.02
Terpenoids	4.84±0.05*	4.26±0.06
Cardiac glycoside	0.36±0.03*	0.19±0.02
Anthocyanin	0.06±0.00*	0.05±0.00
Tannins	9.36±0.04*	9.19±0.02
Carotenoids	1.16±0.05*	0.08±0.02

* significant at $P < 0.05$

Table 3: Qualitative proximate composition of *Moringa* leaf extract

Nutrient	Composition (g/100 g)
Carbohydrate	+++
Protein	++
Fats	+
Fibre	+
Moisture	+
Ash	+

+ = present; ++ = highly present; +++ = very highly present

Table 4: Quantitative proximate composition of *Moringa* leaf extract

Nutrient	Composition (g/100g)
Carbohydrate	57.01 ± 0.01
Protein	18.92 ± 0.02
Fats	2.74 ± 0.03
Fibre	9.31 ± 0.02
Moisture	4.09 ± 0.04
Ash	7.95 ± 0.04

Table 5: Qualitative minerals composition of *Moringa* leaf extract

Minerals	Composition (g/100g)
Nitrogen	++
Calcium	++
Magnesium	+
Potassium	++
Phosphorous	+
Zinc	+
Iron	+
Copper	+
Sulphur	+

+ = present; ++ = highly present

Table 6: Quantitative minerals composition of *Moringa* leaf extract

Minerals	Composition (g/100g)
Nitrogen	3.03 ± 0.02
Calcium	2.09 ± 0.01
Magnesium	0.48 ± 0.00
Potassium	1.62 ± 0.02
Phosphorous	0.44 ± 0.01
Zinc	0.005 ± 0.00
Iron	0.03 ± 0.00
Copper	0.01 ± 0.00
Sulphur	0.85 ± 0.01

IV. Conclusion

The results of the proximate and mineral analyses of the whole leaf extract revealed the presence of appreciable amount of nutrients in leaves of *M. oleifera* which is in line with the observations of Krishnaiah *et al*. (2009) and Oluduro (2012). This proves why leaves of this plant are used as food supplement and essential for infants and nursing mothers (Krishnaiah *et al*., 2009; Oluduro, 2012).

Furthermore, the present study of the phytochemical constituents has authenticated it's usefulness by traditional herbalists in ethnomedicine. However, efforts should be directed towards harnessing it's potentials in drug formulation and development.

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