



Phytochemical and Nutritional Composition Analysis of *Murraya koenigii* Linn Leaves

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Authors' contributions

This work was carried out in collaboration between both authors. Author AJU designed the study, wrote the protocol, and wrote the first draft of the manuscript. Authors AJU and VON managed the literature searches, analyses of the study performed the spectroscopy analysis and author AJU managed the experimental process and identified the species of plant. Both authors read and approved the final manuscript.

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ABSTRACT

Vegetable is an indispensable constituent of human diet that supplies the body with minerals, vitamins and certain hormone precursors, in addition to protein and energy. The phytochemical and proximate analyses of *Murraya koenigii* Linn leaves were carried out according to methods of AOAC. The plant leaves were assayed for contents of vitamins and mineral elements using spectrophotometric methods. The results of phytochemical analysis revealed that leaves of *Murraya koenigii* Linn contained high quantities of flavonoids (600.25±0.41), alkaloids (343.34±0.25) and tannins (206.05±7.50) with low levels of saponins (0.03±0.01) and carotenoids (0.10±0.05) all in mg/100 g). The results of proximate analysis showed a low crude fibre content of 1.78±0.51% and carbohydrate content of 1.29±0.01% but a relatively high content of moisture 84.60±1.20%, fats and oils 5.13±0.95%, proteins 3.60±1.29% and ash 3.60±0%. The results of vitamin compositions indicated high levels of vitamin C (815.00±0.81), B3 (215.01±1.67), B2 (25.68±4.86) and B1 (13.34±0.59) with low content of vitamins E (1.08±0.12) and A (2.98±0.26) all in mg/100 g. The mineral elements constituents showed presence of Fe (9.44±0.07), Ca (3.77±0.33), Na (46.00±2.00), K (3.13±0.02), Mn (3.38±), Ni (0.12±0.01), Cu (2.40±0.07) and Co

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(0.08±0.01) all in mg/100 g. Thus, these mineral concentrations are all below the tolerable levels except Zn (80.67±0.78 mg/100 g) which is 40 mg/day. Despite that this plant contained numerous chemical constituents that have therapeutic effects in the body as well as those that are essential for normal functioning of the body, this research suggest additional phytochemical analysis in way to identify which alkaloids are specifically present in *M. Koenigii* Linn.

Keywords: Vegetable; *Murraya koenigii* Linn; phytochemicals and proximate compositions.

1. INTRODUCTION

Vegetables serve as an indispensable constituent of human diet supplying the body with minerals, vitamins and certain hormone precursors, in addition to protein and energy [1]. Several vegetable species abound in Nigeria and most West African countries where they are used partly as supplementary feed. These vegetables are known to add taste and flavor as well as substantial amount of nutrients to the diet [1].

Although, the amounts of nutrient constituents in the most commonly used vegetables in Nigeria have been studied to some extent [1,2], the lesser known regional and local species remain virtually neglected. One of the most commonly used species in Nigeria is *M. koenigii* Linn.

M. koenigii commonly known as *meethi neem* is a perennial shrub which grows up to 6 m in height [2]. It belongs to the family Rutaceae and it is an aromatic more or less deciduous shrub that is found throughout up to an altitude of 1500 m [3,4]. *M. koenigii* Linn is a native of India and it is found almost everywhere in the Indian subcontinent excluding the higher levels of Himalayas. They are cultivated for their aromatic leaves [5].

M. koenigii is used in traditional medicine as antiemetic, antidiarrhoeal, dysentery, febrifuge, blood purifier, tonic, stomachic, flavouring agent in curries and chutneys [3]. The whole plant is considered to be a tonic and stomachic [6]. The oil is used externally for treatment of bruises, eruption, in soap and perfume industries [4]. It has been reported that the plant possess antioxidant, antibacterial, antifungal, larvicidal and many medicinal properties. The leaves are used traditionally as a spice in curry and other eatables [3]. Almost every part of this plant has a strong characteristic aroma. The people of South-East Nigeria use the leaves of this plant as a spice in different curry preparations.

In the present study, *M. koenigii* was chosen since it is one of the most widely acclaimed

remedies for the treatment of diabetes mellitus [7]. It is used as flavorings, condiment and folk medicine for the treatment of various metabolic and infectious diseases. The leaves, bark, root and fruits are used intensively in Indian indigenous traditional system of medicine from ancient time, as a tonic [6].

In Nigeria like any other developing nation, only few of these shrubs have their bioactive compounds identified. On the other hands, some plants with good bioactive properties have useful mineral and food value for human and animal consumption. This paper was designed to investigate the nutritional and phytochemical compositions of *M. koenigii*.

2. MATERIALS AND METHODS

2.1 Collection and Preparation of *Murraya koenigii* Linn Leaf Extract

The study was carried out in December, 2013. Young leaves *M. koenigii* were procured from Ojige market along University of Nigeria Nsukka (UNN) road in Nsukka Local Government Area of Enugu State, Nigeria. The fresh leaves were rinsed with clean water and shade dried to a constant weight for two weeks. The dried plant leaves were pulverized to fine powder using a grinding machine, packaged in a glass jar stored at 4°C until use.

2.2 Extraction of Plant Materials

Five hundred grams of fine powder of *M. koenigii* was soaked in 1000 ml of aqueous for 24 hours. It was filtered into a graduated beaker and exposed to mild heat at 55°C in water bath until a semi solid extract was obtained. The obtained semi-solid extract was then used for analysis.

2.3 Quantitative Phytochemical and Proximate Analysis

The quantitative phytochemical and proximate compositions were done using the Official method of AOAC [8].

2.4 Determination of Vitamin Content

The leaves of *M. koenigii* Linn were assayed to determine the amount of vitamin A, C, E, B₁, B₂ and B₃ using Spectrophotometric method [9].

2.4 Determination of Trace Elements/ Macronutrient Status

The sample (2 g) was accurately weighed into a clean platinum crucible, ashed at 500°C and cooled to 25°C in a desiccator for 6 hours, and dissolved in 10 ml of 20% nitric acid and filtered into a 100 ml volumetric flask. Analysis of the sample for Fe, Zn, Ca, Na, K, Mn, Ni, Cu and Co contents was carried out in triplicate on the Atomic Absorption Spectrophotometer (AAS) [10].

2.5 Statistical Analysis

All the tested parameters were subjected to statistical analysis using means and standard deviation.

3. RESULTS

The results of phytochemical analysis showed that the leaf extract of *M. koenigii* had varying amounts (mg/100 g) of phytochemical constituents with typical high content of flavonoids, alkaloids, tannins and low concentration of saponins and carotenoids (Table 1). The results of proximate analysis showed that the plant leaves contained variable amount (%) of proximate composition with all below the Recommended Dietary Allowance (RDA) in males and females aged 40-50 years old (g/day) (Table 2). The vitamin analysis showed that the plant leaves contained appreciable quantity of vitamin content with all below the RDA in males and females aged 40-50 years old (g/day) as well as below the tolerable upper intake levels (Table 3). The results of vitamin analysis showed that the plant leaves contained numerous quantities of minerals with all below the RDA in males and females aged 40-50 years old (g/day) except zinc which is above tolerable upper intake levels (Table 4).

4. DISCUSSION

Phytochemical analysis is very useful in the evaluation of medicinal potentials of plant materials. The result of quantitative phytochemical analysis of the leaves of *M.*

kpenigii Linn showed that the leaves are rich in medicinally important phytochemicals such as flavonoids, alkaloids and tannins. This result of *M. koenigii* leaves agreed with the report of Aja et al. [1] who reported that leaf extracts of *Talinum triangulare* leaves contained higher percentage of flavonoids, alkaloids and low level of saponins. Flavonoids are potent water soluble antioxidants and free radical scavengers which prevent oxidative cell damage and have strong anticancer activity [14]. Flavonoids are also known to have anti-inflammatory, anti-allergic and anti-viral properties. They can lower the risk of arthritis, osteoporosis, allergies and viral disease caused by herpes simplex virus, parainfluenza virus and adenovirus [15]. Flavonoids can help prevent atherosclerosis, which is a disease characterized by the deposition of fats inside the arterial wall. Such deposition narrows the arteries hindering blood flow to the vital organs of the body, like heart and brain. This increases the risk of heart attack and stroke. Flavonoids, by preventing atherosclerosis, lower the risk of coronary heart diseases [16].

Alkaloids are the most therapeutically significant plant substance [13,16]. Pure isolated alkaloids and the synthetic derivatives are used as the basic medicinal agents for their analgesic, antispasmodic and bactericidal effects [17]. However, alkaloids inhibit certain mammalian enzymic activities such as those of phosphodiesterase, prolonging the action of cyclic AMP. They also affect glucagons and thyroid stimulating hormones while some forms have been reported to be carcinogenic [18]. It is noteworthy that at the concentration of these chemicals in edible vegetables, they are usually non-toxic because steaming or boiling reduces their levels in vegetables [19]. Thus, the leaves of *M. koenigii* showed high level of alkaloids.

The high content of tannins may be responsible for the astringent and wound healing properties of *M. koenigii* leaves. The level of tannins in the leaves of *M. koenigii* as revealed by this study strongly supports its use for healing of wounds [20]. Tannins are stringent bitter plant polyphenols that bind, precipitate and shrink proteins and various organic compounds. Tannins are known to have anti-viral, anti-tumor, anti-inflammatory and healing properties on wounds, kidney etc [3].

The presence of saponin is an indication that the plants possess the property of precipitating and

coagulating red blood cells. Some of the characteristics include formation of foams in aqueous solutions, hemolytic activity, cholesterol binding properties and bitterness [21]. The result revealed very low level of saponin and this observation may suggest low antioxidant effect. The result showed that the leaves contained low concentration of HCN. This low level of HCN is good as its consumption is not likely to lead to cyanide related toxicity making its consumption safe with respect to cyanide toxicity [22].

The proximate analysis showed that the leaf of *M. koenigii* suggests that the leaves can make fair contributions to protein, fats, etc to diets. The high quantity of fats/oils indicate the plant is a good sources of energy while that of protein showed that the plant help in formation and synthesis of many biologically active molecules such as hormones, enzymes and structural components [15]. The high moisture content is in agreement with the research of Maheswari and Cholarani [4] who reported that the moisture content of methanol leaves extract of *M. koenigii* Linn was found to be 90%.

The result of vitamin analysis showed that the leaves contained variable amounts of vitamins in the order of C>B3>B2>B1>E >A. This observation agreed with the findings of Okwu and Josiah [18] who reported that *Aspilia Africana* and *Bryophyllum pinnatum* are rich in vitamins such as C, B3, B2 and B1. Although, the values of vitamins obtained here are higher than the values reported by Okwu and Josiah [18]. This plant is a good source of ascorbic acid, niacin, riboflavin and thiamine (Table 3). Ascorbic acid is vital for the body functions [15]. Lack of ascorbic acid impairs the normal formation of intercellular substances throughout the body, including collagen, bone matrix and tooth dentine [23]. The pathological change resulting from this defect is the weakening of the endothelial wall of the capillaries due to a reduction in the amount of intercellular substances [15]. Therefore, the clinical manifestations of scurvy hemorrhage from mucous membrane of the mouth or gastrointestinal tract, anemia and pain in the joints can be related to the association lack of ascorbic acid and normal connective tissue metabolism [24]. This function of ascorbic acid also accounts for the requirement for normal wound healing. As a result of the availability of ascorbic acid in high concentration in the vegetable, it can effectively help prevent scurvy and be used in herbal medicine for the treatment of common cold and other diseases [5].

The minerals are very important in human nutrition. Calcium (Ca), potassium (K) and magnesium (Mg) are reported to be responsible for the repair of worn out cells, strong bones and teeth, building of red blood cells and for body mechanisms [15]. Also, Ca and K are essential for disease prevention and control and may therefore contribute to the medicinal influences of the plant [25] Potassium (K) is needed for growth and transmission of the nervous system to transmit messages as well as regulating the contractions of muscles [15].

Minerals are important for vital body functions such as acid, base and water balance. Calcium is good for growth and maintenance of bones, teeth and muscles [10]. Normal extracellular calcium concentrations are necessary for blood coagulation and for the integrity, intracellular cement substances [13]. The metal analysis showed the presence of all the metals screened for which include Fe, Zn, Ca, Na, K, Mn, Ni, Cu and Co. The result of this study is in agreement with the report of Okunrobo et al, [12]. The quantity of these metals revealed that they were well below tolerable upper intake level and within the recommended daily intake in healthy individuals established by the Dietary Reference Intakes (DRIs). However, the zinc content (80.67 ± 0.78 mg/100 g) is well above the tolerable 40 mg daily). Experts (Nutritionists) on vitamins and minerals [14] have established a safe limit of 25 mg daily for zinc which is lower than 80.67 ± 0.78 mg/100 g. The high level of zinc above the tolerable limit can cause abdominal pain, dyspepsia, nausea, vomiting, diarrhea, gastric irritation and gastritis and much more complications on prolonged use. In view of this result obtained, extract of *M. koenigii* leaves should be administered with caution especially in infants.

Table 1. Phytochemical analysis of ethanol extract of *Murraya koenigii* Linn

Phytochemicals	Concentration (mg/100 g)
Alkaloids	343.34±0.25
Cyanogenic glycosides	11.08±0.32
Phenolics	1136.78±0.34
Saponins	0.03±0.01
Flavonoids	600.25±0.41
Tannins	206.05±7.5
Carotenoids	0.10±0.05

Data are means of triplicate determinations on a dry weight basis ± standard deviation

Table 2. Proximate Composition of *Murraya koenigii* Linn Leaves

Variable	Content (%)	RDA in males aged 40-50 years old (g/day) [11]	RDA in females aged 40-50 years old (g/day) [11]
Carbohydrates	1.29±0.01	130	130
Proteins	3.60±1.29	56	46
Fats and Oils	5.13±0.95	20 -35% of calories	20 -35% of calories
Crude fibre	1.78±0.51	38	25
Ash	3.60±0.20	-	-
Moisture	84.60±1.20	-	-

Data are means of triplicate determinations on dry weight basis ± standard deviations

Table 3. Vitamin Composition of *Murraya koenigii* Linn Leaves

.Vitamins	Concentration (mg/100 g)	Dietary RDA in a males aged 40-50 years old (mg/day) [12]	Dietary RDA in a females aged 40-50 years old (mg/day) [12]	Tolerable upper intake levels [25]
A	2.98±0.26	900	700	3000
C	815.00±0.80	90	75	2000
E	1.08±0.12	15	15	1000
B1	13.34±0.59	1.2	1.1	-
B2	25.68±4.86	1.3	1.1	-
B3	215.01±1.67	16	14	35

Data are mean of triplicate determinations on a dry weight basis ± standard deviation

Table 4. Mineral Elements Status of *Murraya koenigii* Linn Leaves

Mineral element	Concentration (mg/100 g)	RDA in males aged 40-50 years old (mg/day) [13]	RDA in females aged 40-50 years old (mg/day) [13]	Tolerable upper intake levels (mg/day) [13]
Fe	9.44±0.07	8	18	45
Zn	80.67±0.78	11	8	40
Ca	3.77±0.33	1000	1000	2500
Na	46.00±2.00	1500	1500	2300
K	3.13±0.02	4700	4700	-
Mn	3.38±0.62	2.3	1.8	11
Ni	0.12±0.01	-	-	1
Cu	2.40±0.07	900	900	10
Co	0.08±0.01	-	-	-

Data are means of triplicate determinations on dry weight basis ± standard deviations

Sodium is the most abundant mineral in *M. koenigii*. The high sodium content of *M. koenigii* might be a disadvantage due to the direct relationship of sodium intake with hypertension on human. Calcium in *M. koenigii* is in moderate level and this calcium concentration is necessary for blood coagulation and for integrity of intracellular cement substances [25]. Thus, the potential of *M. koenigii* to stop bleeding and its use in treating wounds could be as a result of its high calcium content. Also high potassium content suggests that it may enhance vital cell functions including neuro-transmission, muscle contraction, and maintenance of acid-base balance [16].

This study has shown that *M. koenigii* is a good source of phytochemicals that are biologically important, thus it can be potential sources of useful drugs. Since this plant contains appreciable level of vitamins and minerals that are readily available, it could be consumed to supplement the scarce or non available sources of nutrients.

5. CONCLUSION

In conclusion, the result of this study showed that leaf of *Murraya koenigii* contained appreciable amounts of chemical constituents such as phytochemical, proximate, vitamin and mineral constituents and could be useful as a source of

drugs and nutrients. Though the leaves in particular contain relatively high levels of alkaloids, the processing methods prior to consumption which may include cooking reduce their final consumed amount. The levels of its mineral elements contents are below the tolerable limits and within the recommended daily intake except zinc which is above the tolerable limit established by the overseeing body. Therefore, this study suggests additional phytochemical research, in way to identify which alkaloids are specifically present in *Murraya koenigii*. In summary therefore, the plant has high nutritional value and is recommended as a cheap source of plant protein, energy and mineral elements.

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CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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