Phytochemical Screening, Elemental and Proximate Analysis of *Maerua angolensis (Capparaceaea)* Stem Bark

Abstract

This work was designed to explore the phytochemicals, elemental and proximate analysis of Maerua angolensis Stem bark were determined using standard analytical methods. The phytochemical screening showed alkaloid (271.30 mg /100g), tannins (340.25 mg /100g), flavonoid (176.85 mg /100g), reducing sugar (41.20 mg /100g), glycosides (184.30 mg /100g), steroids (112.30 mg /100g), anthraquinones (167.85 mg /100g) and saponin (225.61 mg /100g). Also the elemental analysis carried revealed the concentration of Manganese (0.029 mg/kg), Copper (0.059 mg/kg), Calcium (0.070 mg/kg), Sodium (7.530 mg/kg), Zinc (0.028 mg/kg), Chromium (0.158 mg/kg), Lead (0.007 mg/kg), Iron (0.100 mg/kg) and Magnesium (0.020 mg/kg). The result of the proximate composition showed that the moisture, fat, crude protein, crude fibre, ash, carbohydrate and energy value content of the samples were 3.58±0.04 %, 6.25±0.09 %, 21.79±0.26 %, 48.51±2.31 %, 13.28±1.86 %, 6.60±1.79 % and 169.81±8.49 kcal/100g respectively. The P^H value obtained was 5.65±0.09. These indicate that the plant can be effective source for drugs. The elemental and proximate analysis shows that it contained appreciable amount of nutrients which could be included in diets to supplement human daily nutrient needs and animal.

Key words: Wild, Edible, Plants, Extract, Composition, Drugs and Food

Comment [U1]: pH not P^H

Comment [U2]: Keywords are usually arranged in alphabetical

INTRODUCTION

Natural products and their reactants have been utilized by man since creation, when plants' leaves, bark or root are mixed with water to make a medicinal portion. A complex mixture of organic natural product is actually extracted for its biologically active components [1].

According to FAO, about 1 billion people especially in developing countries depend on edible wild plants in their diets [2]. The use of wild edible plants in different localities provide optimum source of nutrients. Plants serve as indispensable constituents of human diet supplying the body with mineral salts, vitamins and certain hormones precursors, in addition to protein and energy [3]. Also plants serve as a source of medicinal product and shelter to man and his livestock. In the earlier stage man depended on wild food, which is much abundant within his immediate environment, as the population grows, however, sources of food became more difficult to him, which necessitated domestication of many plants [1, 4].

Food is no doubt the most basic necessity for one to efficiently function in his own ecosystem [5]. Since creation, man has used plant as source of food and drug [6]. The use of medicinal plants as food alternative traces back to ancient human civilization [7, 8]. The useful products obtained from plants directly or indirectly, demonstrate their importance to man.

There are about 35,000 species of higher plants that are used for medicinal purposes [9]. Some of these species of plants contain nutrients that have therapeutic properties and are nutritionally important because of their high contains of minerals, essential fatty acids, fibers and proteins [10]. Phytochemicals are chemical compounds that occur naturally in plants. The efficiency of medicinal plants for therapeutic purposes is often based on their organic constituents such as flavonoids, tannins, alkaloids and essential oils [11]. Traditionally the usage of plant in curing illness has deep roots in human history [8]. Ethno pharmacological uses of plants prevail among the various Nigeria communities. Plants continue to play a prominent role in primary health care of about 80% of the world population. [10].

Plants are the cheapest and most important available sources of nutrients, supplying the body with mineral salts, vitamins and certain hormone precursors, protein, energy and essential amino acids [12, 13].

Maerua angolensis (family Capparidaceae) is a tropical plant that is widespread in the savannah area of tropical Africa to South Africa and Swaziland. It is a tree whose size varies from medium to big and growing up to 10 – 20 meters high. It is commonly found growing in bush and rocky areas but planted on graves in Nupe area of Nigeria. Maerua angolensis has a long history of use in traditional medicine to manage various painful conditions in Nigeria and other West African countries [14, 15].

The plant is used in indigenous systems of medicine for the treatment of psychosis ecthyma, epilepsy, diarrhea and dysentery. It is also used as sedative and treatment of liver disease. [7].

Maerua angolensis has been extensively used in traditional system of medicine in many countries. It is used in the treatment of pain, however lacking a pharmacological evaluation for its analgesic effect, the leaves, stem bark and roots of *Maerua angolensis* have significant analgesic activity against chemical induced pain model in mice. In a dose dependent manner, however stem bark extract was more potent. [16]. It is used locally for the treatment of psychosis, ecthyma, epilepsy, laxative sedative, dyspepsia neurasthenia, liver disease [8].

The pharmacological investigation shows that *Maerua angolensis* is worldwide used for antioxidizing value [17]. The oxidative stress defines itself as being a loss of the balance between oxidizing and antioxidants within a cell [18].

Phytochemical screening conducted on the plant of recent showed that the methanol extract of the stem bark contained tannins, saponins, flavonoids, cardiac glycosides and alkaloids [19].

As various medicinal plant species are used either in the form of extract or decoction by the local people in different regions, therefore, evaluating their nutritional significance can help to understand the worth of these plants species in different ecological conditions. Some of these medicinal plants serve as both food and medicine [20].

Quantifying proximate composition is important in ensuring the requirements of food regulations and commercial specifications for instance moisture content of flesh (of a substance) is a good indicator of its relative content of energy, protein and lipid [21, 22].

According to [23] use of wild edible plant in different localities provides optimum source of nutrients. The quantity of nutrient and Phytochemicals varies not only with the species of edible plant but also (for the same Varity) with the location in which they are growing because of the variation of the soil on which they grow and other environmental factors of the location. Hence it is important to evaluate nutrient and phytochemicals of the edible plants in given location, before recommending them as sources of food for the local community.

The information on the nutrient and phytochemicals of Maeruna Angolaensis (capparaceae) stem bark growing in the study area is scanty.

Comment [U3]: angolensis, not Angolensis

The objective of the study is to investigate the phytochemicals, elemental and proximate constituents of Maeruna angolensis (capparaceae) stem bark in the study area. The findings will serve as a guide to dietetics and nutritionist whether or not to recommend it as sources of drugs and food to the local community.

MATERIALS AND METHODS

Sample Collection and Identification

Maerua angolensis plant belongs to the family *Capparaceae* and was collected from the bush area of Muchala, Mubi North Local Government Area of Adamawa State, Nigeria. The plant was

identified by a taxonomist in the Department of biological Science, Adamawa State University Mubi and preserved in the Department of Chemistry.

Preparation of Sample

The stem bark of *Maerua angolensis* plant was air dried in Chemistry laboratory 2, Science Complex of the Faculty of Science, Adamawa State University, Mubi. The plant was air dried under shade and was weighed and grounded to get a coarse powder form using sterile mortar and pestle. The powder was stored in an air tight container and was used for successive analysis [24].

Comment [U4]: how many mesh powder particle size

Phytochemical analysis

Maerua angolensis stem bark was tested for the presence of bioactive compounds. The phytochemicals of the plant samples were estimated following the procedure adopted by Nwankwo and Ukaegbu-Obi, [25]

Test for tannins

200 mg of crude plant extracts was mixed with 2 ml of 2% solution of $FeCl_3$. Blue-green color was observed which indicates the presence of tannins.

Test for flavonoids (alkaline reagent test)

200 mg of extract was mixed with 2 ml of 2% solution of NaOH. An intense yellow colour formed which turned colorless on addition of few drops of diluted acid was observed which indicated the presence of flavonoids.

Test for saponins

200 mg of extract was mixed with 5 ml of distilled water in a test tube and was shaken vigorously. The formation of Stable foam was observed which shows an indication of the presence of saponins.

Comment [U5]: for 10 minutes and add 1 ml HCL 2M, the foam persistent stable

Test for anthraquinones

0.5g of the sample was boiled in 3ml of 1% HCl and filtered. The filtrate was shaken with 5ml benzene and the benzene layer was removed, 10 % NH_4OH was added and pink/violet color in the alkaline phase was observed which indicated the presence of anthraquinones.

Test for glycosides (Salkowski's test)

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200 mg of extract was mixed with 2 ml of chloroform. Then 2 ml of concentrated H_2S0_4 was added carefully and shaken gently. A reddish brown color was observed which indicated the presence of steroidal ring, that is, glycone portion of the glycoside.

Test for alkaloids

200mg of extract was mixed with 10 ml of methanol. To 2ml of the filtrate was added 1% HCl and then steamed. To 1ml of the filtrate was added 6 drops of Wagner reagent. Brownish-red precipitate was observed which indicated the presence of alkaloids.

Test for steroids

To 2ml of acetic anhydride was added 0.5g of the sample followed by an addition of 2ml H_2SO_4. The color changed from violet to blue green indicating the presence of steroid [25]

Test for reducing sugar

0.5g of the sample was dissolved in 5ml water, and small amount of Benedict reagent was added. During a water bath, which is usually 4-10 minute, the solution progressed in the colour of blue (with no glucose presence), green, yellow, orange, red and brown indicating high glucose presence.

Comment [U7]: 8 drops not small amount

Test for terpenoids (Salkowski test)

5 ml of each extract was mixed in 2 ml of chloroform, and concentrated H_2SO_4 (3 ml) was carefully added to form a layer. A reddish brown coloration of the interface was formed which was an indication of positive results for the presence of terpenoids [25]

Determination of phytochemicals by HPLC

5g of prepared sample was placed into $25cm^3$ standard volumetric flask and made up to mark over diluent. The solution was refluxed, shaked, centrifuged and decanted. Then filtrate was filtered using the HPLC grade filter paper [26].

Comment [U8]: and then inject to HPLC

Elemental analysis

The dried sample was weighed into a crucible and placed in a muffle furnace at room temperature and the temperature was raised to 550^0C for three hours to complete ash. The ash was dissolved in hot (10% HNO_3), filtered and diluted to required volume in a standard flask with (0.01M HNO_3). The elements in solution were determined using atomic absorption spectrophotometer (AAS) following the procedure adopted by AOAC [26].

Proximate Analysis of the sample

Proximate Analysis of the samples was carried out following the methods described by Mbaeyi-Nwaoha and Emejulu [27].

Statistical Analysis

All determinations were replicated three times and results were reported in mean (±) standard deviation.

RESULTS

The results of the phytochemical constituents and their quantities are presented in Tables 1 and 2 respectively while Table 3 contains the result of the elemental analysis. The results for the proximate compositions are shown in Table 4.

The results indicates that the plant is rich in crude fibre with the highest percentage followed by crude protein meaning that the plant is rich and a good source of protein. It has appreciable ash content indicating that the plants contain inorganic components. The proximate compositions is in the order Crude Fibre > Crude Protein > Ash Content > Carbohydrate > Crude Lipid > Moisture Content (Table 4). The plant is rich in organic matter with 86.72% indicating that it's a moderate source of energy. Figure 1 Shows the Comparison of the proximate composition of Maerua angolensis with other edible plants.

Table 1: Result of phytochemical constituents present

Phytochemical	Sign
Alkaloids	+
Tannins	+
Flavonoids	+
Reducing sugars	+
Steroids	+
Anthraquinones	+
Saponins	+

Keys: + = Present

Table 2: Result of the quantitative phytochemical analysis of the sample

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(Composition in mg/100g)

Phytochemical Constituents	Values obtained
Alkaloids	271.30
Tannins	340.25
Flavonoids	176.85
Reducing sugars	41.20
Steroids	112.30
Anthraquinones	167.85
Saponins	225.61

Table 3: Results of elemental composition of the samples (mg/kg)

Elements	Concentration
Magnesium (Mg)	2.516 ± 0.020
Iron (Fe)	5.200 ± 0.100
Lead (Pb)	0.146 ± 0.007
Chromium (Cr)	3.233 ± 0.158
Zinc (Zn)	1.256 ± 0.028
Manganese	1.270 ± 0.029
Copper (Cu)	2.243 ± 0.059
Cadmium (Cd)	B.D.L.
Calcium (Ca)	5.066 ± 0.070
Sodium (Na)	163 ±7.530

Keys: B.D.L. = Below Detectable Level
The data are mean of three replicates plus standard deviations.

Table 4 Proximate compositions (% Dry Weight bases) of *Maerua angolensis* stem bark

Parameters	Mean±S.D

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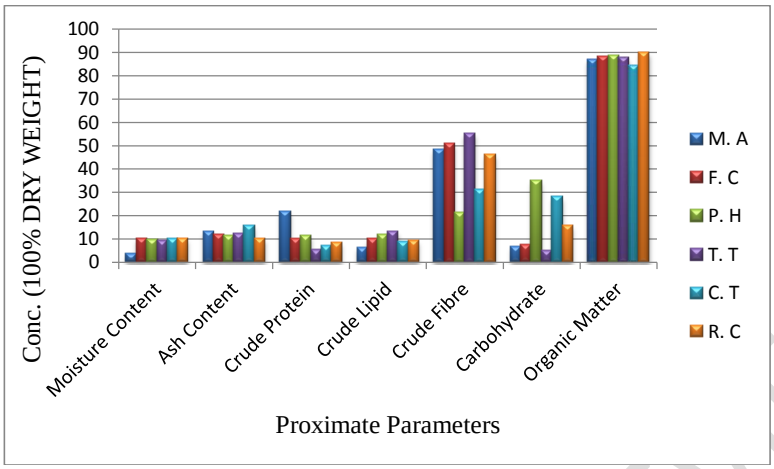
Moisture Content	3.58±0.04
Ash Content	13.28±1.86
Crude Protein	21.79±0.26
Crude Lipid	6.25±0.09
Crude Fibre	48.51±2.31
Carbohydrate Content	6.60±1.79
Organic Matter	86.72±1.86
Caloric Value (kcal/100g)	169.81±8.94
p^H Value	5.65±0.09



M. A = Maerua angolensis, F. C = *Fagonia cretica L.*, P. H = *Peganum harmala L.*, T. T =*Tribulus Terrestris L.*, C. T= Chrozophora tinctoria and R. C = Ricinus communis L.,

Fig. 1 Comparism of the proximate composition of Maerua angolensis with some other edible plants

DISCUSION

Table 1 shows the result of the phytochemical constituents screening which revealed that alkaloids, tannins, flavonoids, reducing sugars, glycosides, steroids, anthraquinones and saponin were presence.

The result of phytochemical analysis revealed the compositions of the constituents in the following order: Tannins (340.25) > Alkaloids (271.30) >Saponins (225.61) > Glycosides (184.30) > Flavonoids (176.85) >Anthraquinones (167.85) > Steroids (112.30) > Reducing sugars 41.20 mg/100g (Table 2).

The presence of these metabolites indicates the great potentials of the plant as a source of useful phytomedicines. For instance the presence of flavonoids might be responsible for its use as anti-inflammatory recipe in Chinese follelore medicine as some flavonoids have anti-inflammatory effects on both acute and chronic inflammation [7].

Comment [U12]: Folklore not follelore

Some plants that posse alkaloids are known for decreasing blood pressure and balancing the nervous system in case of mental illness. The presence of tannins could also show that it is an astringent help in wound healing and anti-parasitic. The presence of saponins shows the class of

natural products involved and can be used to enhance penetration of micro molecules such as protein through cell membrane. It also indicates the plant potential activity on antimicrobial agents [16].

These findings were in agreement with the result reported by Ayo, *et al*. [19] which revealed the presence of reducing sugars, alkaloids, saponins, flavonoids and tannins in the methanolic extract of *Maerua angolensis* leaves.

The result of elemental analysis of the samples revealed that the plant contains Mg, Fe, Pb, Cr, Zn, Mn, Cu, and Ca. The most abundant element is Na (163 ± 7.530), followed by the rest in the order Iron (5.200 ± 0.100) > Calcium (5.06 ± 0.70) > Chromium (3.233 ± 0.158) > Magnesium (2.516 ± 0.020) > Copper (2.243 ± 0.059) > Manganese (1.270 ± 0.029) > Zinc (1.256 ± 0.028) > Lead (0.146 ± 0.007) while Cadmium is below detectable level (Table 3).

Magnesium is an important mineral element in connection with circulatory diseases such as heart disease [7]. High magnesium concentration is a component of leaf chlorophyll in plants.

Copper is an essential trace element in human body and exist as an integral part of copper proteins cerulosmin which is concerned with the release of Iron from the cells into the plasma and is involved in energy metabolism [28]. The presence of copper, manganese and zinc indicates that the plant is essential for immune function [29].

Comment [U13]: Ceruloplasmin not cerulosmin

Lead occurs naturally in the environment. Every one may be exposed to trace amount of lead through air, soil, house hold dust, food, drinking water and various consumer products [30].

Sodium has an important role in maintaining the water balance within the cells and in the function of both nerve impulse and muscles. It also helps in the maintenance of normal acid-base balance. An adult need about 3g per day of sodium but modern dietary habits take in 5 – 20 g per day [31].

Calcium plays an important role in building and maintaining strong bones and teeth, large part of human blood and extracellular fluids. Approximately 99% of the body calcium is stored in the bones and teeth [32]. The studied plant (*Maerua angolensis)* is essential in building up the level of calcium in the body.

Cadmium was not detected in the sample. Cadmium causes kidney and liver problem on long time of its accumulation [33]. *Maerua angolensis* is safe for consumption since these toxic elements are in low concentration or not detected.

The moisture content of the sample was found to be 3.58±0.04% (Table 4). The low moisture content would hinder the growth of microorganisms and the storage life would be high [34]. Moisture content is among the most vital and mostly used measurement in the processing,

preservation and storage of food [35]. The moisture content of sample is lower compared to 9.70%, 10.10%, 10.30% 10.30 and 9.20 in *Peganum harmala L.*, *Chrozophora tinctoria L.*, *Ricinus communis L*. in *Fagonia cretica and Tribulus Terrestris L.* respectively (Figure 1) [36].

The ash content of the sample was 13.28±1.86% on dry matter (DM) bases (Table 4). Ash in food contributes the residue remaining after all the moisture has been removed as well as the organic materials (fat, protein, carbohydrates, vitamins, organic acid etc) have been incinerated at a temperature of about 500^0C. Ash content is generally taken to be a measure of the mineral content of the original food [35, 8]. The ash content of the sample is slightly high compared to 11.20%, 10.10%, 12.00% and 12.10% in *Peganum harmala L.*, *Ricinus communis L.*, *Fagonia cretica and Tribulus Terrestris L.* respectively and slightly lower than *Chrozophora tinctoria L.*, (15.70%) figure 4.

Crude fibre in food or plant is an indication of the level of non-digestible carbohydrate and lignin. The crude fibre obtained in the sample was 48.51±2.31% on DM bases (Table 4). The result obtained showed a good amount of fibre in the stem, an indication that it can serve as a good source of fibre which might aid digestion, help reduce serum cholesterol level, risk of coronary heart disease and hypertension [37]. The crude fibre content was high compared to 21.10%, 30.9% and 46.2% in *Peganum harmala L.*, Chrozophora tinctoria L., and Ricinus communis L. respectively but low compared to 50.8% and 55.20% in *Fagonia cretica and Tribulus Terrestris L.* respectively Figure 4. Crude fibre is made up largely of cellulose together with a little lignin which is indigestible in human [35]). The high fibre and protein content is a further confirmation of its use as vegetable. Fibre reduces tracolonic pressure which is beneficial in diverticular disease. Plants with high fibre are adequate for better rumination and digestion in ruminant animals [8, 36].

Comment [U14]: Intracolonic not tracolonic

The crude lipid content was 6.25±0.09% (D M) bases (Table 4). Lipid provides very good sources of energy and aids in transport of fat soluble vitamins, insulates and protects internal tissues and contributes to important cell processes. More so, it is good to add lipid (fat) to most of our diets, because many body functions depend on lipids [35]. The crude lipid content of *Maerua angolensis* stems is low compared to 11.80%, 8.50%, 9.20%, 9.80% and 13.30% in

Peganum harmala L., Chrozophora tinctoria L., Ricinus communis L., Fagonia cretica and Tribulus Terrestris L. respectively (Figure 1). Crude lipid are the principal sources of energy. One gram of lipid provides 9.0 kcal (37.33 kJ) of energy [37] which indicates that 100 g of *Maerua angolensis* stem lipid should provide about 56.25 kcal (233.31 kJ) of energy.

The crude protein of the sample was 21.79±0.26% DM bases (Table 4). The recommended dietary allowance (RDA) for protein is 56g for individual weighing 70kg and 46g for adult weighing 50kg, children may consume 2kg/day [35, 36]. The plant is a moderate source of protein. According to Akpabio and Ikpe, [35], proteins from plant sources have lower quality but their combination with many other sources of protein such as animal protein may result in adequate nutritional value. The crude protein content of the sample was high compared to 11.20%, 6.90%, 8.40%, 9.80 9.80% and 5.20% in *Peganum harmala L., Chrozophora tinctoria L., Ricinus communis L., Fagonia cretica and Tribulus Terrestris L.* respectively (Figure 1)

Comment [U15]: Too much ??? child needs approximately 18 – 20 grams protein per day

The carbohydrate content was 6.60±1.79% (Table 4). The plant is a low source of carbohydrate when compared with the Recommended Dietary Allowance (RDA) of 130g [34, 35] but can be used as supplement in an extreme condition of carbohydrate requirement. The carbohydrate content of the samples were low compared to 35.00%, 27.90%, 15.80%, 7.20% in *Peganum harmala L., Chrozophora tinctoria L., Ricinus communis L.* and *Fagonia cretica* respectively *but high compared to 5.00% in Tribulus Terrestris L.(Figure 1).* This relatively low carbohydrate content makes it suitable to be eaten when one wants to lose weight [36].

The caloric value of the samples were 169.81±8.49 kcal/100g. An average person requires 2000-3000 kcal per day [16]. The total energy value was low compared to 418.10 kcal/100g, 420.20 kcal/100g, 422.80 kcal/100g, 440.70 kcal/100g, and 380.60 kcal/100 g in *Peganum harmala L.*, Ricinus communis L**.,** *Fagonia cretica L., Tribulus Terrestris L. and* Chrozophora tinctoria L. respectively (figure 1). The plant can contribute to the caloric requirement of the body. The low calorific value of *Maerua angolensis* stem is an indication that it can be recommended to individuals suffering from overweight and obesity [36].

The organic matter content of the samples was obtained to be 86.72±1.86% on dry matter bases (Table 4) indicating a high level of organic components compared to the inorganic composition with a value about 13.28%.

The *pH* value of the samples was 5.65±0.09 indicating that the plant is weakly acidic in nature probably as a result of the soil P^H where the plant's habitation. Based on this finding patient with hyper acidic problem could be advice not to consume the plant in excess.

Comment [U16]: pH not P^H

CONCLUSION

The result of this study indicated that the plant contain some major phytochemicals that inhibits the growth of micro-organism thereby proving very effective source of drugs. This means the plants could be used for remedy of dysentery, diarrhea, typhoid, fever and treatment of hypertension.

Comment [U17]: microorganism not micro-organism

Comment [U18]: providing not proving

Furthermore the result of the elemental analysis showed appreciable amount of minerals content in the plant. This indicates that the plant could be a source of minerals in diet as well as drugs in pharmaceutical industries.

The result of the proximate composition showed the nutritive value of the plant, which indicates that the *Maerua angolensis* analyzed have a great potential as sources of food particularly considering their proximate composition. The ash content signifies that the plant is a potential plant to supply the body with important minerals.
Therefore, *Maerua angolensis* plant could contribute significantly to the nutrient requirement of both men and animals.

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Comment [U19]: There are 10 from 37 references not up to date (more than 10 years)

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