

# DETERMINATION OF MINERAL COMPOSITION, ANTI-MICROBIAL ACTIVITY AND ANTI-NUTRIENT SCREENING OF *Cleome gynandra* (CAT'S WHISKERS)

## ABSTRACT

*Cleome gynandra* (Cat's whiskers) samples extracted with 95% ethanol, showed presence of Ca, Na, Mg and Fe. The Samples contained high Na and low Ca, Mg, and Fe concentrations. Zn, Mn, Cr, Cu, and Pb, were not detected. The anti-microbial activity of the extracts using agar diffusion method showed zones of inhibition (mm) against *Salmonella typhi* ( $11.00 \pm 0.1, 8.00 \pm 0.1, 9.00 \pm 0.1$ ), *Pneumonia spp* ( $11.00 \pm 0.2, 12.00 \pm 0.1, 8.00 \pm 0.2$ ), *Pseudomonas aeruginosa*, ( $11.00 \pm 0.3, 8.00 \pm 0.1, R$ ) and *Staphylococcus aureus* ( $8.00 \pm 0.1, 11.00 \pm 0.2, R$ ), for the leaf, stem and root respectively. The anti-nutrient component showed phytate and oxalate contents were less than is nutritionally significant, while tannins were in traces.

Key words: *Cleome gynandra*, Spectrophotometrically, *Salmonella typhi*, *Pneumonia spp*, *Pseudomonas areuginosa*, and *Staphylococcus aureus*,.

## INTRODUCTION

In Nigeria, as in other tropical African countries where the daily diet is dominated by the same staple foods, vegetables are the cheapest and most readily available sources of important proteins, vitamins, minerals and essential amino acids [1]. Vegetables are important foods both from an economic and nutritional point of view. Vegetables are living entities and respiring when they are freshly harvested, have high water contents and abundant cellulose [2].

Most of these vegetables have both nutritional and medicinal values and used for centuries as remedies for human diseases because they contain components of therapeutic value [3]

Medicinal and aromatic plants have played a vital role in alleviating human sufferings [4]. A medicinal plant is any plant in which one or more of its parts contains substances that can be used for therapeutic purposes or which are precursors for the synthesis of useful drugs. Plants have always been of important therapeutic uses and have been used to cure human and other animal diseases [5]. Traditional medicine is an integral part of the African culture and traditions, and varies between different cultural groups and regions [6]. The awareness of the importance of medicinal plants in human health care in developing countries has resulted in research into traditional medicine with a view to integrating it with modern Orthodox medicine and they have been of great importance to the health of individuals and communities [7, 8] and Many of these indigenous plants are used as spices and foods. They are sometimes added to foods for pregnant and nursing mothers for medicinal purposes [9, 10]. Medicinal plants are generally used in traditional medicine for the treatment of many ailments [11, 12]. The different parts used include leaves, roots, stem, flowers, fruits, seeds, and bark. It is to this effect that this work is carried out on the leaves, stems, and roots of *Cleome gynandra*, in order to evaluate the nutritional and medicinal values of the plant

*Cleome gynandra* (Cat's whiakers), (Kinaski, in Hausa) of *capparaceae* family is found throughout the tropics and subtropics. It occurs probably in all countries of tropical Africa, where it is mainly found near human settlements. The plant is an erect, annual herb that grows up to 150 cm tall, it is strongly branched with tap root and few secondary roots, the stem is densely glandular, leaves alternate, palmately compound with (3, 5, 7) leaflets almost sessile. Flowers are bisexual white or tinged with purple pedicel 1-5-2-5 cm long with 4 sepals, 4 petals, 6 stamens, and a purple ovary. Fruits are long narrow, cylindrical capsules up to 12 cm x 1 cm, seeds are

subglobose, 1-1.5mm in diameter, grey to black, irregularly ribbed. *Cleome* comprises 150-200 species, about 50 of them occurring in Africa [13].

*Cleome gynandra* is highly reputed for its numerous nutritional and medicinal uses. The tender leaves, young shoots and occasionally flowers are boiled or cooked as stew. The leaves are also boiled and water discarded while the paste is made into balls with groundnut cake in Kenya and Zimbabwe [14]. Sometimes the leaves are cooked with milk or other leafy vegetables such as cowpea leave for food. Extracts of the leaves are used in Mubi North L.G.A. of Adamawa State, Nigeria in form of concoction to treat typhoid and anaemia and extracts of roots as medicine for chest pain and leaves extract to treat diarrhoea [13]. The leaves when rubbed into the skin relieve pneumonia also used as eyewash [2].

In the present study, extracts of the leaf, stem and root of *Cleome gynandra* were analyzed for their mineral constituents and were screened for anti-nutrients and antimicrobial activity against gram-positive as well as gram-negative bacteria (*Salmonella typhi*, *Pneumonia spp.*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*.) with the view of confirming or disproving the acclaimed curative properties of the plant.

## MATERIALS AND METHODS

Fresh *cleome gynandra* leaf, stem and root were collected in Mubi North Local Government Area of Adamawa State. The plant was identified and authenticated by Dr. Dogmo of the Forestry Unit Mubi according to Hutchinson and Daziel [15] The FHI number 074 was assigned and a specimen of the plant was deposited in the herbarium. Samples were air dried in the laboratory. The plants was separated into the various parts, leaves, stems and roots and each parts was separately pounded to obtain fine powdered sample and sieved with 2 mm mesh size. The fine powdered samples were stored separately in clean and dry sample containers for extraction.

## Extraction

30 g of each of the fine powdered sample was accurately weighed and dissolved in 200 ml of 95% ethanol for 72 hours before filtration. The concentrated extracts were obtained by rotary evaporation and kept for analysis [16].

## Determination of Mineral constituents

5.0 g of each sample were weighed and placed in crucibles and transferred to a muffle furnace to incinerate for four (4) hrs at 500<sup>0</sup>C until the ash was carbon free (white ash). The samples were then removed, cooled in desiccators and then reweighed to obtain the percentage ash content. The ash was used for the elemental analysis. 10 ml of 0.1 M HCl was added to each of the ashed sample. The mixture was filtered into a 100 ml volumetric flask. The crucible and the filter paper (whatman number one) were washed three times with 10 ml of 0.1 M HCl solution. The absorbance of each element was determined using Atomic Absorption Spectrometer (AAS) Bulk 210 model. Standard solutions of each element were prepared and their absorbances were determined before the sample analysis. The respective concentrations of the elements in the samples were obtained from the standard calibration curves by extrapolation.

## Anti-microbial analysis

The bioactive analysis of the extracts was carried out against *Salmonella typhi*, *Pneumonia spp.*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus* obtained from the General Hospital and New Life Hospital Mubi. The anti-bacterial activities were tested by agar diffusion method.

The ethanolic extracts of the sample obtained after extraction were reconstituted to get the final concentration of 100 mg/ml for the test.

## 98 Sensitivity test

99 Wells of 6 mm diameter were made on the nutrient agar using a standard gauge  
100 (sterile cork borer). The test organisms were inoculated into the nutrient agar after thorough  
101 mixing with Peptone water. 0.3ml of the reconstituted extracts was aseptically introduced into  
102 the wells. Antibiotic discs for both gram positive (Ampiclox) and gram negative (Gentamycin)  
103 organisms were also used as standard control. The plates were all allowed to stand for 30  
104 minutes at room temperature for diffusion of the substance to proceed before the growth of  
105 organisms commenced. The plates were incubated at 37<sup>0</sup>C for 24 hours. The zone of inhibition  
106 which indicates anti-microbial activity was measured and recorded [3].

## 108 Anti-nutrient components evaluation

### 109 Phytate analysis

110 4.0 g of each sample were soaked in 100 ml of 2% HCl for 5 hours and filtered. 25 ml  
111 of the filtrate were placed in a 250 ml conical flask and 5ml of 0.3% ammonium thiocyanate  
112 solution was added. The mixture was then titrated with standard ferric chloride (FeCl<sub>3</sub>) solution  
113 until a brownish-yellow colour persisted for 5 minutes [17].

### 115 Oxalate analysis

116 2.0 g of each sample each was dissolved in 100 ml of 1.5 NH<sub>2</sub>SO<sub>4</sub>. The solutions  
117 were then carefully stirred with magnetic stirrer for 1hour and then filtered. 25 ml of each filtrate  
118 was measured and titrated when hot (80-90<sup>0</sup>C) against 0.1 N KMnO<sub>4</sub> solutions until a faint pink  
119 colour which persisted for at least 30 seconds [18].

### 121 Tannin analysis

1.5 g of each powdered sample was boiled in 5 ml of distilled water in a test tube. The solutions were filtered. 3 drops of 0.1% Ferric chloride was added to each of the filtrate and observed for brownish green or blue-black colouration [7, 19, and 20].

## RESULTS

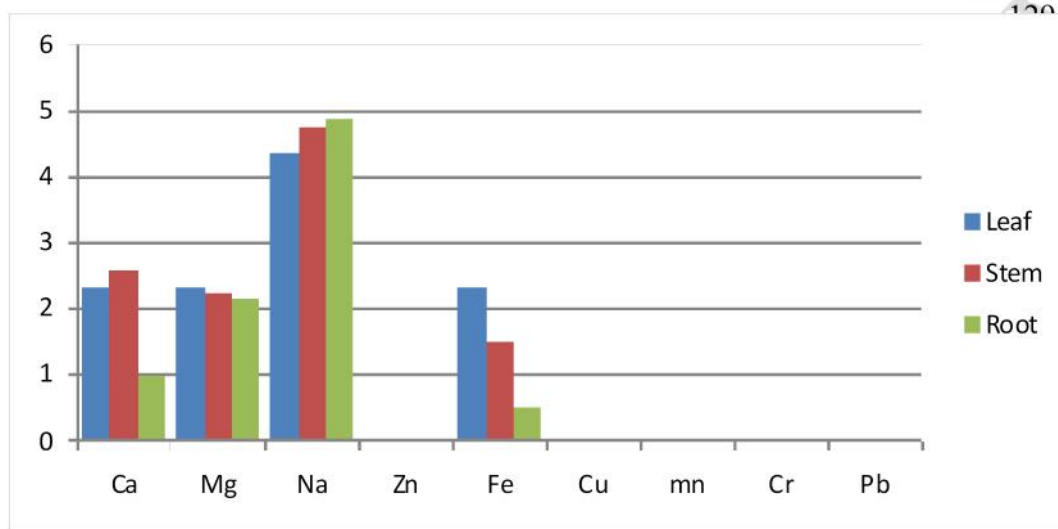


Figure: (1) Results of Mineral constituents; concentration in (ppm).

155

Table (1) Result of antibacterial tests

|                  | Zone of inhibition (mm)  |                          |                               |                               |
|------------------|--------------------------|--------------------------|-------------------------------|-------------------------------|
| Samples          | <i>S. typhi</i>          | <i>P. spp</i>            | <i>P. aeruginosa</i>          | <i>S. aureus</i>              |
| Leaf             | 11.00±0.1                | 11.00±0.2                | 11.00±0.3                     | 08.00±0.1                     |
| Stem             | 08.00±0.1                | 12.00±0.1                | 08.00±0.1                     | 11.00±0.2                     |
| Root             | 09.00±0.1                | 08.00±0.2                | R                             | R                             |
| Standard control | Ampiclox<br>x 50 (14.00) | Ampiclox<br>x 50 (14.00) | Gentamycin<br>x 50<br>(30.00) | Gentamycin<br>x 50<br>(30.00) |

R= Resistance, Mean of three trials ± Standard error.

156

157

158

159

Table (2) Result of anti-nutrients tests

|         | Anti-nutrients (mg/100g) |           |        | 160 |
|---------|--------------------------|-----------|--------|-----|
| Samples | Phytate                  | Oxalate   | Tannin |     |
| Leaf    | 0.85 ±0.01               | 1.58±.002 | Traces |     |
| Stem    | 0.69±0.01                | 0.50±0.01 | Traces |     |
| Root    | 0.65±0.02                | 0.38±0.01 | Traces |     |

Mean of three trials ±Standard error

161

162

163

## 164 DISCUSSION

165 The results obtained from the mineral content evaluation in Figure (1) showed that  
 166 *Cleome gynandra* is a good source of Ca, Mg, Na and Fe, while Zn, Cu, Mn, Cr and Pb were not  
 167 detected. Ca plays an important role in building and maintaining strong bones and teeth, large  
 168 parts of human blood and cellular fluids. Also it is necessary for normal functioning of cardiac  
 169 muscles, blood coagulation, clotting and regulation of cell permeability. Ca deficiency causes  
 170 rickets, back pain, osteoporosis, indigestion, irritability, pre-menstrual tension, and cramping of  
 171 the uterus [21] Mg plays a vital role in the formation and function of bones, muscles and  
 172 prevents high electrolyte disorders, high blood pressure and depression in

173 deficiencies interfere with transmission of nerve and muscle impulses, causing irritability and  
174 nervousness, thus leading to heart diseases. Na strictly helps in ionic balance of water and acid  
175 (osmotic regulation) in the body, and maintain tissue excitability, helps normal muscle  
176 contraction, and formation of gastric juice in the stomach. Deficiency causes nervousness,  
177 mental disorientation, low blood sugar, insomnia and coma. The presence of Fe (iron) plays an  
178 important role in the formation of blood haemoglobin and cytochromes. Deficiency leads to  
179 anaemia, and hyperthyroid [21].

180 Cr, Cu, Pb, Mn and Zn were not detected in *Cleome gynandra*. Trace amount of these elements  
181 are common in our environment and diet and are necessary for good health, but large amount  
182 up to 0.5mg/l may cause acute or chronic toxicity (poisoning). Heavy metals toxicity can result  
183 in damaged or reduced mental and central nervous function, lower energy levels, and damage to  
184 blood composition, lung, kidney, liver and other vital organs [11]. Pb, if present leads to toxicity  
185 in the body; causing respiratory problems and restricts the flow of blood into the body system.  
186 Equally, the Environmental Protection Agency (EPA) declared that there is no safe level of lead  
187 intake. It can cause high blood pressure and reduce haemoglobin production, necessary for O<sub>2</sub>  
188 transportation, thus interfering and can interfere with normal cellular Ca metabolism [22].

189 Cu was not detected though an important compound of many enzyme systems such as  
190 cytochrome oxidase, lysyl oxidase and ceruloplasmin; an iron oxidizing enzyme in blood.  
191 Deficiency of Cu [I don't know, are you referring to CU here] has been associated with cardiac  
192 abnormalities in human and animals such as anaemia and Neutrogena [21]. Cr is of benefit only  
193 to those people working for performance enhancement in physical activities. Also in the core  
194 factors that dictate our overall health and well being. Cr is one of the most toxic elements from  
195 vegetables and its excess leads to malignant growth in the respiratory tract [11].

The result obtained for antimicrobial activity Table(1), showed moderate zone of inhibition for the tested organisms. The root of *Cleome gynandra* was not active against *P. aeruginosa* and *S. aureus* but the leaf and stem were active against all the tested organisms.

Leaves are active against *S. typhi* that causes typhoid, paratyphoid, non-typhoid fever and enteric fever such as gastrointestinal illness, followed by bacteraemia and diarrhoea [23]. This explains their traditional usage to cure numerous diseases in Mubi North L.G.A. Similarly it has been found be active against *Pneumonia spp* that causes infection of wound in burned patients and hospitalised individuals.

The leaf and stem of *Cleome gynandra*. are active against *S. aureus* that causes minor skin infection such as impetigo boils, scalded skin syndrome and abscesses, to diseases such as pneumonia and meningitis. The leaf and stem are also active against *P. aeruginosa* which cause diseases such as sour throat, scarlet fever and kidney disease [24].

Results of the anti-nutrient analysis presented in Table 2 showed that phytate and oxalate were present in small amounts while tannins were not detected or in traces. The values obtained in this study for phytate and oxalate is far below the range of 4-9 mg/L thus is insignificant [25]. When above this range, phytate could be of nutritional danger resulting in the reduction in the availability of many other essential dietary minerals. Oxalate at the above mentioned range could have serious effects on human nutrition and health particularly by decreasing Ca absorption and adding to the formation of kidney stone [25]. Therefore, the reduced oxalate and phytate content in the vegetable makes it good for consumption, without any observable health hazards. This could add to the reasons why most families in Northern Nigeria use *C. gynandra* as source of vegetable for soup preparation.

## CONCLUSION

*C. gynandra* contains chemical constituents responsible for antibacterial activities. This therefore justifies the use of the plant in folklore medicine for treatment of such disease, as ear infection, blood replenishing (in case of anaemia), rheumatism and diarrhoea/ Dysentery / typhoid. Mineral content evaluation showed presence of Ca, Na, Mg, Fe, while Zn, Pb, Cr, Cu, and Mn were absent. The plant is therefore suitable as a medicinal herb and nutritional vegetable.

We recommend toxicological analysis on this plant and if found safe, then its inclusion in the list of excellent medicinal and vegetable sources in the community could be contemplated. The activity of the extracts could further be tested on other microorganisms of importance

## REFERENCES

1. Okafor, J.C (1983): Horticultural Promising Indigenous Wild plant species of the Nigerian Forest zone. *Acta Hort.* 123:165 - 176.
2. Okafor, J.C (1979): Edible Indigenous Woody Plants in the Rural Economy of Nigerian Forest Ecosystem (D.U.U. Okoli Edition). Proceedings of M.A.B workshop on the Nigerian Rainforest Ecosystem. University of Ibadan, Nigeria.
3. Nastro, A. (2001): The effects of Nepeta Cataria extract on adherences and enzyme production of *staphylococcus aurues*. *Int.J. Antmicrobial Agents* 18: 583 – 585.
4. Baguar, S.R. (2001): Textbook of Economic Botany. 1st edition, Pakisdition Publistan by Ferozsous (pvt) Ltd, Lahort
5. Oyetayo, V.O (2008): Microbial Local and Antimicrobial of two Nigerian herbal remedies. *Afr. J. of Traditional Complementary Alternative Medicine* 5 (7): 74 – 78.

- 245 6. Makhubu, K. (2006): New Agriculturalist; Focus on African leafy vegetables.  
246 <http://www.new-ag-infocus/focus/focusitem.php?>
- 247 7. Sofowora, A. (1993): Medicinal Plants and Traditional Medicine in Africa Spectrum Books  
248 Ltd, Ibadan, Nigeria. PP: 191
- 249 8. Edeoga,H.O, Okwu,D.E., Mbaebie, B.O.(2005): Phytochemical Constituents of some  
250 Nigerian medical plant. *Afr. J. Biotechnology*. 4(7): 685 – 688.
- 251 9. Okwu, D.E (1999): Flavouring Properties of Species on Cassava Fufu. *Afr. J. Roots Tuber*  
252 *crops*. 3 (2): 19-21.
- 253 10. Okwu, D.E. (2001): Evaluation of the Chemical Composition of Indigenous plants and  
254 flavouring agents. *Global J. pure and Appl. Sci*. 7(3): 455-459.
- 255 11. Njoku, P.C., Ezeibe, A.U. (2007): Phytochemical and Elemental Analysis of *Helianthus*  
256 *annus* and its use as blood clothing agent. *J.chem.soc. Nigeria*. 32(2) 128-132.
- 257 12. Ogukwe, C.E, Oguizie,C.E. Unaegbu,C, Okolue, B. N (2004): Phytochemical Screening on  
258 the leaves of *sansevieria trifasciata*. *J. Chem. Soc. Nig*. 29 (1): 8-10
- 259 13. Grubben, G.J.H. and Denton, O.A (2004): Plant Resources of tropical Africa Two  
260 vegetables. (CK) PROTA Foundation, Wageningen, Netherland. PP: 191-194.
- 261 14. Samuel N. and Brian G, (2007); Science Direct-Scientia Horticulturae. Vol.114 (3): Pp; 194-  
262 198
- 263 15. Dalziel, J. M; (1956): Useful Plants of West Tropical Africa. Crown Agents for the Colonies,  
264 London, Pp. 179 – 183.
- 265 16.OKogun, J.I (2000): Methods of Medical Plants Extract preparation, National Institute for  
266 Pharmaceutical Research and Development (NIPRD), Idu – Abuja, Nigeria
- 267 17. Reddy, J.A and Kove, N.A (1999): Determination of phytate in unpurified extracts of seeds  
268 and products of their processing. *J. Natural Remedies*. 1:23-30.

- 269 18. Day and Underwood. (1986): Pearson's Chemical Analysis of food. 8<sup>th</sup> Edition. Churchill  
270 Livingstone, England.
- 271 19. Evans, W.C and Trease, G.C. (1989): Pharmacognosy. 11<sup>th</sup> Edition. Brailier Tridel Can.  
272 Macmillan Publishers, London.
- 273 20. Harbone, J.B. (1973): Phytochemical Methods. Chapman and Hill Ltd, London. PP: 49 –  
274 188.
- 275 21. Siddhuraju and Becker (2001): <http://www.unix-oit.umiss-edu//mecclmen/581minerals.htm>
- 276 22. Montague and Peter.(2010):“Hearth Effects of lead, Online”.  
277 [http://www.welohart.net/lead/lead health](http://www.welohart.net/lead/lead%20health)
- 278 23. Machkaire, V., Turner, A. D. and Chivige, O. A. (2011): International Society for  
279 Horticultural Science. [www.pubhort.org](http://www.pubhort.org).
- 280 24. Robert, F. B. (1995): Basic Medical Microbiology. 5<sup>th</sup> Edition Lippincott Williams and  
281 Wilkins. A wolters Kluwers Company by little Brown and Company (Inc).ISBN  
282 0-316-10445-0: Pp: 250 - 300.
- 283 25. Andrew Weil, M. D. (2011): Are Phytates Bad or Good? Weil Lifestyle, LLC.  
284  
285