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# Chemical composition and antimicrobial activities of adventitious root sap of *Musanga cecropioides*

**Uwah A. F.[1], Otitoju O.[2], Ndem J. I.[1] and Peter A. I.[3]**

[1]*Department of Biochemistry, Faculty of Basic Medical Sciences, University of Uyo, Akwa Ibom State, Nigeria*
[2]*Department of Biochemistry, Faculty of Pure and Applied Sciences, Federal University Wukari Taraba State Nigeria*
[3]*Department of Human Anatomy, Faculty of Basic Medical Sciences, University of Uyo, Akwa Ibom State, Nigeria*

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**ABSTRACT**

*Utilization of adventitious root sap of Musanga cecropioides for various health and nutritional purposes in humans and livestock have been reported by many traditional and rural dwellers in Uyo metropolis. The present study quantitatively investigated the bioactive and elemental composition and the antimicrobial activities of the sap for the purpose of establishing its medicinal properties. The sap was shown to contain medicinally significant amount of tannins and saponins, with amount of oxalate that was quite below toxic dose. An appreciable amount of potassium (6.389±0342mg/L), calcium (34.330±2.273mg/L), magne sium (5.344±0.115mg/L) and phosphorus (12.150±1.737mg/L), with a low level of sodium (0.109±0.022mg/L) were found in the sap. Very low amount of heavy metals were demonstrated in the sap. The root sap of Musanga cecropioides produced significant antimicrobial activities against both gram negative and gram positive bacterial and significant antifungal activity.*

**Key *w*ords***: *Root sap, bioactivity, medicinal properties, antimicrobial, toxicology.*

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## INTRODUCTION

In sub-Sahara Africa, and indeed many other regions of the world, health care delivery largely depends on the use of plant parts and extracts. Reports on the effects of these medicinal plants on animal and human health are diverse. Although these effects are largely attributed to the active components of these plant materials [1,2], yet information on the chemical composition of many of these plant materials are still scarce [3]. The chemical evaluation of medicinal plants and their isolates have transformed traditional medicine from an almost invisible trade into a modern industrial enterprise, capable of making significant contribution to both health care delivery and economic growth of most developing countries [4]. Moreover, the World Health Organization (W.H.O.) had recognized traditional herbal medicine as a building block of primary health care [5]. *Musanga Cecropioides* is a common tree found in tropical African forest reported as a native of Angola, Cameroon, Cote d' Voire, Democratic Republic of Congo, Ethiopia, Ghana, Liberia, Sierra Leon, Sudan, Togo, Uganda and Nigeria [6]. It is abundant in swamp forest, river or lake side and has an altitude of 700-1200mm, with large adventitious roots. The fruits are dispersed by elephants and animals. They are raised from seed in Democratic Republic of Congo [7,6].

Many researchers have reported on the medical uses of different parts of *Musanga Cecropioides* in different countries of tropical Africa. Uterotonic effect of the leaves has been reported by Kamanyi *et al.*, [8], while the hypotensive effects of for both the water extract of the leaf and stem bark was reported by Dongmo *et al.*, [9]. The bark-macerate is used as a decoction for pulmonary disorders, while the bark scrapings are used as blood purifier, galactogogue, analgesic and antipyretics [6].The adventitious root sap is used as topical embrocation for pulmonary congestion and as lactation stimulants. The root sap is also used as pain killer and in the treatment of rheumatism, blood disorders and venereal diseases [6,7].

Some researchers had studied the chemical composition of the plant and reported the isolation of isovetixen, vitexin, choloroganic acid and procyanidins from the leaves, which are reported to be responsible for the hypotensive effect of the leaf extract. Phytochemical studies of the leaves and stem bark requited the presence of triterpenoid acid, alkaloid, tannins, flavonoids, saponins and glycosides [10,11,12,13].

The aerial roots and the young branches are noted for their capacity to yielding large amount of potable sap which is a source of drinking water and of great importance to several tribes in South-East Nigeria and Western Cameroon [6]. The villagers depend upon it in dry seasons. Hunters and monkeys are reported to draw impromptu drinks from the root sap. [6].

Despite the extensive consumption of the root sap of *M. cecropioides* for various purposes, the chemical composition of the root sap is still not reported. The present study is designed to evaluate the chemical composition of the root sap of the plant and also study the antimicrobial properties, which will serve as a preliminary study on the safety of this widely used plant product. It will also supply some basic information on the mechanism of action of certain medicinal effect attributed to the root sap of the plant.

## MATERIALS AND METHODS

### Collection and Identification of Sample Plant

The plant sample was collected from African Regional Aquaculture Centre, Alun in River State, South-South Region of Nigeria. The plant was identified and authenticated by the Department of Botany, University of Uyo, Nigeria. The microorganism isolate was obtained at the University of Uyo Health Centre and Pharmaceutical Microbiology Laboratory of the University of Uyo. The root sap was obtained by cutting an adventitious root of the plant slantingly and allowing the sap to flow freely into a clean conical flash, while the sap for microbiological analysis was directly collected into a plain sterile sample bottles. The root sap was analyzed within six hours of collection.

### Determination of Chemical Composition

All chemicals and reagents used in this work were of analytical grade
Bioactive components of the sap were determined by the methods of A. O. A. C [14]. Quantitative determination of elemental composition was carried by using Atomic Adsorption spectrometry (AAS) (Unicam, Perkin-Euner, U.K.).

### Antimicrobial Activities

Antibacterial and antifungal activities were determined by agar difference method [15]. All bacterial plates were incubated at 37$^{o}$C while fungal plates were incubated at 28$^{o}$C, Gentamycin and streptomycin were used as standard for bacterial activities, while nystatin was used for fungal activities.

## RESULTS

### The Bioactive Components

Result of phytochemical analysis of the adventitious root sap of *Musanga cecropioides* are shown in table I.

**TABLE 1: Results of Phytochemical Composition of the Root Sap of *M. Cecropioides***

| ***Phytochemical*** | ***Quantity (mg/100ml) Mean ± SD*** |
|---|---|
| Hydrocyanide (HCN) | 0.00 |
| Total oxalate | 26.40±4.52 |
| Soluble oxalate | 8.80±0.33 |
| Tannin | 6.23±1.65 |
| Saponin | 3.81±0.48 |
| Alkaloids | 0.00 |
| Phytate | 0.00 |

### Elemental Composition

The results of element composition of the root sap of M. cecropioides is shown in Table 2 below

### Antimicrobial Activities

The inhibition zones of different concentrations of the root sap of *M. cecropioides* for different organisms are shown on Table 3.

**TABLE 2: Elemental Components of the Root Sap of *M. Cecropioides***

| Elements | Quantity (mg/L) Mean ± SD |
|---|---|
| Calcium (Ca) | 34.330±2.273 |
| Phosphorus (P) | 12.150±1.737 |
| Magnesium (Mg) | 5.344±0.115 |
| Potassium (K) | 6.389±0342 |
| Sodium (Na) | 0.109±0.022 |
| Zinc (Zn) | 0.091±0.007 |
| Iron (Fe) | 0.074±0.004 |
| Copper (Cu) | 0.110±0.012 |
| Cadmium (Cd) | 0.010 ± 0,001 |

**TABLE 3: Inhibition Zones of microorganisms with different concentrations of Root Sap of *M. Cecropioides***

| Test organism | Zone of inhibition (mm) with different concentration of Root sap (mg/ml) | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 400 | 500 | concentrated | standard |
| *E. coli* | 12.0 | 13.0 | 16.0 | 16.0 | 20.0 | 25.0 |
| *Streptococcus sp* | - | - | 4.0 | 6.0 | 10.0 | 20.0 |
| *Staphylococcus sp* | - | 3.0 | 6.0 | 7.0 | 12.0 | 21.0 |
| *Candida albicans* | 3.0 | 4.0 | 7.0 | 11.0 | 14.0 | 15.0 |

## DISCUSSION

Traditionally *Musanga cecropioides* is of great importance among the rural dwellers in Akwa Ibom state Nigeria in the treatment of various ailments. There are traditional report of its use in the treatment of upper respiratory tract infection (cough), treatment of dirty wounds and stomach upset. Among the women there are reports that the root sap is use in the treatment of vaginal candidiasis. Like *Musanga cecropioides* there are other medicinal plants with various medicinal benefits but there no known scientific interpretation apart from their perceived traditional uses. Therefore our objective for this research work is to establish its antimicrobial activities.

Evaluation of the bioactive composition of root sap of *Musanga cecropioides* show that total oxalate level of 26.40±4.52 mg/dl and soluble oxalate level of 8.80±0.33 mg/dl. Oxalate is an antitnutrient and the soluble component of oxalate is that which is toxic to the body, with a lethal dose range of 200-500 mg [16]. This level of oxalate in the sap is far below the toxic dose. Administration of 1-4 g/kg of the sap to experimental animals did not show sign of acute toxicity [7].

The concentration of tannin in the root sap is 6.23±1.65 mg/L. The level of tannin may contribute to the antimicrobial properties of the root sap. Tannins could precipitate proteins, especially proline-rich proteins, which may be useful in the treatment of wounds and burns [6].

The root sap contains 3.81±0.48 mg/100dl of saponins (Table 1). Saponins have antimicrobial activities by their ability to complex with sterols in fungal and bacterial membranes [17]. This may also account for the antinfective properties of the root sap. Hydorcyanide, phytate and alkaloids were not found in the root sap of *M. cecropioides*. The absence of these antitnutrients in the root sap of the tree make the sap absolutely non-toxic to animals [7].

The levels of micro and macro elements are shown in Table 2. Calcium level in the root sap is 34.330±2.273 mg/L. This appreciable level of calcium may play a role in the use of the root sap as lactation stimulant and in the treatment of paralysis [6].

The concentration of potassium and sodium in the root sap are 6.389±0342 mg/L and 0.109±0.022 mg/L respectively. This concentration of potassium, with relatively very low level of sodium in the sap may be responsible for its hypotensive effect due to their effects on the heart and smooth muscles.

Phosphorus content of the root sap is 12.150±1.737 mg/L and that of magnesium is 5.344±0.115 mg/L. Phosphorus is required in biochemical reactions as the currency for energy transformation. Magnesium plays an important role as capacitor for enzymes, especially ATP-dependent processes [18]. The levels of phosphate and magnesium may account for the diverse physiochemical effects of the root sap and also account for its mechanical values.

The level of heavy metal assessed, namely Zinc, Cadmium, Copper and Iron are 0.091±0.007 mg/L, 0.074±0.004 mg/L, 0.110±0.012 mg/L and 0.010 ± 0.001 mg/L respectively. These levels show that the root sap does not accumulate these metallic elements, and therefore, may not pose any adverse health effect to users.

The result of this studies reveal that the root sap of *Musanga cecropioides* produced significant antimicrobial activities against both gram negative and gram positive bacterial and significant antifungal activity. The results are recorded in Table 3. The antimicrobial activities of the root sap of the tree has been attributed to the chemical constituents of the sap [19]. The root sap was most active against *Escherichia Coli*, with an inhibition zone of 20 mm, when compared with standard (25mm). The root sap is also active against *streptococcus sp* and *staphylococcus sp* with inhibition zones of 10 mm and 12 mm respectively, when compared with the standards (20 mm and 21 mm respectively). This may be why the root sap is effective in the treatment of wounds, burns and diarrhea [6].

*Candida Albicans* has a significant zone of inhibition, (14 mm) almost the same as the standard nystatin (16 mm). This may explain the effectiveness of the sap against ringworm, mouth sore and vaginal infection [6].

The results of this study show that *Musanga cecropioides* possess antimicrobial activity and could be a potent therapeutic agent against burns.

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