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Original Research Article
Phytochemical and mineral analysis of *Grewia mollis* stems bark

ABSTRACT

Aims: Aqueous extract of *Grewia mollis* stem bark was analyzed for its phytochemical and mineral compositions.
Place and Duration of Study: Department of Biochemistry, University of Jos, Jos, between June 2013 and July 2013.
Methodology: The phytochemical screening and mineral composition of the stem bark was carried out using standard methods.
Results: The phytochemical screening revealed the presence of Tannins, Saponins, Cardiac glycosides, Flavonoids, Steroids, Phenols and Resins. Alkaloids and Carbohydrates were however not detected. Analysis of the mineral constituents showed that the plant contains among others Manganese (1.899 g/100g), Zinc (0.375 g/100g), Magnesium (287.060 g/100g), Iron (47.941 g/100g), Copper (0.270 g/100g) and Lead (0.206 g/100g).
Conclusion: The constituent phytochemicals and minerals may account for varied ethno-botanical uses of the plant in folk medicine.

Keywords: Grewia mollis; phytochemical constituents; Mineral constituents; Medicinal plants

1. INTRODUCTION

Plants that possess therapeutic properties or exert beneficial pharmacological effects in the animal body are generally termed as “medicinal plants”. And It is now been established that the plants which naturally synthesize and accumulate some secondary metabolites and vitamins, possess medicinal properties [1]. Medicinal plants constitute an important natural wealth of a country. They play a significant role in providing primary health care services to rural people. They also serve as therapeutic agents as well as important raw materials for manufacture of traditional and modern medicine. Substantial amount of foreign exchange can be earned by exporting medicinal plants to other countries. In this way indigenous medicinal plants play significant role in the economy of a country [1].

Medicinal plants contain both organic and inorganic constituents, and many medicinal plants are found to be rich in one or more individual elements, thereby providing a possible link to the therapeutic action of the medicines [2, 3]. Trace elements play a vital role in the formation of bioactive chemical constituents in medicinal plants and are therefore responsible for both their medicinal and toxic properties [4]. Thus, a quantitative estimation of minor and trace element can be important in determining the effectiveness and toxicity of the medicinal plants in treating various diseases and understanding their pharmacological actions [5].

Grewia mollis (Tiliaceae) is a shrub or tree widely distributed in northern Nigeria and some African countries. It is known to be a strong fire-resistant plant and its various parts are used in food and medicines [6]. In Nigeria, the stem bark powder or mucilage of this plant is used as a thickener in local cakes made from beans and corn flour commonly called “*Kosa*” and “*Punkasau*” respectively [6,7]. The dried stem bark is ground and the powder mixed with beans or corn flour thereby enhancing the texture of the food product. Some findings

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demonstrated that mucilage obtained from the stem bark *G. mollis* can serve as a good binder in paracetamol formulations [8, 9]. While as recent reports suggest that high concentration of this stem bark in dietary exposure may cause some adverse effects, especially liver injury [6]. The phytochemical studies of *G. mollis* indicated presence of tannins, saponins, flavonoids, glycosides, phenols and steroids but absence of alkaloids in the leaves and stem bark [10] while the presence of alkaloids was revealed in the roots [11]. The infusion of bark obtained by cold or hot maceration in water is applied to give a smooth surface to mud walls and floors [12] while the wood ash is used as salt substitute including the ash of the leaves, stems, and roots. Also, the flowers, buds, and young shoots are added to soups and sauces as garnishing while, in Sudan, the young leaves are cooked and eaten as vegetables. The fruit is eaten raw or boiled [13]. Studies have also demonstrated a wide spectrum of therapeutic effects such as hepatoprotective [14], antibacterial [15] and Anti-Inflammatory [15] activities. The present study was undertaken to evaluate the phytochemical and mineral compositions of *Grewia mollis* stem bark.

2. MATERIAL AND METHODS

2.1 Chemicals and Reagents

The sodium hydroxide, ferric chloride, copper acetate, used were products of East Anglia Chemicals, Hadleigh Ipswich Suffolk; the petroleum ether (40 – 60°C) used was a product of Eagle Scientific Limited, Unit 5, Eldson Rd., Beeston, Nottingham; the chloroform, ammonium sulphate, sulphuric acid, naphthol, amyl alcohol, acetone, methanol, ethanol used were products of BDH Chemicals Ltd., Poole, England. Cupric sulphate, 5-hydrate was a product of J.T. Baker Chemicals Co., Phillipsmore, N.Z. All other reagents used were of analytical grade and prepared in the Biochemistry laboratory, University of Jos, Nigeria, with all-glass apparatus.

2.2 Plant Material

The stem bark of *Grewia mollis* was obtained from Akwanga-Nasarawa, Nasarawa State, Nigeria and was authenticated at Herbarium of the Department of Botany, University of Jos, Nigeria. A voucher specimen was deposited at the Herbarium of this Institute.

2.3 Preparation of Extract

The stem barks of *grewia mollis* were washed and oven dried at 40°C for 72 hours to a constant weight. The dried pieces were then pulverized using an electric blender. The powdered material was stocked in a glass container from which 150 g was extracted in 1500 ml of cold distilled water for 48 hours at 37°C. This was then filtered with Whatman No. 1 filter paper. The filtrate was concentrated on a steam bath to give the extract. The extract was then used for phytochemical and mineral analysis.

2.4 Phytochemical Screening of the extract

The aqueous crude extract of *Grewia mollis* stem bark was subjected to various chemical tests in order to determine the secondary metabolites present by using the standard procedures as described by Sofowora [16], Trease and Evans [17] and Harborne [18]

2.4.1 Test for alkaloids

1ml of the extract was stirred with 5ml of 1% aqueous HCl on a steam bath and filtered while hot. Distilled water was added to the residue and 1ml of the filtrate was treated with a few drops of either Mayer's reagent (Potassium mercuric iodide solution). The formation of a cream colour with Mayer's reagent indicates the presence of alkaloids.

2.4.2 Test for flavonoids

A few chop of 1% NH₃ solution was added to the aqueous extract of the plant sample in a test tube. A yellow coloration was observed for the presence of flavonoids.

2.4.3 Test for steroids

0.5 ml aqueous stem bark extract was evaporated and dissolved in 2 ml chloroform. 2 ml of conc. H₂SO₄ was introduced carefully by the side wall of the test tube. Formation of red colour ring confirmed the presence of steroid.

2.4.4 Test for phenols

5 ml of the extract was pipetted into a 30 ml test tube, and then 10ml of distilled water was added. 2 ml of ammonium hydroxide solution and 5 ml of concentrated amyl alcohol were also added and left to react for 30 min. Development of bluish green colour was taken as a positive presence of phenol.

2.4.5 Test for resins

0.5 ml of extract was evaporated and dissolved in 2 ml of petroleum ether, 2ml of 2% copper acetate solution was then added and the mixture was shaken vigorously and allowed to separate, a green colour indicated the presence of resin.

2.4.6 Test for tannins

1ml of extract was boiled in 20ml of water in a test and then filtered. A few drops of 0.1% ferric chloride was added and observed green or a blue – black coloration which confirms the presence of tannin

2.4.7 Test for saponins

2 ml of double distilled water was added to 1 ml of the extract. Few drops of olive oil were added and agitated. Formation of soluble emulsion indicated the presence of saponin.

2.4.8 Test for cardiac glycosides

0.5 ml of the extract was evaporated and dissolved in 1 ml glacial acetic acid. One drop of 10% ferric chloride was then added. 1 ml of conc. H₂SO₄ was added by the side of the test tube. Appearance of brown colour ring at the interface indicated of presence of cardiac glycosides.

2.4.9 Test for carbohydrates

To 2 ml of the extract was added 2 drops of 10% alcoholic solution of naphthol followed by 2 ml concentrated H₂SO₄, gently poured along the side of the test tube at an angle of 45°. Formation of a purple ring at the interface of the two liquid layers confirmed a positive result for the presence of carbohydrates.

2.5 Mineral Analysis

The atomic Absorption spectrophotometer (AAS) was used for the analyses of Magnesium, Zinc, Iron, Manganese, Copper and Lead in the stem bark of *Grewia mollis*. Using AAS, a known amount of the sample was placed in a dish and heated with burnsen burner in a fume cupboard until there was no smoke emitted. This was transferred to the dessicator in other for it to cool after which 0.1 ml HCl solution was added to the ash. The resulting solution was filtered and diluted. Suitable salts of the metals in questions were used to make their standards, lamps were fixed and the analyses were done [19].

2.6 Statistical Analysis

The data were expressed as Mean ± Standard Error of Mean values.

3. RESULTS

Table 1 shows the phytochemicals present in *Grewia mollis* stem bark. Tannins, Saponins, Cardiac glycosides, Flavonoids, Steroids, Phenols, and Resins were detected in our study. However, Alkaloids and Carbohydrates were not detected which was in support with Onwuliri *et al.* [10]. The mineral analysis of *Grewia mollis* (Table 2) showed rich content of macro and micro elements like Manganese (1.899 g/100g), Zinc (0.375 g/100g), Magnesium (287.060 g/100g), Iron (47.941 g/100g) and Copper (0.270 g/100g). The plant also contains minute amount of Lead (0.206 g/100g).

Table 1: Qualitative phytochemical screening of *Grewia mollis* Stem Bark

Phytochemicals	<i>Grewia mollis</i> stem bark
Alkaloids	-
Flavonoids	+
Tannins	+
Saponins	++
Steroids	+
Cardiac glycosides	+
Phenols	+
Resins	+
Carbohydrates	-

Key= +: present; ++: very present; -: absent

Table 2: Mineral composition of *Grewia mollis* Stem Bark

Minerals	Composition (g/100g)
Manganese	1.899±0.003
Zinc	0.375±0.001
Magnesium	287.060±0.001
Iron	47.941±0.002
Lead	0.206±0.001
Copper	0.270±0.001

Values are expressed as Mean ± SEM (n = 3).

DISCUSSION

A medicinal plant is any plant in which one or more of its organs contains substances that can be used for therapeutic purpose of which are precursors for the synthesis of useful drugs. The crude extracts or purified form of plant has been used as medicines and cosmetics [1]. The medicinal value of these plants lies in bioactive phytochemical constituents that produce definite physiological action on the human body [20]. In this study, the phytochemical investigation of *Grewia mollis* stem bark indicates the presence of Tannins, Saponins, Cardiac glycosides, Flavonoids, Steroids, Phenols and Resins. This is in agreement with the work done by Onwuliri *et al.* [10]. These phytochemicals are well known for their pharmacological activities.

Saponins are steroid or triterpenoid glycosides characterised by their bitter or astringent taste, foaming properties [21]. According to Studies, saponins show antitumor and anti-mutagenic activities and can lower the risk of human cancers, by preventing cancer cells from growing. They seem to react with the cholesterol rich membranes of cancer cells, thereby limiting their growth and viability. Rao and Sung [22] found that saponins may help to prevent colon

176 cancer. Anti-hyperglycemic potential of saponins has also been reported [23, 24]. Hence, due
177 to the presence of saponin in *Grewia mollis* stem bark; it may be used as an anti-diabetic
178 agent. Furthermore, studies have shown that plants containing saponins have hemolytic
179 activities on red blood cell membrane [25]. This may also be applicable to *G. mollis* stem bark.

180 Tannins and flavonoids are thought to be responsible for anti-diarrheal activity [26].
181 Investigations of their mode of action indicate that tannins and flavonoids increase colonic
182 water and electrolyte reabsorption while other phytochemicals act by inhibiting intestinal
183 mobility [26]. This explains the anti-diarrheal use of *Grewia mollis* stem bark in traditional
184 medicine. In addition, tannin has astringent properties, hastens the healing of wounds and
185 inflamed mucous membrane. Plants with tannins are used for healing of wounds, varicose
186 ulcers, hemorrhoids, frost-bite and burns [27, 28]. The biological functions of flavonoids
187 include protection against allergies, inflammation, platelets aggregation, microbes, ulcer and
188 tumour [29]. They are free radical scavengers, super antioxidants and potent water soluble
189 thus preventing oxidative damage and have strong anti-cancer activity [30]. Thus, the
190 acclaimed anti-inflammatory and wound healing uses of *Grewia mollis* stem bark extract may
191 be attributed to flavonoids and tannins.

192 Cardiac glycosides were found to be present in *Grewia mollis* stem bark, a compound that has
193 been shown to aid in treatment for congestive heart failure and cardiac arrhythmia. This is
194 another reason why this plant is widely used in traditional medicine. Cardiac glycosides work
195 by inhibiting the Na^+/K^+ pump. This causes an increase in the level of sodium ions in the
196 myocytes, which then leads to a rise in the level of calcium ions. This inhibition increases the
197 amount of Ca^{2+} ions available for contraction of the heart muscle, improves cardiac output and
198 reduces distention of the heart [31].

199
200 Phenolic compounds have antimicrobial properties. Phenol and phenolic compounds have
201 been extensively used in disinfections and remain the standards which other bactericides are
202 compared [32]. Thus, the presence of phenolic compounds in *Grewia mollis* stem bark might
203 be responsible for its antimicrobial activities. Other phytochemicals such as Steroids and
204 Resins might be responsible for the some pharmacological activities of the plant.

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206 Minerals which are either macrominerals or microminerals are essential for the normal growth
207 and maintenance of the body. The mineral analysis of *Grewia mollis* stem bark shows the
208 presence of Manganese, Zinc, Magnesium, Iron, Copper and minute amount of Lead (Table
209 2).

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211 Magnesium is involved in over 300 enzymatic reactions in the body [33, 34], including
212 glycolysis, the Krebs cycle, creatine phosphate formation, nucleic acid synthesis, amino acid
213 activation, cardiac and smooth muscle contractility, cyclic AMP formation, and protein
214 synthesis. Magnesium is also important in the proper utilization of vitamins B and E and
215 functions with other minerals such as calcium, sodium and potassium in maintaining fluid and
216 electrolyte balance [35].

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218 Copper is an essential trace element for humans and animals. The ability of copper to easily
219 accept and donate electrons explains its important role in oxidation-reduction reactions and
220 scavenging free radicals [36].

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222 Iron is very important in the formation of haemoglobin in red blood cells and deficiency of iron
223 leads to anaemia. *Grewia mollis* stem bark could be used as a source of iron in the treatment
224 of iron-deficiency anaemia.

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Manganese plays an important role in a number of physiologic processes, as a constituent of multiple enzymes and an activator of other enzymes [37]. A number of manganese-activated enzymes play important roles in the metabolism of carbohydrates, amino acids, and cholesterol. It is also thought to aid in the maintenance of epithelia tissue [38].

Zinc is essential in the activation of certain enzymes. These include dehydrogenase, alkaline phosphatase and carboxypeptidase. Zinc containing organic compounds is employed as astringent and anti-fungal agents. It aids wound healing and metabolism of nucleic acid and insulin. Zinc in excess causes anaemia and if deficient in the body can lead to dermatitis [39].

Effect of lead deficiency in the body results in anemia while excess lead (Pb) in the body can cause brain damage [40].

5. CONCLUSION

This study shows that *Grewia mollis* stem bark is a rich source of significant phytochemicals and minerals which justify the various therapeutic uses attributed to it in folklore medicine. However the presence of trace amount of lead (Pb) calls for caution because of its toxicity.

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