Preliminary phytochemical screening of *Eichhornia crassipes*: the world’s worst aquatic weed

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**ABSTRACT**

*Eichhornia crassipes* is so called menace and nuisance is considered as the world’s worst aquatic plant but a highly productive aquatic weed that causes a serious hindrance to nation’s development activities. The present investigation was planned to explore the potential of *Eichhornia crassipes* in a way that, its positive attributes outweigh the negative ones. The present paper deals with the phytochemical screening of any therapeutic importance from *Eichhornia crassipes.* Qualitative analysis of the plant parts have revealed the presence of various components of medical importance including tannins, phlobatannin, steroid, terpenoid, alkaloid, flavonoid, phenolic contents, quinone, anthraquinone and cardiac glycosides. Because of the rich diversity of this aquatic plant it is expected that screening and scientific evaluation of plant extracts may prove beneficial for the mankind along with the management of the weed. The result obtained indicates that though the plant is an aquatic weed is good services of phytochemicals needed for maintenance of good health and can also be exploited in the manufacture of drugs.

**Keywords:** *Eichhornia crassipes*, Phytochemicals, Water hyacinth.

**INTRODUCTION**

Phytochemicals are non-nutritive plant chemicals that have protective or disease preventive properties. Plant produces these chemicals to protect itself but recent research demonstrates that many phytochemicals can protect humans against diseases. The roles of plants in maintaining health is well documented [36]. The general assumption is that the active dietary constituents contributing to the protective effects of the plant materials are phytochemicals, vitamins & minerals. Phytochemicals are present in a variety of plants utilized as important components of both human and animal diets. The usefulness of the plant materials medicinally is due to the presence of bioactive constituents such as alkaloid, tannin, flavonoid and phenolic compounds [9]. Alkaloids play some metabolic role & control development in living system [12]. They are also involved in protective role in animals and are used as medicine especially the steroidal alkaloids [45]. Tannins are known to inhibit pathogenic fungi [6]. Studies by Kim et al. and Okwu [27, 39] revealed that flavonoids apart from their antioxidant protective effects, inhibits the initiation, promotion and progression of tumors.

*Eichhornia crassipes* (Mart) Solms commonly known as water hyacinth is warm water aquatic plant belonging to the family Pontederiaceae. Water hyacinth is listed as one of the most productive plant on earth and is considered the world’s worst aquatic weed [22, 48, 18]. Its habitat ranges from tropical desert to subtropical or warm temperate desert to rainforest zones. It tolerates annual temperatures ranging from 21.1°C to 27.2°C and its pH tolerance is estimated at 5.0 to 7.5. The “beautiful blue devil” water hyacinth, recognized by its lavender flowers & shining bright leaves which spreads at an alarming rate. Coupled with near stable nature of the tropical environment, the plant is euryhaline, tolerating both fresh & marine water; hence its spread knows no boundaries. Recently, considerable attention has been given to harvesting this aquatic plant for practical uses to partially defray the cost of removing plants from waterways and use as economical sources in many parts of the world. Though very less pharmacological study on *Eichhornia crassipes* has been reported, this study was designed to evaluate the phytochemical screening of pharmacological active substances of water hyacinth, in order to establish the molecular basis for some of its therapeutic properties in folkloric use.

**MATERIALS & METHODS:**

Water hyacinth (*Eichhornia crassipes*) plants were collected from the water bodies in Bilaspur district of Chhattisgarh (21°37’-25°7’ N latitude and 81°12’-83°40’ E longitude). Fresh shoots and rhizomes were washed several times under running tap water followed by surface sterilization by Mercuro Chloric (0.01%). The shoot and rhizome parts were separated and shade dried followed by oven-drying at 50°C for 24 hours. These plant materials were grinded to powder and used for further analysis.

**Preparation of Sample for analysis:**

The aqueous extract and the powdered specimens were tested chemically using standard procedures [19, 46, 44]. The plant samples (Shoot and rhizome) were air dried and ground in to uniform powder. The aqueous extract of each sample was prepared by soaking 100g of dried powdered samples in 200ml of distilled water for 12 hours. The extracts were filtered using Whatman filter paper No. 42 (125 mm) and used for tests.

**Phytochemical Analysis:**

**Test for Tannin:** About 0.5g of the dried powdered samples were boiled in 20 ml of water in a test tube and then filtered. A few drops of 0.1% ferric chloride was added and observed for brownish green or a blue-black coloration.

**Test for Phlobatannin:** Deposition of a red precipitate when an aqueous extract of each shoot and rhizome was boiled with 1% aqueous hydrochloric acid was taken as criterion for the presence of phlobatannin.

**Test for Saponin:** About 2g of the powdered sample (shoot and rhizome) was boiled in 20ml of distilled water in a water bath and filtered. 10ml of the filtrate was mixed with 5ml of distilled water and shaken vigorously for a stable persis-
**Test for Steroid:** Two ml of acetic acid anhydride was added to 0.5g ethanolic extract of each sample (shoot extract and rhizome extract) with 2ml H2SO4. The colour changes from yellow to blue or green indicating the presence of steroidal compounds.

**Test for Terpenoid (Salkowski test):** Five ml of each extract (shoot extract and rhizome extract of water hyacinth) was mixed in 2ml of chloroform and Concentrated H2SO4 (3ml) was carefully added to form a layer. A reddish brown colouration of the interface was formed to show positive result for the presence of terpenoid.

**Test for Alkaloid:** 5ml of extract was added to 2ml of hydrochloric acid. To this acidic medium, 1ml of Dragendorff’s reagent was added. An orange or red precipitate forms immediately, indicates the presence of alkaloid.

**Test for Flavonoid:** 5ml of dilute ammonia solution was added to a portion of aqueous filtrate of shoot extract and rhizome extract followed by addition of Conc. H2SO4. A yellow colouration observed in each extract indicates the presence of flavonoid. The yellow colour disappears on standing.

**Test for Phenol and Quinone:** Thin layer chromatography (TLC) technique of crude extracts was applied for the detection of phenol and quinone using the standard method of Harborne [19].

**Test for Anthraquinone:** Five ml of each extract solutions were hydrolyzed with diluted Conc. H2SO4 extracted with benzene. One ml of dilute ammonia was added to it. Rose pink coloration suggests the positive response for anthraquinone.

**Test for Cardiac glycosides (Keller-Killani test):** Five ml of each extract of shoot & rhizome was treated with 2 ml of glacial acetic acid containing one drop of ferric chloride solution. This was underlayed with 1ml of Conc. H2SO4. A brown ring of the interface indicates a deoxy sugar characteristic of Cardenolides. A violet ring may appear below the brown ring, while in the acetic acid layer, a greenish ring may form just gradually throughout thin layer.

**RESULTS:**

The phytochemical composition of the *Eichhornia crassipes* determined is summarized in table 1. The successive extract of shoot and rhizome of water hyacinth have revealed the presence of tannins, phlobatannin, steroid, terpenoid, alkaloid, flavonoid, phenolic contents, quinone, anthraquinone and cardiac glycosides. However, saponin was not detected in both shoot and rhizome studied parts of the plant. Other than saponin, all bioactive compounds were detected in the shoot whereas in the rhizome part phlobatannin and cardiac glycosides were not found.

Table 1: Qualitative analysis of the phytochemicals in the shoot and rhizome of *Eichhornia crassipes*

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Phytochemicals</th>
<th>Shoot</th>
<th>Rhizome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Tannin</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>2.</td>
<td>Phlobatannin</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>3.</td>
<td>Steroid</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>4.</td>
<td>Terpenoid</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>5.</td>
<td>Alkaloid</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>6.</td>
<td>Flavonoid</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>7.</td>
<td>Phenolic contents</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>8.</td>
<td>Quinone</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>9.</td>
<td>Anthraquinone</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>10.</td>
<td>Cardiac glycosides</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>11.</td>
<td>Saponin</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Key: + shows presence of phytochemical, - shows absence of phytochemical

**DISCUSSION:**

The curative properties of plants are perhaps due to the presence of various secondary metabolites which are the non-nutritive plant compounds. These classes (such as alkaloid, tannin, anthraquinone and flavonoid) of compounds are known to have curative activity against several pathogens and therefore could suggest the use traditionally for the treatment of various illnesses [21, 47]. The phytochemicals are known to have antimicrobial activity [11]. Tannin has been found to possess antiprotozoal properties, and therefore could suggest the use traditionally for the treatment of various illnesses [21, 47]. The phytochemicals are known to have antimicrobial activity [11]. Tannin has been found to possess antiprotozoal properties, and therefore could suggest the use traditionally for the treatment of various illnesses [21, 47]. The phytochemicals are known to have antimicrobial activity [11]. Tannin has been found to possess antiprotozoal properties, and therefore could suggest the use traditionally for the treatment of various illnesses [21, 47].

**Kandukuri et al.** [25] demonstrated the presence of alkaloid, phenol, steroidal, tannin, triterpenoid and Saponin in *Eichhornia crassipes* whereas reported the absence of flavonoid. Ndubuizi et al. [37] revealed the presence of saponin, glycoside and anthraquinone but absence of alkaloid in water hyacinth. Presence of flavonoid in this plant was also reported by Nyananyo et al. [35] concluded the plants that possessed tannin; Cardiac glycoside & glycoside are the most effective for managing hypertension and also providing protection for the heart. Flavonoids are antioxidants and free radical scavengers which prevent oxidative cell damage, have strong anticancer activity and protect the cell against all stages of carcinogenesis [39]. Flavonoid, in intestinal tract lowers the risk of heart disease [40]. Phenolic compounds are extensively used in disinfections & remain the standard with which other bactericidies are compared [16]. Glycosides serve as defense mechanisms against predation by many microorganisms, insects and herbivores [10]. According to Lewis and Elvin–Lewis [30], alkaloid and glycoside functions with the aid of their defense mechanism act as phytoprotective agent against invading microorganism.

Huma Ali et al. [23] reported water hyacinth as a safe cancer medicine and revealed tumor inhibition potential. According to Gonzalez et al. [17] the optimal effectiveness of a medicinal plant may not be due to one main active constituent, but to the combined action of different compounds originally in the plant. The results obtained in the present investigation show the presence of phytochemicals which take part in defense mechanism of the plant. Hence, a complete study conducted with the purpose of finding these chemicals in water hyacinth plant is worthwhile as the output is “Best out of waste”. It can be suggested that *Eichhornia crassipes* are not only interesting source of therapeutic activities but also potential source of phytochemicals. These findings can form the basis of further studies to isolate active compounds, to find new therapeutic principles. Thus the preliminary screening tests may be useful in the detection of the bioactive principles and subsequently may lead to the drug discovery and development of the water hyacinth plant. Even though, this is only a preliminary study of the occurrence of the certain properties of *Eichhornia crassipes* an in-depth study will provide a good concrete base of all the phytochemicals functions mention above.