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Phytochemical Screening and Elemental Analysis of *Corchorus olitorius* L. Plant

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ABSTRACT

***Background*:** *Corchorus olitorius has been very important plant due to its historical importance. Routine usage of the plant has necessitated very studies on its vital routine so as to determine its safe margin.*

Aim: *This study was conducted to analyse the phytochemical constituents and concentration of some heavy metals in Corchorus olitorius plant.*

Method*: Standard methods of phytochemical analysis were adopted from the procedures of Evans, Sofowora and Harborne while the heavy metals were analysed using Atomic Absorption Spectroscopy (AAS).*

Result: *The phytochemical screening revealed the presence of Carbohydrate, Cardiac glycosides, saponins, tannins, terpenoids, flavonoids, alkaloids, steroids, while anthraquinone was absent in the extract while the Heavy metal analysis indicates the presence of lead (Pb), Chromium (Cr), Sodium (Na), Magnesium (Mg), Manganese (Mn), Potassium (K), Iron (Fe), Copper (Cu), Calcium (Ca) and zinc (Zn).*

Conclusion: *The presence of flavonoids, alkaloids, and tannins is an indication that the plant may possess activities such as anti-inflammatory, anti-oxidant and anti-microbial properties which can used positively for human health while the essential elements in the plant can contribute significantly as dietary sources for essential micro-nutrients. Similarly, this study has validated the traditional use of the plant.*

Key words: Phytochemical analysis, *Corchorus olitorius*, elemental analysis, AAS

INTRODUCTION

Plants are unique source of food, medicinal artifacts, energy and shelter for both human and animal. In fact, the plants play a major role in the maintenance of life on planet earth. Many useful harvests obtained from plants directly or indirectly validate their importance to the human and other living organisms [1]. They convert simple substances into complicated entities producing chemicals that are essential for human health. Medicinal plants have been used as folk medicines by the people throughout the world [2].

Seeking remedies for human ailment from the environment has formed the basis for therapeutics investigations of plant sources [3]. The use of plants for healing purposes has been the most ancient form of medicine known and the quest for plants with medicinal properties has continued to receive attention as scientists are in need of plants, particularly of ethno- botanical significance for a complete range of biological activities,

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which ranges from antibiotic to anti cancerous [4]

Phyto-constituents serve the plants by contributing some secondary functions such as growth, safeguarding the plants by activating defense mechanism, imparting color, odor, and flavor [5]. Natural products and their derivatives exhibit minimal side effects and better efficacy than their synthetic counterparts [6]. These plant-derived components like flavonoids, quinine, terpenoid, etc conduct certain biological functions that enhance therapeutic activities such as anti-carcinogenic, anti-mutagenic, anti-inflammatory, and antioxidant properties [7].

It is of great interest to carry out phytochemical screening of these plants in order to validate their use in modern and folk medicines and to reveal the key principle by the extraction of their constituents [8]. The toxicity of some heavy metals in plants have been of concern to farmers and of dangers to final consumers. Most of these heavy metals have immediate effect while some of them have a gradual long-term effect on consumers and also the ecosystem in which we live. In other words, the heavy metals are persistent contaminants in the environment and since they do not decompose, they remain in the soil and water systems for years and thereby affecting both the plants and animals due to gradual accumulation [9].

Corchorus olitorius L commonly known as jute is a green leafy plant belonging to Malvaceae family and it is recognized for its rich nutritional profile and diverse medicinal properties, making it a valuable asset in traditional medicine [10]. The plant's leaves are particularly noted for their high content of vitamins, minerals, and bioactive compounds, which contribute to its therapeutic potential. It is an herbaceous plant usually cultivated for its fibre. However, the leaves are used and consumed as vegetable in certain cultures thus tribes in Nigeria used it in preparing vegetable soup and has a variety of names for it. The Hausa called *'Ayoyo'*, the Yorubas called it *'Ewedu'* and so for other tribes within or outside Nigeria [11],[12]. *Corchorus olitorius* is commonly in Africa, Europe and Asia. Leaves or whole plant are boiled, dried or freshly used in food [6]. The plant is rich in minerals, vitamins, fiber and ascorbic acid that provide cell renewal and energy production, it is also used in the medical field due to its antimicrobial and antioxidant effects [13].

This research work is designed to identify the phytoconstituents of the plant as well as its elements present in it for the sole aim of quantifying the bioactive compounds and essential elements which largely contribute to the various nutritional and medicinal properties of the plant.

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Fig 1: A Jute Plantation in a Farmland at Zaria, Kaduna State, Nigeria

MATERIALS AND METHOD

Sample Collection and Identification

Fresh leaves of *Corchorus olitorius* were obtained from Zaria, Zaria Local Government Area of Kaduna State on 24th January 2022 and was identified by Mallam A.B. Murtala of the herbarium section of the Department of Biological science Kaduna State University. A voucher number was given as KASU/BSH/778. The fresh leaves were separated from the stalk, washed and air dried at room temperature (24˚C) and then pulverized, crushed into fine powder and washed and kept until use.

Sample Preparation and Extraction

Ethanolic extract of the Corchorus olitorius leaves was prepared by soaking 400 g of the dried powdered leaves in 1000 ml of absolute ethanol at room temperature for 48 hrs (Maceration). The extract was thereafter filtered first through a Whatmann filter paper No.42 (125 mm). the extract was then concentrated using a rotary evaporator with water bath set at 40^0C to one-tenth its original volume and finally with a freeze drier. The dried residue (crude) was then stored at 4^0C until use [14].

Phytochemical screening

Preliminary phytochemical screening was carried out on the crude ethanolic extract (CEE) according to standard procedures of [15],[16],[17] respectively. The following phytochemical components were determined: Alkaloids, Tannins, Cardiac glycosides, Carbohydrates, Flavonoids, Saponins, Triterpenes and Anthraquinones.

Test for tannins

Each extract (0.5 g) to be tested was stirred with 10 ml of distilled water and filtered. The filtrate was used for the following tests as described.

1. **Ferric Chloride**
   To 2 ml of the filtrate, a few drops of 1 % ferric chloride solution was added, occurrence of a blue-black precipitate confirmed the presence of tannins.
2. **Lead Acetate**

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A mixture of equal volumes of 10 % lead acetate (ethanoate) was added to 2 ml of the filtrate. The formation of a white precipitate was an indication of the presence of tannins.

Test for Anthraquinones

1. Borntrager's Test

Each extract (0.5 g) was shaken with 10 ml of benzene and filtered. Then 5 ml of 10% ammonia solution was added to the filtrate and the mixture was shaken. The appearance of violet colour in the ammoniacal (lower) phase was taken as the presence of free anthraquinones.

2.Test for Combined Anthraquinones

The extract (0.5 g) was shaken with 10 ml aqueous sulphuric acid (H_2SO_4) and then filtered while hot, the filtrate was shaken with 5 ml of benzene; the benzene layer separated and half its own volume of 10 % ammonia solution was added. The appearance of red colour in the ammoniacal (lower) phase was taken as the presence of combined anthraquinones.

Test for Alkaloids

Each (0.5 g) of the extracts were stirred with 5 ml of 1 % aqueous hydrochloric acid on water bath and then filtered. The filtrate (3 ml) was divided into 3 portions in a test tube and was used for the test below:

1.Dragendroff's Test:

Two (2) drops of Dragendroff's reagent were added to the first portion of the filtrate; the occurrence of an orange-red precipitate indicated the presence of alkaloids.

2.Meyer's Test:

Ten (10) ml of methanol was added to the second portion of the filtrate and filtered. To 2 mL of the filtrate, 1 % hydrochloric acid was added; the mixture was then boiled and filtered. Meyer's reagent (6 drops) was added to 1 mL of the filtrate. A creamy, reddish-brown precipitate was an indication of the presence of alkaloids.

3.Wagner's Test:

Few drops of Wagner's reagents were added to a portion of the extract, whitish precipitate indicates the presence of alkaloids.

Tests for carbohydrates

Molisch's Test for Carbohydrates:

To 1 ml of the filtrate, 1 ml of Molish's reagent was added in a test tube, followed by 1 ml of concentrated sulphuric acid down the test tube to form a lower layer. A reddish colour at the interfacial ring indicates the presence of carbohydrate.

Tests for Saponins

Frothing test

About 10ml of distilled water was added to a portion of the extract and was shaken vigorously for 30seconds. The tube was allowed to stand in a vertical position and was observed for 30mins. A honeycomb froth that persists for 10-15mins indicates presence of saponins.

Test for Flavonoids

1. Shinoda Test

A portion of the extract was dissolved in 1-2ml of 50% methanol in the heat metallic magnesium chips and few drops of concentrated hydrochloric acid were added. Appearance of red color indicates presence of flavonoids.

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2. Ferric chloride method

Each of the extract was boiled with distilled water and then filtered. To 2 ml of the filtrate, a few drops of 10 % ferric chloride solution were added. A blue-green coloration was an indication of the presence of a phenolic hydroxyl group.

Test for Steroid and Triterpenes

Liebermann-Burchard's test

To a portion of the extract, equal volume of acetic acid anhydride was added and mixed gently. 1ml of concentrated sulphuric acid was added down the side of the test tube to form a lower layer. A colour change observed immediately and later indicates the presence of steroid and triterpenes. Red, pink or purple colour indicates the presence of Triterpenes while blue or blue green indicates steroids

Test for Cardiac Glycoside

Kella-killiani's test

A portion of the extract was dissolved in 1ml of glacial acetic acid containing traces of ferric chloride solution. This was then transferred into a dry test tube and 1ml of concentrated sulphuric acid was added down the side of the test tube to form a lower layer at the bottom. Observed carefully at the interphase for purple brown ring, this indicates the presence of deoxy sugars and pale green colour in the upper acetic acid layer indicates the presence of cardiac glycosides.

Determination of Bio-accumulated Trace / heavy metal

Ground and dried sample of *Corchorus olitorius* weighing 0.5g, was transferred into a porcelain crucible and placed in a muffle furnace GLM-3. The furnace was set at 500℃ for 5hours. The sample was removed and cooled in a desiccator. 0.5g of the ash was then digested in a 250ml beaker with 20cm^3 of aqua-regia (mixture of $HClO_4$, H_2SO_4, and HNO_3 in a ratio 1:4:3) and the beaker was placed in a fume cupboard. The beaker was then covered with a watch glass and was gently heated at 150℃. The mixture was evaporated in a fume cupboard until the brown fumes disappeared leaving the white fumes, and the content reduced to 5cm^3. The mixture was then brought to room temperature, and it was made up to 50cm^3. The sample was then filtered into a sample using Whatmann's filter paper no.4 and it was ready for Atomic Absorption spectrophotometer (AAS) PG 990 Model analysis [18][19]

RESULTS

Phytochemical analysis revealed the presence of tannins, alkaloids, carbohydrates, saponins, flavonoids and terpenoids/steroids while anthraquinone was not detected (Table 1).

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Table 1: Qualitative Phytochemical Screening of *Corchorus olitorius* plant

PHYTOCHEMICALS	TEST	OBSERVATION	INFERENCE
Tannins	Ferric chloride	Blue-black precipitate obtained	+
	Lead acetate	White precipitate obtained	+
Alkaloids	Dragendoff's reagent	Orange-red precipitate obtained	+
	Mayer's reagent	creamy reddish brown red appeared	+
	Wagner's reagent	white precipitate obtained	+
Carbohydrates	Molisch's	reddish color appeared	+
Saponins	Frothing	froth persisted	+
Flavonoids	Shinoda	red precipitate obtained	+
	Ferric chloride	blue-green precipitate obtained	+
Terpenoids/Steroids	Liebermann-Burchard,s	Colour change appeared from violent to blue	++
Anthraquinones	Borntrager's	violet colour appeared	_
Cardiac glycosides	Kella-killiani's	Redish brown layer was formed which turned bluish green later	+

Keys: + indicates present
- indicates absence

The plant had high bioaccumulation/concentration of potassium (22.58) followed by Calcium (13.34) and Iron (2.39) far above the recommended does by [19],[20] [21]. While Magnesium (4), Copper (0.16), Zinc (0.43), Sodium (0.19) and Manganese (0.031) are relatively below or within the permissible and recommended limits (Table 2).

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Table 2: Result of the determination of trace / heavy metals in the leaves of *Corchorus olitorius* plant

S/N	Elements	Concentration (mg/L)	NAFDAC Standard	FAO/WHO Standard
1	Iron (Fe)	2.39	0.30	0.30
2	Copper (Cu)	0.16	1.50	2.00
3	Calcium (Ca)	13.34	6.40	6.10
4	Magnesium (Mg)	4.00	5.10	4.90
5	Zinc (Zn)	0.43	8.0	5.00
6	Sodium (Na)	0.19	2.00	2.50
7	Manganese (Mn)	0.031	0.20	1.02
8	Potassium (K)	22.58	_	12.0
9	Lead (Pb)	No trace	0.01	0.01
10	Chromium (Cr)	No trace	0.05	0.05

Keys: NAFDAC = National Agency for Food and Drug Administration and Control
FAO = Food and Agricultural Organisation, WHO = World Health Organisation

DISCUSSION

The result for the phytochemical screening of the Ethanolic extract of *Corchorus olitorius* (Jute mallow) showed the presence of Carbohydrates, Saponins, Tannins, Terpenoids/Steroids and Cardiac glycosides in the extract of the plant [22]. It also showed negative in case of Anthraquinones which are considered toxic and poisonous which can be detrimental to human health. The Anthraquinones do generate reactive oxygen species (ROS) which could lead to oxidative stress in cells. The process is linked to their REDOX properties where H_2O_2 is produced and significantly contribute to cytotoxicity [23]. Since jute mallow is an edible plant, hence the absence of anthraquinone makes it non-toxic [24], [25]. In a related reviews some importance of the phytocompounds have been highlighted and this include and not limited to the health benefits of some of them such as, Saponins which have effect on blood cholesterol levels, cancer, bone health and stimulation of the immune system and they are also found to be strong expectorant and aid the absorption of nutrients [3]. Dietary intake of flavonoids containing foods have the potential to lower the risk of certain free radical pathophysiology. The flavonoids also have been reported to have effects on the central Nervous System, cardiotonic, lipid lowering, anti-ulcer, hepato-protective and hypoglycemic activities as well [26],[27]. Cardio glycosides are also of medicinal significance and used in the treatment of congestive heart failure and cardiac arrhythmia [28]. Phenols and phenolic compounds have marvelous antimicrobial potential and have been extensively used in disinfections [29],[6]. Steroids are pharmacologically active compounds and show analgesic properties and central nervous system activities. Some tannins stimulate glucose uptake and exhibit insulin like activity acting as glucose transport activators of fat cells [30]. Terpenoids display momentous pharmacological

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activities which include but not limited to antiviral, antibacterial, antimalarial, anti-inflammatory, cholesterol synthesis inhibition and anti-cancer activities [31].

The concentration of Mg, Cu, Zn, Mn and Na detected in the leaves of jute mallow were significantly below the maximum value recommended by [21][32] while Fe, Ca, K, were significantly above the maximum value recommended by NAFDAC and FAO/WHO. Potassium had no NAFDAC but FAO/WHO had proposed permissible limit in water not exceeding 12mg/L. However, any trace of potassium may either be toxic or safe according to SON, NAFDAC and FAO/WHO (2004). Therefore, potassium is safe to consume in some plants and sometimes if wrongly abused can be toxic.

Copper is an essential micronutrient which functions as a biocatalyst required for body pigmentation [33].

In addition, Iron maintains a healthy central nervous system, prevents anemia and interrelated with the function of Zinc and Iron in the body [34].

In this study, lead (Pb) and Chromium (Cr) were not detected (no trace). This is consistent with the report of Ladipo and Doherty (41), which stated that lead was not detected in vegetable sample analyzed at the time of their study. Chromium plays a vital role in the metabolism of cholesterol, fat and glucose. Its deficiency causes hyperglycemia, elevate body fat and decrease sperm count. When in high concentration, it is toxic and carcinogenic [34].

Zinc concentration of 0.43 mg/L is lower than the permissible limits [19],[35]. However, zinc is the least toxic and an essential element in human diet as it is required to maintain the functioning of the immune system. Zinc deficiency in the diet may be highly detrimental to human health than too much zinc in the diet. The recommended dietary allowance for zinc is 15mg/day for men and 12 mg/day for women according to agency for toxic substance and disease registry, but high concentration of zinc may cause vomiting, renal damage cramps etc [36].

Iron (Fe) is the most abundant and essential constituent for all plants and animals. On the other hand, at high concentration, it causes tissue damage and some other disease in humans. It is also responsible for anemia and neurode generative conditions in human being [35].

Calcium is a nutrient that all living organisms need, including humans. It is the most abundant mineral in the body and it is vital for bone health. Humans need calcium to build and maintain strong bones; 9.9% of the body's calcium is in the bones and teeth. It is also necessary for maintaining healthy communication between brain and other parts of the body. It plays a major role in muscle movement and cardiovascular function. High levels of calcium in the body can cause nausea, dry mouth, belly pain, an irregular heartbeat, confusion and it may cause even death in humans.

The concentration of magnesium detected was below the maximum recommended limit by [20]. Magnesium is an important mineral, playing a role in over 300 enzymes reactions. Its many functions include, helping with muscle and nerve functioning, regulating blood pressure and supporting the immune system [37]. High level of magnesium can cause kidney problem, low level blood pressure, urine retention, nausea and

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vomiting, depression, a loss of central nervous system control [38].

The study revealed the presence of some macronutrients that are within acceptable range, while some are either above or below the accepted concentrations. Both the heavy elements and essential trace elements are known to influence various body functions based on their concentrations [39][40].

CONCLUSION

The phytochemical screening revealed the presence of some important secondary metabolites which are compounds capable of causing varied physiochemical and pharmacological effects. Their presence therefore seems to support the traditional use of the plant in the management of various diseases thus suggesting these compounds may contribute significantly to the plant's therapeutic efficacy. The presence of some heavy trace elements either absent, above or below FAO/WHO acceptable levels is an indication that the plant is a potential valuable resource in herbal medicine.

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