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Unlocking the Green Pharmacy: Qualitative Phytochemical Screening of *Adiantum Raddianum* Leaf Extracts

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Abstract

Evaluating the existence of various phytochemicals in plants requires qualitative phytochemical research. Medicinal plants are those that have therapeutic significance. The use of medicinal plants for therapeutic determinations is crucial for preserving community and individual health. The medicinal value of these plants stems from a diversity of chemical compounds that have precise physiological properties on people. Amongst these plant bioactive constituents, phenolic compounds, tannins, alkaloids and flavonoids, are the furthermost noteworthy. The main objective of the current study is to extract and analyse diverse phytochemicals from the leaves of *Adiantum Raddianum* plant. The plant Adiantum Raddianum, also called Delta maidenhair fern, belongs to the genus Adiantum and family Pteridaceae. This study clarifies whether primary or secondary phytochemicals are present in *Adiantum Raddianum* plant. The phytochemical screening has revealed the presence of phenol, flavonoids, saponin, tannin, alkaloids, protein, glycosides, and carbs. The diverse array of phytochemicals identified in *Adiantum Raddianum* underscores its potential as a significant source of natural bioactive agents. The current study directs the researcher to extract unique therapeutic compounds from various *Adiantum Raddianum* plant components in an effort to find innovative pharmaceutical products

KEYWORDS

Adiantum Raddianum, Phytochemical constituents, Bioactive constituents, Medicinal Plant, Qualitative screening.

1.0 INTRODUCTION

Herbalists use medicinal herbs, which are believed to have certain therapeutic characteristics. In rural and tribal regions, they serve as the easily accessible source for medical care [1]. Scientists are increasingly interested in biologically active plant-based composites for treating infectious disorders [2]. Medicinal plants are vitally important to human health, the existence of certain chemical compounds that have a particular physiological impact on the human body is thought to be responsible for these medicinal potentials [3]. Numerous pharmacologically active ingredients found in herbal remedies can have medicinal properties [4]. Plant extracts work together with various nutrients and fibers to create a consistent defence mechanism against stress and disease [5]. Traditional remedies based on herbs have been practiced extensively for many years because of its natural nature and little negative side effects [6]. Biologically active substances derived from herbs are of great interest to

researchers studying diseases that are infectious [7]. Tannins, flavonoids, and phenolic compounds are among some of the most common plant biologically active substances [8]. Medicinal plants have an enormous impact on new medications and medical items [9]. The use of plant extracts as organic antioxidants and antibacterial agents is growing [6]. Phytoconstituents have a major impact on human physiology [10]. The body's phytochemicals work with proteins and minerals to shield the body against illnesses and stressful situations. [11]. For a long time, natural materials have been utilized in medicine [12]. Bark, leaves, flowers, roots, fruit, and seeds can all be used to make medications [13].

One of the greatest basic and traditional forms of therapeutic medicine is the usage of plants with biologically active elements in humans [14]. Even though over 6,000 drugs have been developed using different plant sources of information [15]. The genus *Adiantum* of the *Adiantaceae* family grows in mild tropical and subtropical climates [16]. The genus contains 200 species, the majority of which have been identified in South America and there are also approximately 30 species in China [17]. Phytochemical research revealed the presence of triterpenoids and flavonoids in the plants of the genus Adiantum. Pharmacological studies have shown that some important Adiantum species have antibacterial potentials [18]. The Pteridaceae genus Adiantum is extremely dominant across numerous plant groups, especially in tropical and temperate regions [19]. Several of these species, commonly referred to as maidenhair ferns, have been employed medicinally all over the world [20]. They have anti-dysentery, antiviral, antibacterial, and anticancer properties. Adiantum species are traditionally used to treat respiratory conditions like fever, pneumonia, cough, cold, and mucus production [21].

MATERIALS AND METHODS

Plant Extracts

The *Adiantum raddianum* plant species' fresh, healthy, and disease-free leaves were gathered from the District of Malakand, KPK, Pakistan. The plant samples were cleaned with distilled water and allowed to dry for 17 days at room temperature in a shaded area. The *Adiantum raddianum* leaves were cleaned, dried, and ground into a powder employing a grinder to make them suitable for the typical solvent extraction procedure.

2.1.Solvent Extraction Process

60 grams of leaves were soaked in 500 millilitres of ethanol for 15 days at ambient temperature as part of the extraction process. After a period of fifteen days, the extracts were filtered. The concentrate moiety was subsequently obtained by incubating the filtrate for eighteen days at ambient temperature.

2.2.Reagents

Ninhydrin, sulphates, benzene, picric acid, sodium carbonate, glacial acetic acid, concentrated and diluted sulphuric acid, chloroform, ethyl acetate, and concentrated and diluted hydrochloric acid.

2.4. Analysis for phytochemical

2.4.1 Analysis for Cardiac Glycosides

Reagents that mixed around 5 ml of each extract with 2 ml of glacial acetic acid and a drop of ferric chloride solution were used to identify cardiac glycosides. One millilitre of strong sulphuric acid was then added. Cardenolide's deoxysugar property is indicated by the brown ring at the contact.

2.4.2 Analysis for Steroids and Phytosterols

One millilitre of plant extract, one millilitre of chloroform, and a few drops of strong sulphuric acid were introduced to a sulphuric acid test to find phytosterols. Steroids are indicated by the production of a brown ring, whereas phytosterols are indicated by the formation of a colour that is blue.

2.4.3 Analysis for Tannin

Add a few drops of a 0.1% ferric chloride ($FeCl_3$) solution to 5 mL of sample extract and 20 mL of chloroform to identify tannin. After filtration, the presence of tannins was shown by the formation of a brownish colour.

2.4.4 Analysis for Saponins Glycosides

By forcefully mixing an equal volume of extract material and water, the foam test was performed to detect the presence of saponins and glycosides. The persistent foam was found to include saponin glycosides.

2.4.5 Analysis for Alkaloid

To check for alkaloids, 1 mL of sample extract (a

saturated aqueous solution of picric acid) was mixed with 3 mL of Hager's reagent. Alkaloids were detected by the formation of yellow precipitate.

2.4.6 Analysis for Terpenoids

Carefully combine 5 mL of the sample extract with 2 mL of chloroform and 3 mL of strong sulphuric acid. Terpenoids were confirmed by the development of a layer of reddish brown foam.

2.4.7 Analysis for Saponins

By boiling 5 ml of each extract sample in 20 ml of chloroform in a water bath and filtering, saponins were identified. After filtering, 10 mL of the filtrate was combined with 5 mL of distilled water and violently shaken to produce a stable and long-lasting foam. Before trying to create an emulsion, the foam was combined with three drops of olive oil and forcefully agitated.

2.4.8 Analysis for Flavonoids

Prior being processed with concentrated H2SO4, a fraction of the filtrate from each plant extract and chloroform was treated with five milliliters of ammonia solution. Each extract had the colour of gold that indicated the presence of flavonoids.

2.4.9. Test for Reducing sugar

2.5.9.1 Benedict's test

The mixture of Benedict and an equivalent volume of the sample extract were placed in a test tube and heated in a water bath for approximately five minutes in order to detect the presence of reducing sugar. The presence of reducing sugar in the sample is shown by the solution turning green, yellow, or red.

2.5.9.2 Fehling's test

In a test tube, two milliliters of Fehling's solution (containing equal amounts of Fehling's A and B) were combined with a comparable quantity of the sample extract. After that, the mixture had been heated in a water bath for five to ten minutes. The existence of reducing sugar is indicated by the production of brick red ppt.

2.4.10. Test for the presence of Non-reducing sugar

Test solution does not give response to Fehling's and Benedict's test.

RESULTS AND DISCUSSION

According to the experimental results, a wide range of secondary metabolites have been successfully found by qualitative phytochemical examination of *Adiantum raddianum* leaf extracts. The alkaloids were found in significant amounts in the examination, and Hager's, Wagner's, and Harborne's diagnostic assays uniformly identified them. Additionally, the extracts showed positive results for saponin and cardiac glycosides, indicating a complex glycosidic composition in the leaf tissue. The ferric chloride test revealed a considerable quantity of tannins, whereas the sulfuric acid test verified the existence of steroids and phytosteroids. The variety of chemicals of the species was further demonstrated by the identification of terpenoids and flavonoids using chloroform and sulfuric acid reagents, correspondingly. The results pertaining to saponins' glycosidic forms were supported by the foam test, which gave a definite positive signal for saponins. Benedict's and Fehling's examinations of the leaves' carbohydrate content revealed a favorable response for lowering sugars. However, the iodine test for non-reducing sugars yielded a negative result, indicating the absence of starch. This suggests that the basic carbohydrates are kept in their simpler, reducing forms. Together, these findings offer a thorough chemical fingerprint of the leaf extract. To guarantee the precision and repeatability of the data, every test was run three times. A high yield is suggested by the strong color changes seen in the alkaloid and flavonoid assays. These results provide the basic information for the pharmacological discussion that follows. The detected chemicals' diversity is consistent with ferns' recognized chemical complexity. All things considered, the screening verifies that the leaves are a rich source of bioactive components.

Adiantum raddianum significance as a major source of naturally occurring bioactive compounds is highlighted by the wide variety of phytochemicals found in it. The strong occurrence of alkaloids is especially significant because these nitrogenous chemicals are often linked to antibacterial, analgesic, and anti-inflammatory properties in medicinal plants.

Similarly, the presence of tannins and flavonoids indicates that the extract has a significant antioxidant activity. These phenolic compounds are well known for their capacity to scavenge free radicals, which helps repair wounds and shields cellular structures from oxidative stress. The discovery of terpenoids, which frequently show strong antifungal and antibacterial qualities by rupturing microbial cell membranes, further improves the plant's therapeutic profile. The traditional usage of Adiantum species to manage cardiovascular health and systemic circulation has a scientific basis due to the presence of cardiac glycosides. Furthermore, because saponins have surfactant qualities that can affect the bioavailability and absorption of other co-occurring phytochemicals, their detection is important. A metabolic preference for reducing sugars is revealed by the study of carbohydrates; these sugars are probably used as immediate energy sources or as building blocks for the creation of secondary metabolites. A particular physiological condition of the leaves at the time of collection, cantered on active metabolism rather than long-term storage, is suggested by the lack of non-reducing carbohydrates (starch). These results support the "Maidenhair fern's" ethno-medical reputation for healing inflammatory and respiratory ailments. The plant's total medicinal efficacy is probably due to the synergy of these several kinds of compounds—glycosides, phenolics, and alkaloids. By establishing a crucial chemical baseline, this finding supports additional research into the isolation of certain compounds. To ascertain the precise pharmacological efficacy of these components, bioactivity-guided fractionation should be given top priority in future studies. The study advances our knowledge of pteridophyte chemistry by recording this chemical signature. In the end, A. raddianum is a viable option for the creation of standardized herbal extracts and contemporary medication production.

Table 1. Phytochemicals screening of Leaves extracts of *Adiantum Raddianum*

S.No	Phytochemicals	Test	Leaves
1	**Analysis for Cardiac Glycosides**	**Acetic acids**	**Positive**
2	**Analysis for steroids and Phytosteroids**	**Sulphuric Acids**	**Positive**
3	**Analysis for Tannin**	**Ferric chlorides**	**Positive**
4	**Analysis for Saponin glycosides**	**Foam**	**Positive**
5	**Analysis for Alkaloids**	**Hagers**	**Positive**
		Wagners	**Positive**
		Harborne	**Positive**
6	**Analysis for Terpenoids**	**Chloroform**	**Positive**
7	**Analysis for Saponins**	**Foam**	**Positive**

8	**Analysis for Flavonoids**	**Sulphuric acids**	**Positive**
9	**Reducing sugar**	**Benedict's test** **Fehling's test**	**Positive** **Positive**
10	**Non Reducing sugar**	**Iodine test**	**Negative**

CONCLUSION

An important starting point for comprehending the therapeutic probable of this particular fern species is the phytochemical analysis of *Adiantum raddianum* leaves. This study has successfully discovered a wide range of secondary metabolites, such as alkaloids, flavonoids, tannins, terpenoids, and other glycosides, using a number of qualitative assays. These substances demonstrate that the plant is a rich source of bioactive chemicals that can have important physiological impacts. In particular, the extract may have high antibacterial, antioxidant, and anti-inflammatory qualities due to the strong presence of alkaloids and phenolic compounds.

Additionally, the discovery of cardiac glycosides and steroids offers a chemical justification for its conventional application in the treatment of cardiovascular and systemic health. The lack of non-reducing sugars reveals a distinct metabolic profile characterized by conjugated glycosidic forms and simpler, more accessible carbs. All of these results support the Adiantum genus' ethno-medical repute and highlight its significance in the hunt for natural pharmaceutical substances.

This screening procedure obliges as a crucial overture to bioactivity guided fractionation and supplementary complex quantitative analysis. To ascertain their precise modes of action and therapeutic thresholds, future research should concentrate on isolating these particular ingredients. The work offers a solid basis for the creation of standardized herbal formulations or the synthesis of novel medications derived from plants by establishing this chemical fingerprint. In the end, the findings highlight how important it is to protect biodiversity because species like A. raddianum have unrealized medical potential..

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CONFLICT OF INTEREST

Authors express no conflict of interest

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