

Preliminary Phytochemical Screening of Different Solvent Extracts of *Adiantum caudatum* L. from Chalisgaon Region

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Abstract: The present study was conducted in order to determine the preliminary phytochemical constituents of *Adiantum caudatum* by the use of different solvent extracts like petroleum ether, ethanol, methanol and aqueous extracts. The study showed that different extracts contain alkaloids, flavonoids, phenols, saponins, steroids, tannins, terpenoids and glycosides in varying concentrations. Among the tested solvents, the methanol and aqueous extracts showed relatively higher abundance of phytochemicals, suggesting the greater efficiency of polar solvents in extracting bioactive compounds. Alkaloids, flavonoids, tannins, terpenoids and glycosides were strongly present in methanolic and aqueous extracts whereas phenols were strongly present in all extracts. Considerable amounts of saponins were found in petroleum ether, ethanol and water extracts. Mild steroids were present in all the extracts. The results indicate that *Adiantum caudatum* is a rich source of pharmacologically important secondary metabolites with potential antioxidant, antimicrobial and therapeutic properties. It is particularly indicative of the significant medicinal value of phenolic and flavonoid compounds. These findings support the traditional medicinal use of *Adiantum caudatum* and give scientific basis for further pharmacological, isolation of bioactive compounds and drug development research.

Keywords: phytochemicals extracts, solvents, antioxidant etc.

1. Introduction

Plants contain many different antioxidants that occur naturally and have been shown to help get rid of oxygen or free radicals. Nowadays there is a great interest in the study of antioxidant compounds, as they can inhibit the scavenging of free radicals of molecules. In poor countries like those in Asia and Africa, there is still a great deal of importance placed on the use of medicinal herbs in their practices. Medicinal plants complement or replace modern-day medical treatments that are often insufficient to access and further enhance their access. In addition, medicinal plants enhance the health and safety of local populations. These plants are not only extremely important to day-to-day living, but they are also intricately connected to a wide range of cultural, social and economic occurrences which take place during the course of life, including ageing, illness and death (Ragupathy et al., 2008).

Pteridophytes, commonly known as ferns, are an ancient group of vascular plants of great medicinal importance. *Adiantum* species are commonly known in traditional systems of medicine for their therapeutic uses. The genus *Adiantum*, belonging to the family Pteridaceae, includes about 200 species in tropical and temperate regions. Several species of this genus are used traditionally for the treatment of cough, fever, jaundice, skin disorders, wounds, diabetes and respiratory ailments. *Adiantum caudatum* L. (trailing maidenhair fern) is an important medicinal fern used in traditional herbal medicine. The species is well known for its therapeutic properties and has attracted considerable attention due to its pharmacological potential. The presence of flavonoids and phenolic compounds, terpenoids, triterpenoids, and other bioactive metabolites in *A. caudatum* has been reported in previous studies. These compounds are important for its antioxidant, antimicrobial and anti-

inflammatory activities. Methanolic extracts of *Adiantum caudatum* showed high phenolic and flavonoid content with strong antioxidant and antibacterial activities (Ahmed et al., 2015). Similarly, John Peter Paul (2018) found diverse phytochemical compounds like alkaloids, flavonoids, saponins, steroids, tannins and glycosides in different solvent extracts of *A. caudatum*. Arai et al. (2001) isolated further triterpenoids from this fern, confirming its richness in phytochemicals. However, a detailed phytochemical evaluation using different solvent extracts is still crucial to understand the bioactive profile of *Adiantum caudatum* in a better way despite the medicinal importance of this plant. Therefore, the present study was undertaken for the preliminary phytochemical screening of petroleum ether, ethanol, methanol, and aqueous extracts of *Adiantum caudatum* to determine the major secondary metabolites present in this species. The findings of this study could be useful for future pharmacological studies and isolation of bioactive compounds.

2. Material and Method

Plant material for the present work was mainly collected from Chalisgaon region of Maharashtra, India. Through the Department of Botany, Maharaja Sayajirao Gaikwad Arts, Science & Commerce College, Malegaon, Dist-Nashik (03), Savitribai Phule Pune University, Pune during period of Oct.2023 to Dec.2025.

Sample collection and powder preparation:

The Plant sample was collected from Chalisgaon region. We collected the plant fragments, washed them with running water to remove any residual soil particles and then autoclaved them. Fresh plant leaves were air-dried at room temperature for 10 days and then ground with an automatic grinder. The dust free plant powder was stored at 4 °C in

airtight container for further use (Mehra and De, 2017). The ingredients were then dried and ground into a fine powder.

Solvent extraction:

Crude plant extract was prepared by Soxhlet extraction process. About 25 g of powdered plant material (leaves) was taken in a thimble and extracted with different solvents (petroleum ether, methanol, ethanol and aqueous extract) using 250 ml of each solvent. All the extracts were evaporated using rotary evaporator and yield % was noted. For further studies, dried extracts were stored in sealed containers. The concentrated extracts were subjected to a number of chemical tests to identify the various phytoconstituents. The dried extract was dissolved in 10% dimethyl sulfoxide and kept in the refrigerator for future use (Mohanta et al., 2007). Qualitative screening was done for the presence of biochemicals such as alkaloids, flavonoids, phenols, saponins, steroids, tannins, terpenoids and glycosides.

1) Test for Alkaloids:

Mayer's test: Take 1 ml of plant extract in a test tube. Add a few drops of Mayer's reagent. Shake well to combine. The precipitate forms in test tube. The formation of cream-coloured (yellowish or white) precipitates in the test tube will indicate a positive result. The plant sample in question contains alkaloids. (W.C. Evans & G.E. Trease, 2002).

2) Test for Flavonoids:

Ferric chloride test: In a test tube add 1 mL of plant extract and a few drops of neutral ferric chloride solution. Mix well. The presence of flavonoids and other phenolic chemicals is indicated by the formation of a green-black colouration (J. B. Harborne, 1998; A. Sofowora, 2008).

3) Test for phenolic compounds:

Ferric Chloride Test: Add a few drops of neutral ferric chloride solution to a test tube containing 1 ml of plant extract. Blend well. The presence of phenolic compounds is indicated by the appearance of red, blue, purple or blackish-green colouration (J. B. Harborne, 1998; A. Sofowora, 2008).

4) Test for Saponins:

Foam test: Combine 5 mL of plant extract (filtrate) with 20 mL of distilled water. Shake the test tube thoroughly, and then let it stand for a few minutes. Saponins are present when stable and persistent foam is formed (J. B. Harborne, 1998; A. Sofowora, 2008).

5) Test for steroids:

Liebermann Burchard test: To the concentrated extract of the plant add 2 ml of acetic anhydride and 1 ml of concentrated sulphuric acid down the side of the test tube. Blue to green colour indicates the presence of Steroids (G. E. Trease & W. C. Evans, 2002; J. B. Harborne, 1998).

6) Test for Tannins:

Ferric chloride test: Add two ml of ferric chloride (FeCl₃) solution to the ethanolic plant extract. Presence of Tannins was detected by the formation of blue-black or greenish black colouration or precipitate (J. B. Harborne, 1998; A. Sofowora, 2008).

7) Test for Terpenoids:

Salkowski's Test: Add 2 mL of chloroform to the plant extract and carefully add 3 mL of concentrated sulphuric acid down the side of the test tube. The presence of terpenoids is indicated by formation of reddish-brown colouration at the contact (J. B. Harborne, 1998; G. E. Trease & W. C. Evans, 2002).

8) Cardiac Glycoside Detection

Keller-Killani test: Add 1 mL of FeCl₃ reagent (5% solution of ferric chloride and glacial acetic acid) to the plant extract. Now carefully add a few drops of concentrated sulphuric acid down the side of the test tube. A greenish blue colouration develops within few minutes indicating the presence of cardiac glycosides (G. E. Trease & W. C. Evans, 2002; J. B. Harborne, 1998).

3. Observation

Table: Preliminary phytochemical activity in *Adiantum caudatum*

S. No.	Name of the compound	Petroleum ether extract	Ethanol extract	Methanol extract	Aqueous extract
1.	Alkaloid	+	+	++	++
2.	Flavonoid	+	+	++	++
3.	Phenols	++	++	++	++
4.	Saponins	++	++	+	++
5.	Steroids	+	+	+	+
6.	Tanins	+	+	++	++
7.	Terpenoids	+	++	++	++
8.	Glycosides	+	+	++	++

Where: + = Present, ++ = Strongly Present, - = Absent

4. Result and Discussion

Preliminary phytochemical screening of various solvent extracts (petroleum ether, ethanol, methanol and aqueous) of *Adiantum caudatum* revealed the presence of several bioactive compounds such as alkaloids, flavonoids, phenols, saponins, steroids, tannins, terpenoids and glycosides.

The methanolic and aqueous extracts exhibited relatively higher phytochemical abundance among all the extracts indicating that the polar solvents are more efficient in extracting the bioactive constituents from *A. caudatum*. Methanol and aqueous extracts were strongly (++) in alkaloids, flavonoids, tannins and glycosides. Phenols were highly present (++) in all extracts, showing the wide distribution of phenolic compounds in this species. Petroleum ether, ethanol and aqueous extracts were found to

be highly rich in saponins but comparatively less in methanol extract. Steroids were mildly present (+) in all solvent extracts. The observed phytochemical profile revealed that *Adiantum caudatum* is a good source of secondary metabolites of potential medicinal importance. The high amount of phenols and flavonoids illustrates the high antioxidant potential, while the presence of alkaloids, terpenoids and glycosides may provide antimicrobial, anti-inflammatory and therapeutic activities. These results were in accordance with the study of Ahmed et al. (2015) who reported that methanolic extract of *A. caudatum* had the highest phenolic and flavonoid content as compared to hexane and aqueous extract. Moreover, their work revealed strong antioxidant and antibacterial potential, which was mainly attributed to phenolic and flavonoid constituents. This supports the strong presence of phenols and flavonoids seen in the current study. Likewise, John Peter Paul (2018) performed preliminary phytochemical screening of *Adiantum caudatum* by using methanol, acetone, benzene and hexane extracts and found the presence of alkaloids, flavonoids, saponins, steroids, tannins and glycosides. The current findings are in good agreement with this report, however, the current study further emphasises higher phytochemical richness in aqueous extract. A phytochemical study of Arai et al. (2001) isolated several triterpenoids from *Adiantum caudatum*, confirming that this species is an important source of terpenoid compounds. The current study demonstrated strong detection of terpenoids in ethanol, methanol and aqueous extracts which supported previous chemical studies. Similarly, comparative studies with *Adiantum capillus-veneris* also showed similar patterns of phytochemical. High levels of flavonoids, tannins, phenolics, triterpenoids and phytosterols are reported to be present in this species. These compounds have been linked to antioxidant, antimicrobial and anti-inflammatory properties. Such a similarity in phytochemical composition leads to the wide preservation of medicinal properties in the genus *Adiantum*. Several species of *Adiantum* were reported to be rich in flavonoid glycosides and phenolic compounds which are important chemotaxonomic markers (Cooper-Driver and Swain, 1977). The present study further corroborates this observation by the high abundance of phenols and glycosides and confirms the chemotaxonomic significance of such metabolites in *Adiantum* species. Rani Jasmine et al. (2021) studied the phytochemicals of *Adiantum caudatum* and *Adiantum hispidulum* and found that the two species contain flavonoids, phenols, tannins, and saponins, with *A. caudatum* showing slightly higher antioxidant activity. This is in agreement with the present findings where the abundance of phenols and flavonoids suggest strong pharmacological potential.

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