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Phytochemical analysis of medicinal plants: Unveiling the therapeutic potential of curcum longa, aloe barbadensis, moringa oleifera, and azadirachta indica

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Abstract
This study investigates the phytochemical composition of four medicinal plants, revealing a diverse array of bioactive compounds with potential medicinal properties. The results support the traditional use of these plants in various therapeutic applications and highlight their potential as valuable resources for drug development and herbal product standardization.
For this study, four medicinal plants such as Curcum longa, Aloe barbadensis, Moringa oleifera, Azadirachta indica were selected. This present study reports the solvent extract and aqueous prepared from four Indian plants belonging to different families collected from home town. The aim of the present study was to investigate the presence of phytochemicals in selected medicinal plants. Solvents used were ethanol or methanol. carbohydrates, proteins, amino acids, fatty acids, alkaloids, glycosides, flavonoids, terpenoids, saponins were detected in all of the plants tested. These tested plants (Curcum longa, Aloe barbadensis, Moringa oleifera, Azadirachta indica) contain medicinally important bioactive compounds and it justifies their use in the traditional medicines for the treatment of different diseases. It was concluded that the plants studied were rich in phytochemicals with significant pharmacological and medicinal applications.

Keywords: Phytochemical analysis, plant sample, medicinal plants, tests

Introduction
Medicinal plants have been a cornerstone of traditional medicine for centuries, offering a rich source of bioactive compounds with potential therapeutic applications. The increasing demand for natural and sustainable healthcare solutions has led to a resurgence of interest in phytochemical research. This study focuses on four medicinal plants - Curcum longa, Aloe barbadensis, Moringa oleifera, and Azadirachta indica traditionally used in various cultures for their medicinal properties. This study aims to investigate the phytochemical constituents of these plants, exploring their potential as valuable resources for drug development and herbal product standardization.
Phytochemicals generally originating from the plant source are nothing but the bioactive compounds also known as secondary metabolites. There are two types of metabolites produced in plants *viz*. Primary metabolites and Secondary metabolites. Primary metabolites are important for the plant's regular metabolism such as growth and development. Secondary metabolites produced by plants may have little need for them. Medicinal plants contain some organic compounds which provide definite physiological action on the human body and these bioactive substances include tannins, alkaloids, carbohydrates, terpenoids, steroids and flavonoids. These compounds are synthesized by primary or rather secondary metabolism of living organisms. Secondary metabolites are chemically and taxonomically extremely diverse compounds with obscure function.
The potential of the phytochemicals have large scale pharmacological and biological activities such as antioxidant constituents (hydrolysable tannins, phenolic acid and flavonoids etc.) of the plant materials for the care of health and protection from coronary heart diseases, cancer, anti-carcinogenic and anti-mutagenic effects.

Materials and methods
Collection of plants material
Fresh parts of four medicinal plants Curcum longa (leaves), Aloe barbadensis (leaf), Moringa oleifera (leaves),
Azadirachta indica (leaves) were collected from different regions of Nashik district. The plant materials were taxonomically identified and authenticated by The Department of botany, Pune University, Pimpalgaon (B), India. The plant materials were used in their fresh state, without removing the water content, and without grinding them into a fine powder. This approach might be suitable for certain applications where the natural moisture and texture of the leaves are important, such as phytochemical analysis.

Preparation of plants extract
Cold water extraction
Weigh 5 grams of plant leaves and measure 100 mL of ethanol. Blend the plant leaves with a small amount of solvent (e.g., 20 mL) in a blender or crush them using a mortar and pestle to release the phytochemicals. Add the remaining solvent (e.g., 80 mL) to the blended or crushed plant material. Allow the mixture to steep for 30 minutes. Filter the solution through filter paper or a clean cloth to remove the plant material. Store the plant leaf solution in an airtight container in the refrigerator or freezer for further analysis or use.

Solvent extraction
Maceration: this is the cold solvent extraction method, where the plant material is soaked in a solvent (eg.; ethanol) for a period of time to release the phytochemicals.

Primary metabolites
The extract was tested for the presence of bioactive compounds by using following standard methods.

1. Test for carbohydrates Molisch's test
Extract was mixed with 2ml of molisch's reagents and the mixture was shaken properly.
After that 2 ml concentrated H2SO4 was poured carefully along the side of the test tube. Appearance of a violet ring at the interphase indicates the presence of carbohydrates.

2. Test for protein Biuret test
Adding a few drops of copper sulfate solution to a mixture of an aqueous analyte and a strong base; such as sodium or potassium hydroxide. If the solution turns purple, the sample contains protein.

1. **3. Test for amino acids Ninhydrin test**
2. Mix 1-2 ml of sample with 1-2 ml of ninhydrin reagent. Heat the mixture in a boiling water bath for 5-10 minutes. Observe for a purple coloration.

3. **4. Test for fatty acids Salkowski test**
Extract (5ml) was mixed with chloroform (2ml) and concentrated sulphuric acid (3ml) was carefully added to form a layer. A reddish brown coloration of the interface was formed to show positive results for the presence of fatty acids.

Table 1: Ethnobotanical information of selected medicinal plants species for phytochemicals analysis in Nashik District

Sr.no.	Plants	Local names	Plant part used
1)	Curcum longa	Haldi	Leaves
2)	Aloe barbadensis	Aloevera	Leaves
3)	Moringa oleifera,	Drumstick	Leaves
4)	Azadirachta indica	Neem	Leaves

Table 2: Primary metabolites constituents of four medicinal plants studied.

Sr.no.	Plants names	Carbohydrates	Protein	Amino acid	Fatty acid
1)	Curcum longa	+	+	+	-
2)	Aloe barbadensis	+	+	+	+
3)	Moringa oleifera	+	+	+	+
4)	Azadirachta indica	+	+	+	+

Secondary metabolites
The extract was tested for the presence of bioactive compounds by using following standard methods.

1. Test for alkaloids Mayer's test
Few drops of Mayer's reagent were added to 1 mL of extract. A yellowish or white precipitate was formed, indicating the presence of alkaloids.

2. Test for glycosides Legals test
Add 1-2 ml of sodium nitrate solution to 1-2 ml of sample. Add 1-2 ml hydrochloric acid to the mixture. If observed, yellow and orange coloration indicates the presence of glycosides.

3. Test for flavonoids Shinoda test
Extract was mixed with a few fragments of magnesium ribbon and conc. HCL was added drop wise. Pink scarlet color appeared after a few minutes which indicates the presence of flavonoids.

4. Test for terpenoids Salkowski's test
Extract was mixed with 2 ml chloroform and Shake it properly. Add 3 ml of conc. Sulfuric acid. A reddish brown color appeared which indicates the presence of terpenoids.

5. Test for saponin Dragendroff's test
By adding a few drops of Dragendorff's reagent to 2 mL of extract, a brownish red precipitate was formed, indicating the presence of saponin.

Table 3: Secondary metabolites constituents of four medicinal plants studied

Sr.n.	Plants	Alkaloids	Glycosides	Flavonoids	Terpenoids	Saponin
1)	Curcum longa	+	+	+	,+	-
2)	Aloe barbadensis	+	+	+	-	+
3)	Moringa oleifera	+	+	+	+	+
4)	Azadirachta indica	+	+	+	+	+

Discussion
Phytochemical analysis conducted on the plant's extracts revealed the presence of constituents which are known to exhibit medicinal as well as physiological activities. Analysis of the plant's extracts revealed the presence of phytochemicals such as carbohydrates, proteins, amino acids, fatty acids, alkaloids, glycosides, flavonoids, terpenoids, and saponins. The results obtained in this study thus suggest the identified phytochemical compounds may be the bioactive constituents and these plants are proving to be an increasingly valuable reservoir of bioactive compounds of substantial medicinal merit.

Conclusion
In conclusion, the phytochemical analysis of Curcum longa, Aloe barbadensis, Moringa oleifera, and Azadirachta indica revealed the presence of diverse bioactive compounds with potential medicinal properties. The results of this study support the traditional use of these plants in various therapeutic applications. Further research is needed to fully explore the pharmacological potential of these plants and their constituents. However, this study contributes to the existing knowledge on the phytochemical composition of these plants and highlights their potential as valuable resources for the development of new drugs and therapies. The findings of this study may also be useful for the

standardization and quality control of herbal products derived from these plants.

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