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Phytochemical and pharmacological analysis of commonly used ethnomedicinal plants

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Abstract

Over the years, many different communities have found and made use of the medicinal substances found in plants as a means of alleviating a wide range of health problems. Some of the best places to find novel drugs or compounds to employ in existing ones are in the plant materials that have long been used as traditional remedies for diabetes. Traditional healers in many countries, particularly those in the developing world, prescribe plant extracts or other folk plant treatments for diabetes, and the patients often take them as directed. After the obtained plant materials were verified and identified, they were subjected to a series of extractions to extract the desired compounds. In order to determine if chemical components were present, the produced extracts underwent phytochemical screening using a battery of qualitative assays. We used the Salkowski and Liebermann assays for sterols, the b-naphthol assay for glycosides, and Dragendorff's s test for alkaloids. Carotenoids were determined by the Carr-price reaction, triterpenoids by the Liberman-Burchard test, flavonoids by the Shinoda test, naphthoquinones by the Juglone test, and naphthalenoids by this same method. The Matchstick Test was then used to determine the tannin content. The current research shows that *Moringa oleifera* stem bark and Caesalpinia pulcherrima pod extracts contain a wide variety of phytoconstituents, including glycosides, phenolic compounds, sterols, triterpenoids, and flavonoids. Since these chemicals have pharmacological effects.

Keywords: Biological activity, medicinal plants, phytochemistry, secondary metabolites

Introduction

Asthma, gastrointestinal issues, skin disorders, respiratory and urinary complications, liver and cardiovascular disease, and other ailments have all been treated with plants for a long time due to the well-established belief that plants contain biologically active compounds with therapeutic qualities. There has been a recent uptick in the market for pharmaceuticals generated from plants, which are often thought of as safer alternatives to synthetic medications [1].

There are bioactive substances in medicinal plants that help treat a wide range of illnesses. The use of medicinal plants as a biological control in agriculture has many benefits, including the reduction of agricultural plant diseases and an increase in harvest output. The bioactive chemicals found in medicinal plants have antimicrobial and antifungal effects, making them an invaluable tool for farmers in the fight against plant diseases. Plants, leaves, vegetables, and roots contain phytochemicals as a natural defensive mechanism against illness. Primary and secondary compounds are known as phytochemicals. Proteins, chlorophyll, and common sugars make up the main components, while terpenoid, alkaloid, and phenolic substances make up the secondary compounds. Chemically and taxonomically varied molecules with unclear functions are known as secondary metabolites. They find extensive use in a myriad of fields, including medicine, agriculture, veterinary medicine, scientific research, and many more. Numerous phytochemicals from various chemical classes have been shown to prevent the growth of certain bacteria in laboratory settings. Phytomedicines have included plant materials since the beginning of recorded history [2].

According to the World Health Organization (WHO), traditional medicine is all about using what people have learned through years of experience, either orally or in writing, to treat and prevent illness and social unrest, whether it be physical, mental, or social in nature. Traditional medicine is the only source of health treatment for an estimated 75–90% of the world's rural population (not including those in Western nations). This is due to a combination of factors, including financial constraints that prevent individuals from purchasing costly contemporary medications and a preference for more culturally acceptable practices that address psychological requirements more effectively [3].

It is thought that ethnomedical traditions might provide a foundation for creating safe and effective medicines. Despite Ethiopia's rich cultural, ethnic, and botanical variety, research on traditional medicinal plants (TMP) has lagged behind the country's lengthy history of traditional medicine, Additionally, for a long time, people in many regions of Ethiopia have relied on medicinal plants to cure illnesses in both humans and cattle [4].

The use of herbal medicines derived from ethnomedicinal plants has recently grown in prominence globally, including in India. In India, local communities or tribal groups have traditionally preserved and passed on their knowledge of traditional medicine. This age-old wisdom originates from the Ayurvedic and Siddha medical traditions of India, which are enjoying a renaissance in the West. There is a high demand for ethnomedicines and herbal remedies because of their low cost and lack of adverse effects. Not long ago, the World Health Organization (WHO) acknowledged traditional medicine's value in healthcare as well. The Ayurvedic and Siddha medical systems both use formulations derived from specific plant components to address a wide range of medical conditions. Many plants that are described in traditional medical systems like Ayurveda and Siddha have been studied scientifically over the last thirty years. The herbal medication business and the pharmaceutical sector both rely on scientific study of ethnomedicinal plants for evidence-based alternative therapies. Natural product pharmaceuticals may be used safely and effectively on a global scale if the use of ethnomedicinal plants in traditional medicine or in the production of Ayurvedic medicines or other herbal remedies is backed by scientific data [5].

Literature Review

Gupta (2024) Researchers hope that studying phytochemicals would help them better understand how to employ plants as medicines. In this study, we will have a look at five native plants of Chhattisgarh and see what bioactive components they contain. The plants used for this research are Bengal quince (Aegle marmelos), Bottlebrush asparagus (Asparagus racemosus), Curcuma amada, asthma plant (Euphorbia hirta), and Oriental cashew (Semecarpus anacardium). This review provides a comprehensive overview of the plants' botanical, phytochemical, and pharmacological research. We have also done research on their medicinal qualities and how they may be used to treat a wide range of illnesses. We have covered the ways in which the plants may help people's health and fight diseases [6].

Jain (2024) Exploring its traditional applications and pharmacological qualities, this research offers a comprehensive analysis of the phytochemical content across various regions of Achyranthes aspera [7].

Vm (2024) There is evidence that Abutilon indicum has a wide range of pharmacological effects, including those against bacteria, inflammation, diabetes, arthritic joints, hypoglycemia, ulcers, aphrodisiacs, diarrhea, seizures, mycotic infections, larvicidal effects, analgesics, and sedatives. Urinary tract infections may be alleviated with Abutilon indicum milk, while gout, polyuria, and hemorrhagic diseases can be treated with the plant's roots according to Ayurvedic medicine. Ulcers, jaundice, leprosy, and piles are among the many ailments for which the herb is prescribed in the Siddha medicinal system. In Unani medicine, the plant is used to cure chest discomfort, piles, and bronchitis. It has been noted that different parts of plants have a diverse range of phytochemical components. This article is a comprehensive review of the research on the medicinal uses, chemical composition, phytochemical properties, and pharmacological properties of the Abutilon indicum plant [8].

Onyancha (2024) We used targeted search keywords and phrases to gather pertinent material from English-language internet sources published between 2000 and July 2023 on medicinal plants, even though ethnic cultures have utilized them for illness prevention and treatment since ancient times. The findings revealed that the genus *Sarcophyte consists* of just two species: *Sarcophyte sanguinea* Sparrm. and *Sarcophyte piriei* Hutch. These plants have a long history of use in traditional medicine for a variety of human ailments, including cancer, skin, gastrointestinal, and urinogenital tract problems, as well as in ethnoveterinary medicine for animals. Flavonoids (diinsinol, diinsinin, and naringenin) are the most abundant of thirteen secondary metabolites discovered in the two plants. The scavenging of radicals such as 2,2-diphenyl-1-picrylhydrazyl (DPPH) and 2-2′-Azino-di-[3-ethylbenzthiazoline sulfonate (ABTS) (IC 50: 4.62 ± 0.14 μg/mL), chelating iron (IC 50: 1.82 ± 0.01 μg/mL, 3.50 ± 0.09 μg/mL), and nitric oxide (IC 50: 9.97 ± 0.88 μg/mL, 9.09 ± 0.11 μg/mL), according to the report, S. piriei has antioxidant activity. Antimicrobial activity against Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Vibrio fluvialis, and Enterococcus avium was observed in the methanolic stem extracts of S. piriei. The minimum inhibitory concentration (MIC) values ranged from 0.16 to 0.625 mg/mL, and the minimum bactericidal concentration (MBC) was found to be 1.25 to 5 mg/mL. Extracts from both plant species were also shown to have cytotoxic effects. The aqueous rhizome extract of Sarcophyte piriei inhibited prostaglandin production (IC 50 = 0.2 mg/mL) and edema (1,000 mg/kg), indicating that the plant may have medicinal potential. Prostaglandin production was also suppressed by diinsinol and diinsinin, which were isolated from S. *sanguinea* [9].

Nanaiah (2024) One ethnomedicinal plant native to the western Ghats, *Justicia wynaadensis* (Nees) T. Anderson., has tremendous therapeutic potential. The folkflore of Karnataka's Coorg (Kodagu) District traditionally utilize the herb, which is locally known as Maddhu Thoppu, to protect themselves from local ailments. Among the many beneficial medical characteristics of J. *wynaadensis* are its antioxidant, anti-inflammatory, antibacterial, and *animutagenic* actions. The therapeutic characteristics of J. *wynaadensis* suggest it may have future application as a phyto medicine. The therapeutic virtues of Justicia *wynaadensis* reach their climax on the 18th day of Aati masa or Kakkada, according to observations. It is said that the plant's health advantages are amplified when consumed on this day. The objective of this literature review is to identify gaps in our understanding of J. *wynaadensis's* pharmacological, phytochemical, and medicinal functions so that we may conduct future study and fully explore its potential as an herbal medicine [10].

Materials and Methods

Plant material

Native to the Nashik District in Maharashtra, India, we gathered pods of the Caesalpiniaceae family and stem bark of the Moringaceae family.

Chemicals

The following chemicals were acquired from Research Lab. Fine Chem. Mumbai: carrageenan, allloxan, diphenyl phosphate, gallic acid, and routine chemicals. We bought a Borosil glass column from Research Lab. Fine Chem. in Mumbai. Its dimensions are 60 cm in height and 3 cm in diameter. The silica gel is BOC grade. We got our brine shrimp eggs from the Maharashtra government's fishery department in Dapachari, Thane district, India. The solvents, including chloroform, benzene, ethyl acetate, petroleum ether (60-80 °C), methanol, and RLCC, Mumbai, were all purchased.

Drugs

The pharmaceutical company Novartis Pharmaceuticals Ltd. supplied the Dicloenac (Voveran tablets), Albendazole solution, and injectable water.

Methods

The extraction of plant-based natural compounds from dried tissue is the typical application of this method. An equipment known as a Soxhlet extraction is used to continuously extract solids from hot solvents. After dipping a matchstick into the extract's methanolic solution, let it dry, and then dip it into HCl once again. After drying, place the stick near an open flame. The presence of tannins was shown by the flame's magenta hue as it burned. The adsorbent media slurry (silica gel-G) was prepared in distilled water and then put over the TLC glass plates in a uniform thin layer. The plates were then heated in an oven at 105ºC for 30 minutes to activate the slurry. After immersing the capillary into the solution under study and applying the sample along the capillary tube's origin line, about 2 cm from the bottom, the area was allowed to air-dry. Saturate the glass chamber with mobile phase before using it for TLC. After filling the chamber with mobile phase, the lid was placed on top. I let it approximately half an hour to soak. The chamber was saturated, and the plate was then left in the chamber.

Statistical Analysis

The mean ± SEM has been used to reflect the results of all the previous observations. Using GraphPad InStat version 5.00, developed by GraphPad Software, CA, USA, we conducted an analysis of variance (ANOVA) using Dunnett's test multiple comparisons to identify the statistical variation between the groups. A significance criterion of $P < 0.05$ was established.

Results

Extractive value

Petroleum ether (1.21%), chloroform (2.46%), and methanol (13.32%) were the solvents used to extract the Caesalpinia pulcherrima. Petroleum ether (0.89%), chloroform (3.6%), and methanol (16.63%) were the solvents used to extract *Moringa oleifera*. (Refer to Table 1);

Table 1: Extractive values (% w/w yield) of plant material with different solvents.

Extract	% of extract obtained	
	Caesalpinia pulcherrima	***Moringa oleifera***
Petroleum ether	1.21	0.89
Chloroform	2.46	3.6
Methanol	13.32	16.63

Examination of the phytochemical composition of Caesalpinia pulcherrima pods and *Moringa oleifera* stem bark.

The presence of distinct phytochemicals in different extracts of Caesalpinia pulcherrima pods and *Moringa oleifera* stem bark was found by preliminary phytochemical analysis (Table No. 2).

Table 2: Phytochemical analysis of different extracts of pods of *Caesalpinia pulcherrima* and stem bark of *Moringa oleifera*.

	Test name	**Extracts**					
		Caesalpinia pulcherrima			***Moringa oleifera***		
		Pet ether	**Chloroform**	**Methanol**	**Pet ether**	**Chloroform**	**Methanol**
Test for Sterols	Salkovaski test Liberman test	+	-	-	+	-	-
Test for Glycosides	β-napthol test	-	-	+	-	-	+
Test for Alkaloids	Dragendorff test, Mayer's test, Wagner's test, Hager's test	-	-	-	-	+	-
Test for Triterpenoids	Libermann-Burchard test	+	+	-	+	-	-
Test for Flavonoids	Shinodha Test Antimony trichloride test Ferric chloride test	-	-	+	-	-	+
Test for Anthraquinones	Juglone test	-	-	-	-	-	-
Test for Carotenoids	Ferric chloride test, Matchstick test	-	-	-	-	-	-
Test for Tannins	Carr-price test	-	-	+	-	-	+

Acute toxicity study

The extracts were shown to be harmless in acute toxicity testing. Throughout the duration of the trial, no harmful effects or fatalities were detected. The dosages were set for the pharmacological investigation since all the animals were alive, healthy, and active throughout the observation study.

Total phenolics content

The methanolic extracts of *Moringa oleifera* and Caesalpinia pulcherrima contained total phenolics with gallic acid equivalents of 50.72 and 38.04% w/w, respectively. The outcome may be seen in Table No. 3.

Table 3: Calibration Curve data of gallic acid

Sr. No.	Concentration (µg/ml)	Absorbance
1	1	0.374
2	2	0.498
3	3	0.567
4	4	0.699
5	5	0.791
6	6	0.904
7	7	1.005
8	8	1.147
9	Methanol Extract of C. pulcherrima	1.354
10	Methanol Extract of M. oleifera	1.098

Antioxidant activity by Nitrous oxide free radical scavenging assay

The activity of nitric oxide radical scavenging was assessed using the methodology described by Garrat (1964). An IC50 value of 107.59 µg/ml was observed for petroleum ether, 73.08 µg/ml for chloroform, 68.44 µg/ml for methanolic extracts of Caesalpinia pulcherrima, and 12.59 µg/ml for ascorbic acid as a nitric oxide radical scavenger. Researchers discovered that methanol extract effectively scavenged nitric oxide radicals. (See Table 4).

Table 4: DPPH free radical scavenging activity of extracts of *Moringa oleifera*

Test component	Conc. (µg/ml)	% inhibition	IC50(µg/ml)
	25	17.18	
Petroleum ether Extract	50	25.89	
(PE)	75	29.91	124.75
	100	34.14	
	25	13.65	
Chloroform Extract	50	25.58	
(CE)	75	38.24	112.08
	100	50.68	
	25	20.63	
Methanol Extract	50	34.12	
(ME)	75	45.73	54.34
	100	78.49	
	5	15.64	
Ascorbic acid	10	34.51	
	15	51.45	13.86
(ASA)	20	73.87	
	25	91.93	

Cytotoxic Activity

Research on the extracts revealed that they were very toxic to brine shrimp. These extracts show great promise as a potential anticancer drug produced from plants. The crude petroleum ether extract (750 µg/ml), chloroform extract (800 µg/ml), and methanolic extract (900 µg/ml) of Caesalpinia pulcherrima pods were found to have LC 50 values in the brine shrimp lethality bioassay (Table No. 5). The stem bark of *Moringa oleifera* was tested for LC 50 values in three different extracts: crude petroleum ether (850 µg/ml), chloroform (800 µg/ml), and methanolic (900 µg/ml). The sixth table

Table 5: Brine shrimp bioassay of extracts of *Caesalpinia pulcherrima*.

Sr. No.	Group	LC_{50} (µg/ml)
1	*Caesalpinia pulcherrima* Pet Ether extract	750
2	*Caesalpinia pulcherrima* Chloroform extract	800
3	*Caesalpinia pulcherrima* Methanol extract	900

Table 6: Brine shrimp bioassay of extracts of *Moringa oleifera*.

Sr. No.	Group	LC_{50} (µg/ml)
1	*Moringa oleifera* Pet Ether extract	850
2	*Moringa oleifera* Chloroform extract	800
3	*Moringa oleifera* Methanol extract	900

Antimicrobial Activity

Across inhibition zone in comparison to petroleum ether and methanolic extracts, chloroform extracts of Caesalpinia pulcherrima and *Moringa oleifera* have superior antibacterial activity. Chloroform extracts of both plants exhibited strong antibacterial activity against the highest number of test microorganisms, according to the minimum inhibitory concentration testing. Only representative microorganisms were examined for the minimum inhibitory concentration research; the findings are given in Tables 7 and 8.

Table 7: Minimal Inhibitory Concentration of Extracts of *Caesalpinia pulcherrima* by Turbidimetry Method

Extract	Minimal Inhibitory Concentration (µg/ml)				
	Escherichia coli	***Staphylococcus aureus***	***Psuedomonas aeruginosa***	***Bacillus subtilis***	***Bacillus megaterium***
Petroleum ether	50	75	75	150	200
Chloroform	75	50	100	200	75
Methanol	50	100	200	250	100

Table 8: Minimal Inhibitory Concentration of Extracts of *Moringa oleifera* by Turbidimetry Method

Extract	Minimal Inhibitory Concentration (µg/ml)				
	Escherichiacoli	***Staphylococcus aureus***	***Pseudomonas aeruginosa***	***Bacillus subtilis***	***Bacillus megaterium***
Petroleum ether	50	100	200	250	100
Chloroform	100	200	75	150	100
Methanol	150	100	50	150	100

Conclusion

A possible source of beneficial medications might be the medicinal plants of Uzbekistan that have been described. Biological activity has been shown by structurally varied chemicals that have been isolated and identified from native plants.

The current research shows that *Moringa oleifera* stem bark and Caesalpinia pulcherrima pod extracts contain a wide variety of phytoconstituents, including glycosides, phenolic compounds, sterols, triterpenoids, and flavonoids. Since these chemicals have pharmacological effects.

In comparison to the other plants studied, the methanolic extracts of Caesalpinia pulcherrima and *Moringa oleifera* exhibited the greatest levels of polyphenol content. The findings of the antioxidant activity should also be explained

by the amount of polyphenol content in both plant extracts. The phenolics are well-known to be an important class of antioxidant chemicals. New research shows that there are discrepancies in the test systems for determining the antioxidants qualities, therefore using the DPPH techniques will give you the most accurate picture of the results.
The molecular mechanisms of action in vitro and in vivo, as well as the safety of plant extracts for human use, need more research into indigenous plants and their components.

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