

DIVERSITY AND PHARMACOLOGICAL POTENTIAL OF MEDICINAL PLANTS IN THE MALWA REGION OF PUNJAB

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ABSTRACT

Medicinal plants play a significant role in traditional healthcare systems and serve as an important source of bioactive compounds for pharmaceutical applications. The present study was conducted to document the ecological diversity and medicinal importance of plant species occurring in the Malwa agro-climatic zone of Punjab, India. Systematic surveys were carried out across 64 sites distributed in four districts, namely Faridkot, Fazilka, Ferozepur, and Sri Muktsar Sahib. A total of 159 plant species belonging to 129 genera and 47 families were documented. Poaceae was the dominant family with 27 species, followed by Fabaceae, Euphorbiaceae, Amaranthaceae, and Asteraceae. Secondary literature analysis revealed that the documented species possessed diverse pharmacological activities and ethnomedicinal applications. Anti-inflammatory activity was the most dominant therapeutic category, followed by antimicrobial, antibacterial, antifungal, antioxidant, wound healing, digestive, antidiabetic, respiratory, hepatoprotective, urinary, analgesic, and anticancer properties. Leaves were the most frequently utilized plant part, while common preparation methods included decoction, juice, paste, powder, infusion, poultice, and extract preparation. The study highlights the rich medicinal plant diversity of the Malwa region and emphasizes its importance for traditional healthcare, pharmaceutical research, conservation planning, and sustainable utilization of plant resources.

Key words: Medicinal plants, biodiversity, bioactive compounds, sustainable utilization.

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INTRODUCTION

Medicinal plants play a vital role in ensuring human health and well-being. Since ancient times, these plants have grown naturally in the wild, and humans have traditionally utilized them for the prevention and treatment of diseases, as well as for maintaining overall health and wellness in different societies. In India, 8000 medicinal plants species are used by various communities across the ecosystem for curing diseases while only 10% (880 plant species) are active in trade and commerce¹. There are many classical Indian system of medicines such as Ayurveda, Siddha, Unani, Amchi, Tibetan uses collectively-1800 medicinal plant species for the preparation of drugs². Most of these ingredients used in the preparation of medicines are collected from wild sources, while only a few species are cultivated on a limited scale. It is estimated that nearly every tenth plant species is utilized in the preparation of drugs and healthcare products, with approximately 50,000 medicinal plant species being used worldwide for therapeutic purposes³. India is recognized as one of the world's

megadiverse countries, harboring approximately 45,000 plant species, of which nearly 7,500 species are reported to possess medicinal value in traditional healthcare systems⁴. Above mentioned details clearly suggested that India has great potential in the diversity of medicinal plants. Due to its diverse distribution of medicinal plants people have developed their own traditional uses of plants in their daily routines. Medicinal plants continue to provide lead molecules for the development of modern pharmaceuticals and nutraceuticals.

Punjab is an agrarian state and presently, 82% of the geographical area of the state is under cultivation while forest cover area is merely 3.67%. Due to urbanization, agriculture intensification and habitat degradation Punjab has lost its maximum dense forest cover resulting in the loss of biodiversity⁵. But still many plant species is present in open forest and local people use these plants species to cure ailments and diseases. The limited forest area and increasing urbanization exert pressure on native medicinal plant diversity. Several floristic and ethnobotanical studies have documented medicinal plants from Punjab during

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the last two decades^{6,7,8}. However, comprehensive ethnopharmacological documentation integrating medicinal diversity with pharmaceutical relevance from the Malwa and Doaba regions remains limited. This study is designed to fulfill the gap and target the Malwa region of Punjab. The present study highlights the diversity and medicinal potential of plant species occurring in the Malwa region of Punjab and provides valuable baseline information on their ethnomedicinal importance. Documentation of medicinal plant diversity in the region will contribute to a better understanding of the available herbal resources and their therapeutic applications. Furthermore, the study will serve as an important reference for future research related to conservation, sustainable utilization, pharmacological exploration, and the promotion of traditional healthcare systems in the Malwa region of Punjab.

MATERIAL AND METHODS

Study Area

Punjab is situated in the northwestern part of India. It shares its northern boundary with Himachal Pradesh, while Haryana and Rajasthan form its southern boundaries. The climate of Punjab ranges from semi-arid to arid conditions, with variations from semi-desert to desert-type climate in different regions of the state. Punjab is traditionally divided into three major regions namely Majha, Doaba, and Malwa based primarily on river systems, physiography, historical settlement patterns, and cultural characteristics⁹. The Majha region lies between the Ravi and Beas rivers, Doaba lies between the Beas and Sutlej rivers, whereas Malwa occupies the area south of the Sutlej River⁹. These regions also differ in dialect, agricultural practices, vegetation, and socio-cultural traditions, making them important geographical and ethnobotanical units for biodiversity studies¹⁰. This area is sparsely forested area but have a variety of plant species and these species are traditionally used for food, fodder and medicine. The plant present in these area have great potential and are used by local people and traditional healer to cure various diseases.

The present study was conducted in four districts of the Malwa region of Punjab, namely Faridkot, Fazilka, Ferozpur, and Sri Muktsar Sahib (Figure 1). These districts have different climatic condition and fall under western plain zone and western zone agro-climatic zones¹.

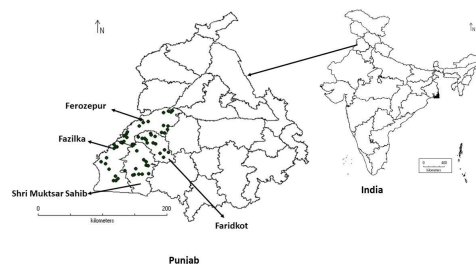


Figure 1. Study Area showing map of 64 sites sampled in 4 districts of Punjab

Systematic surveys were carried out to assess the ecological diversity of plant species across four districts of the Malwa region of Punjab (Figure 1). A total of 64 sampling sites were selected, comprising 16 locations from each district. These sampling sites includes with agricultural fields, wetlands, roadside habitats, grasslands, wastelands, orchards, and riverbanks. Plant specimens collected from these sites were processed and preserved as herbarium records for taxonomic identification. The geographical coordinates, including latitude and longitude of each sampling site, were recorded using a Global Positioning System (GPS) and subsequently mapped with DIVA-GIS software. Identification of plant specimens was performed using regional floras and standard taxonomic keys, and the authenticated specimens were deposited in the herbarium of Sant Baba Bhag Singh University. After critical identification, a comprehensive checklist of plant species was prepared in MS Excel. The scientific names, family classification, and growth forms of all recorded species were further verified and updated according to the World Flora Online database¹¹.

The collected data were analyzed to determine the taxonomic representation of plant diversity in terms of the total number of species, genera, and families. Based on their growth habit, the recorded plant species were categorized into herbs, shrubs, grasses, climbers, big grasses, aquatic plants, herbaceous tall plants, bamboo, sedges, and lianas. Furthermore, the documented plant species were evaluated for their medicinal importance and biological activities through extensive review of secondary literature, including published books, scientific journals, and research articles. The compiled medicinal information along with corresponding references was systematically organized and presented in Table 2. The data compiled from secondary sources were further analyzed to evaluate the major ailments and pharmacological activities associated with the recorded plant species, along with the plant parts utilized and the different modes of herbal preparation employed in traditional medicinal practices.

RESULTS AND DISCUSSION

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The present investigation documented a total of 159 plant species from 64 surveyed sites distributed across four districts of Punjab, namely Faridkot, Fazilka, Ferozepur, and Sri Muktsar Sahib. These species belonged to 129 genera and 47 families (Table 1). Among the recorded families, Poaceae was the most dominant, represented by 27 species, followed by Fabaceae with 15 species, Euphorbiaceae with 11 species, and Amaranthaceae and Asteraceae with 9 species each. Convolvulaceae and Malvaceae contributed 7 species each, whereas Apocynaceae and Cucurbitaceae were represented by 5 species each. Bignoniaceae, Meliaceae, Rutaceae, and Solanaceae accounted for 4 species each, while Lamiaceae, Moraceae, and Myrtaceae were represented by 3 species each. Furthermore, Anacardiaceae, Brassicaceae, Cordiaceae, Menispermaceae, Nyctaginaceae, Portulacaceae, Rhamnaceae, and Rubiaceae contributed 2 species each, whereas the remaining families were represented by a single species (Figure 2; Table 2).

A comparable study conducted by Sidhu et al.¹² in the Jalandhar district of Punjab reported 119 medicinal plant species belonging to 109 genera and 57 families that were traditionally utilized for the treatment of various ailments by local inhabitants. In their study, Apiaceae was the dominant family with eight species, followed by Fabaceae with seven species, while Euphorbiaceae, Solanaceae, and Poaceae were represented by six species each in different medicinal preparations. The predominance of families such as Poaceae, Fabaceae, Euphorbiaceae, Amaranthaceae, and Asteraceae in the present investigation indicates the adaptability and ecological dominance of these taxa under the semi-arid to arid agro-climatic conditions of the Malwa region of Punjab. Similar observations have also been reported from different regions of India, where Poaceae and Fabaceae were found among the most represented medicinal plant families due to their wide ecological amplitude and ethnomedicinal utility^{6,13}

Table 1 Taxonomic representation

Family	47
Genus	129
Species	159

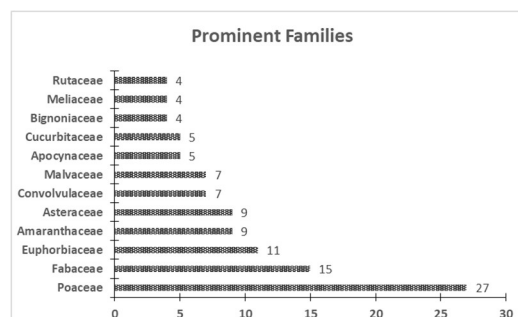


Figure 2 Prominent families of plant species

These 159 plant species categorized into 37% herbs, 23% trees, 13% grasses, 12% Shrubs, 7% Climbers, 2% Big grasses and Aquatic plants each while 1% Sedges, Lianas, Bamboo and Herbaceous tall plant (Figure 3). It was found that herbs are often used in medicinal ailments and cure after trees. Kaur et al¹⁴ also documented that 46 % herbaceous, 32% tree, 18% shrubs, 4% climbers belonging to different families used to cure 109 diseases in Kapurthala district of Punjab. In our study, herbs contribute 53% including herbs, sedges and aquatic plants.

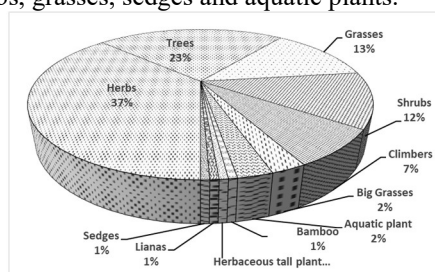


Figure 3 Growth form of the plant species.

Our study supports diverse medicinal vegetation associated with agricultural fields, wetlands, roadside habitats, grasslands, wastelands, orchards, and riverbanks. Ethnobotanical studies conducted in Punjab have reported the occurrence of numerous medicinal species traditionally utilized by rural communities for primary healthcare⁶. Medicinal plants continue to serve as major sources of bioactive compounds for drug discovery. Secondary metabolites such as alkaloids, flavonoids, terpenoids, tannins, glycosides, and phenolics isolated from medicinal plants exhibit significant therapeutic potential. The pharmaceutical industry increasingly utilizes herbal extracts in the preparation of nutraceuticals, herbal formulations, cosmetics, phytopharmaceuticals, and alternative medicines. Our results signifies that all species have some sort of medicinal values and can be utilized for medicinal purpose (table 2).

Table 2

S. No.	Plant Species	Famil y	Growth Form	Reporte d Medici nal Uses
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1	<i>Abutilon indicum</i>	Malvaceae	Herb	Used as anti-inflammatory, analgesic, diuretic, and in treatment of ulcers and urinary disorders ²⁷ .				inflammatory, antiasthmatic, and antimicrobial agent ²⁹ .
2	<i>Abutilon theophrasti</i>	Malvaceae	Herb	Seeds and leaves reported for anti-inflammatory activity and used for treatment of fever and dysentery ²⁸ .				Bark used for fever, ulcers, inflammation, and skin diseases ³¹ .
3	<i>Acalypha indica</i>	Euphorbiaceae	Herb	Herb used for bronchitis, skin diseases, wound healing, and antimicrobial activity ²⁹ .				Fruit and leaves used for diarrhea, dysentery, diabetes, and gastric disorders ³² .
4	<i>Acalypha paniculata</i>	Euphorbiaceae	Herb	Used for digestive disorders, skin infections, and fever management ³⁰ .				Used for kidney stones, wound healing, and anti-inflammatory purposes ³³ .
5	<i>Achyranthes aspera</i>	Amaranthaceae	Herb	Used as laxative, anti-				Applied for wound healing, fever, pain relief, and antimicrobial activity ³⁴ .
6	<i>Adina cordifolia</i>	Rubiaceae	Tree					
7	<i>Aegle marmelos</i>	Rutaceae	Tree					
8	<i>Aerva javanica</i>	Amaranthaceae	Herb					
9	<i>Ageratum conyzoides</i>	Asteraceae	Herb					
10	<i>Ageratum houstonianum</i>	Asteraceae	Herb					

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				e for wounds, skin infections, and inflammatory disorders ³⁵ .				disorders, inflammation, and skin ailments ⁴⁰ .	
11	<i>Ailanthus altissima</i>	Simaroubaceae	Tree	Bark used against dysentery, asthma, epilepsy, and as an antiparasitic agent ³⁶ .	16	<i>Alternanthera pungens</i>	Amaranthaceae	Herb	Traditionally employed for wound healing, fever, and pain relief ⁴¹ .
12	<i>Ajuga integrifolia</i>	Lamiaceae	Herb	Used for malaria, hypertension, diabetes, and stomach disorders ³⁷ .	17	<i>Amaranthus albus</i>	Amaranthaceae	Herb	Used for gastrointestinal ailments and having diuretic, anti-inflammatory activities ⁴² .
13	<i>Albizia lebbek</i>	Fabaceae	Tree	Used as antiasthmatic, anti-inflammatory, anti-allergic and antimicrobial remedy ³⁸ .	18	<i>Amaranthus viridis</i>	Amaranthaceae	Herb	Used for anemia, dysentery, ulcers, and have anti-inflammatory activity ⁴³ .
14	<i>Alternanthera caracasana</i>	Amaranthaceae	Herb	Used as medicine for fever, wound healing, and inflammation ³⁹ .	19	<i>Astronium graveolens</i>	Anacardiaceae	Tree	Bark traditionally used for respiratory disorders and wound healing ⁴⁴ .
15	<i>Alternanthera philoxeroides</i>	Amaranthaceae	Herb	Used traditionally for gastrointestinal	20	<i>Atriplex crassifolia</i>	Amaranthaceae	Herb	Used traditionally for digestive

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				disorders and have anti-inflammatory applications ⁴⁵ .
21	<i>Azadirachta indica</i>	Meliaceae	Tree	Widely used for wound healing, and skin disorders and have antimicrobial, antidiabetic, antifungal properties ⁴⁶ .
22	<i>Bambusa</i> sp.	Poaceae	Bamboo	Leaves and shoots used for anti-inflammatory, antioxidant, and respiratory disorders ⁴⁷ .
23	<i>Bauhinia purpurea</i>	Fabaceae	Tree	Used in treatment of inflammation, ulcers, diarrhea, and diabetes ⁴⁸ .
24	<i>Blainvillea acmella</i>	Asteraceae	Herb	Used for wound healing fever and anti-inflammatory

				purpose ⁴⁹ .
25	<i>Boerhaavia diffusa</i>	Nyctaginaceae	Herb	It has hepatoprotective, diuretic, anti-inflammatory, and nephroprotective properties ⁵⁰ .
26	<i>Bothriochloa pertusa</i>	Poaceae	Grass	Used in folk veterinary medicine for wound healing ⁵¹ .
27	<i>Bougainvillea spectabilis</i>	Nyctaginaceae	Shrub	Used for diabetes, hepatitis, cough, and have antimicrobial activity ⁵² .
28	<i>Brachypodium distachyon</i>	Poaceae	Grass	Used for anti-inflammatory and fodder-based ethnomedicine ⁵³ .
29	<i>Brassica rapa subsp. oleifera</i>	Brassicaceae	Herb	Seeds and oil used for anti-inflammatory, cardiovascular, and

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				digestive health applications ⁵⁴ .					
30	<i>Calotropis procera</i>	Apocynaceae	Shrub	Used for skin diseases, wound healing, pain relief and have anti-inflammatory, and antimicrobial properties ⁵⁵ .	34	<i>Caudanthera edulis</i>	Apocynaceae	Herb	Traditionally used for gastrointestinal disorders, inflammation, and wound healing. Tubers and aerial parts are employed in folk medicine for weakness and digestive ailments ⁵⁹ .
31	<i>Cannabis sativa</i>	Cannabaceae	Herb	Used for pain management, antiemetic activity, epilepsy, and neurological disorders ⁵⁶ .					Used in ethnoveterinary medicine for wound healing, digestive disorders, and traditional livestock remedies and reported to have antioxidant phytochemical constituents ⁶⁰ .
32	<i>Cascabela thevetia</i>	Apocynaceae	Shrub	Used as medicinal to treat oedema, diuretic, and cardiac disorders ⁵⁷ .	35	<i>Cenchrus setaceus</i>	Poaceae	Big Grass	Traditionally used for fever, urinary
33	<i>Cassia fistula</i>	Fabaceae	Tree	Used as laxative, antimicrobial, antipyretic, and anti-inflammatory agent ⁵⁸ .	36	<i>Cenchrus setiger</i>	Poaceae	Big Grass	

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				disorders, fodder-related ethnovegetary practices, and in anti-inflammatory folk remedies ⁶¹ .					Used as antimicrobial, antidiabetic, laxative, and anti-inflammatory medicine ⁶⁵ .
37	<i>Chenopodium album</i>	Chenopodiaceae	Herb	Used in treatment of intestinal disorders, rheumatism, and as an antioxidant source ⁶² .	40	<i>Citrullus colocynthis</i>	Cucurbitaceae	Climber	Used for antimicrobial activity, digestion improvement, and antioxidant applications ⁶⁶ .
38	<i>Chrysopogon zizanioides</i>	Poaceae	Grass	Traditionally used for cooling, skin diseases, inflammation, and aromatic therapy ⁶³ .	41	<i>Citrus limon</i>	Rutaceae	Tree	Used in diabetes management, wound healing, and antimicrobial therapy ⁶⁷ .
39	<i>Cissampelos pareira</i>	Menispermaceae	Climber	Used for urinary disorders, fever, inflammation, and have antimicrobial properties ⁶⁴ .	42	<i>Citrus reticulata</i>	Rutaceae	Tree	Having properties anthelmintic, antiseptic, antiscorbutic, carminative, febrifuge, sudorific, and cardiac stimulant ⁶⁸ .
					43	<i>Cleome viscosa</i>	Capparidaceae	Herb	

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44	<i>Coccinia grandis</i>	Cucurbitaceae	Climber	Used for wound-healing and advantageous for cardiovascular health. It has antidiabetic, anticancer, antiparasitic, antimicrobial, hepatoprotective, analgesic, antipyretic, anti-Alzheimer's, anticataract, antileishmanial, anti-anaphylactic, antihistaminic ⁶⁹ .				antioxidant, antimicrobial, and anti-inflammatory activities ⁷⁰ .	
				46	<i>Convolvulus prostratus</i>	Convolvulaceae	Herb	Used as anxiolytic, memory enhancer, brain tonic and nervine tonic ⁷¹ .	
				47	<i>Cordia dichotoma</i>	Cordiaceae	Tree	Used for cough, fever, diarrhea, ulcers, and have anti-inflammatory purposes ⁷⁰ .	
45	<i>Convolvulus arvensis</i>	Convolvulaceae	Climber	Traditionally used for constipation, fever, wound healing, inflammation, gastrointestinal disorders, and as a mild laxative. Reported	48	<i>Cordia myxa</i>	Cordiaceae	Tree	Used in chest and urinary tract infections, diarrhoea, dysentery, tuberculosis, liver and spleen disorders, chronic fever, malaria. It has antidiabetic,

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				analgesic, anti-inflammatory, anti-cancer, antioxidant, antiplasmodial, hepatoprotective, hypotensive, antiulcer and antimicrobial activities ⁷² .				and anti-inflammatory properties ⁷³ .	
					51	<i>Croton bonplandianus</i>	Euphorbiaceae	Subshrub	Used as antioxidant anticancer and hepatoprotective agent and have antimicrobial activities ⁷⁴ .
49	<i>Cortaderia selloana</i>	Poaceae	Grass	Traditionally used in folk remedies for urinary disorders, wound healing, and inflammatory conditions. It has antioxidant and antimicrobial phytochemicals in grass extracts ⁶⁰ .	52	<i>Croton pungens</i>	Euphorbiaceae	Herb	Traditionally used for wound healing, skin infections, inflammation, antimicrobial applications, and application in treatment of gastrointestinal disorders. It also possess antioxidant and analgesic activities ⁷⁵ .
50	<i>Crotalaria juncea</i>	Fabaceae	Herb	Used as antioxidant, anti-tyrosinase and have anti-aging,	53	<i>Cucumis engleri</i>	Cucurbitaceae	Climber	Used traditionally for digestive disorders, fever,

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				inflammation, and nutritional supplementation. It also possess antioxidant and antimicrobial properties ⁷⁶ .						
54	<i>Cucumis maderaspatanus</i>	Cucurbitaceae	Climber	Used in the treatment asthma, histamine, bronchitis, chronic obstructive lung disorder, high fever, flu and also in Rheumatoid arthritis, hypertension. It has antioxidant, antidiabetic, antimicrobial, anaesthetic, anti-wart, larvicidal activities ⁷⁷ .						
55	<i>Cucumis melo</i>	Cucurbitaceae	Climber							Fruit has been used in kidney problems, painful and burning urination, urinary tract ulcers, urinary retention, cough, hot inflammation of the liver, liver and bile blockage. It has antimicrobial, antioxidant, antihyperlipidemic, anti-inflammatory, analgesic, diuretic, anthelmintic, nephroprotective and cytotoxic, analgesic and Anti-inflammatory, antioxidant and free radical scavenging

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				ing activities ⁷⁸ .
56	<i>Cuscuta reflexa</i>	Convolvulaceae	Climber	Used in liver disorders, headaches, antimicrobial and antioxidant applications ⁷⁹ .
57	<i>Cyanotis axillaris</i>	Commelinaceae	Herb	Used in wounds healing, skin infections, inflammation, and fever. The whole plant have antimicrobial, antioxidant, and anti-inflammatory activities ⁸⁰ .
58	<i>Cymbopogon citratus</i>	Poaceae	Grass	Used as antimicrobial, anxiolytic, antipyretic, and digestive aid ⁸¹ .

59	<i>Cynodon dactylon</i>	Poaceae	Grass	Used for wound healing, diabetes, antimicrobial, and anti-inflammatory treatments ⁸² .
60	<i>Cyperus sp.</i>	Cyperaceae	sedges	-
61	<i>Dactyloctenium aegyptium</i>	Poaceae	Grass	Traditionally used for fever, wound healing, digestive disorders, diuretic applications, and ethnoveterinary medicine. Reported antioxidant and antimicrobial activities in phytochemical studies ⁶¹ .
62	<i>Dalbergia sissoo</i>	Fabaceae	Tree	Used in skin diseases, ulcers, dysentery, and anti-inflammatory preparations ⁸³ .

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63	<i>Dasmostachya bipinnata</i>	Poaceae	Grass	Traditionally used for dysentery, diarrhea, urinary disorders, fever, skin diseases, wound healing, and inflammation. Also reported for antimicrobial and antioxidant activities ⁶¹ .				eye diseases, in cough, in fever, and inflammation of wounds. It has antioxidant, antidiabetic, antimicrobial, hepatoprotective and other biological activities ⁸⁵ .	
64	<i>Datura stramonium</i>	Solanaaceae	Herb	Used traditionally for pain relief, asthma and have antispasmodic activity ⁸⁴ .				Used for stomachic, bowel complaints, urinary disorders, constipation, lactation purposes, renal protection, fever, laxatives, diuretics. It has antimicrobial, anticancer, antioxidant, hepatoprotective, antitesticular, anti-	
65	<i>Dicliptera bupleuroides</i>	Acantaceae	Herb	Fresh leaves of this plant used to cure diabetes, poultice in eczema, juice used to cure stomach troubles, as a tonic, in					
					66	<i>Digera muricata</i>	Amaranthaceae	Herb	

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				inflammatory, renal protection properties ⁸⁶ .				ant activity ⁸⁷ .	
67	<i>Digitaria sp.</i>	Poaceae	Grass	-				Used traditionally in hypertension, influenza, urinary disorders, fever, wounds, and inflammatory conditions. Exhibits antimicrobial and antioxidant properties ⁸⁸ .	
68	<i>Echinochloa colona</i>	Poaceae	Grass	Traditionally used for fever, digestive disorders, wound healing, and ethnoveterinary medicine. Reported antioxidant and antimicrobial properties in phytochemical investigations ⁶⁰ .	70	<i>Eleusine indica</i>	Poaceae	Grass	Used in ethnomedicine for digestive disorders, fever, wound healing, and livestock herbal remedies. Traditional grass preparations are also employed as anti-inflammatory
69	<i>Echinochloa crus-galli</i>	Poaceae	Grass	Used in folk medicine for spleen disorders, inflammation, fever, and as a nutritive medicinal grass. Reported antioxidant	71	<i>Eragrostis tenella</i>	Poaceae	Grass	

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				agents ⁶¹ .					body pain, latex is used to treat arthritis ⁹² .
72	<i>Eucalyptus sp.</i>	Myrtaceae	Tree	Used for respiratory infections, antimicrobial activity, and cough remedies ⁸⁹ .					Traditionally used for skin diseases, diarrhea, dysentery, wound healing, inflammation, and antimicrobial applications. Reported antioxidant and analgesic properties in phytochemical studies ⁹⁰ .
73	<i>Euphorbia hirta</i>	Euphorbiaceae	Herb	Used in asthma, gastrointestinal disorders, wound healing, and antimicrobial therapy ⁹⁰ .	76	<i>Euphorbia serpens</i>	Euphorbiaceae	Herb	Used for dysentery, asthma, bronchitis, skin diseases, diarrhea, inflammation, and antimicrobial treatments. Exhibits
74	<i>Euphorbia prostrata</i>	Euphorbiaceae	Herb	Used for reducing hemorrhoidal symptoms, including pain, bleeding, and inflammation. anti-inflammatory, analgesic, and venotonic properties ⁹¹ .	77	<i>Euphorbia thymifolia</i>	Euphorbiaceae	Herb	
75	<i>Euphorbia royleana</i>	Euphorbiaceae	Shrub	Used for skin problems and					

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				antioxidant and antidiabetic activities ⁹³ .				ulcers, and skin disorders ⁹⁸ .	
78	<i>Ficus benghalensis</i>	Moraceae	Tree	Used for diabetes, diarrhea, wound healing, and inflammatory disorders ⁹⁴ .	83	<i>Ipomoea cairica</i>	Convolvulaceae	Climber	Traditionally used for inflammation, skin diseases, rheumatism, wound healing, and antimicrobial applications. Reported antioxidant and cytotoxic activities ⁹⁹ .
79	<i>Ficus religiosa</i>	Moraceae	Tree	Used in asthma, diabetes, ulcers, antimicrobial, and antioxidant applications ⁹⁵ .					Used in traditional medicine for pain relief, inflammation, gastrointestinal disorders, and antimicrobial applications. Seeds and extracts are also reported for antioxidant activity ¹⁰⁰ .
80	<i>Fumaria parviflora</i>	Papaveraceae	Herb	Having antioxidant activity due to flavonoids and phenolic compounds ⁹⁶ .	84	<i>Ipomoea purpurea</i>	Convolvulaceae	Climber	
81	<i>Hibiscus rosasinensis</i>	Malvaceae	Shrub	Used in hair growth promotion, wound healing, hypertension, and antioxidant therapy ⁹⁷ .					
82	<i>Indigofera tinctoria</i>	Fabaceae	Shrub	used in cancer, bronchitis,					

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85	<i>Jacaranda mimosifolia</i>	Bignoniaceae	Tree	Traditionally used in skin diseases, venereal infections, wounds, and microbial infections. Exhibits antimicrobial, antioxidant, and anti-inflammatory properties ¹⁰¹ .	agents ¹⁰² .
86	<i>Jatropha gossypifolia</i>	Euphorbiaceae	Shrub	Used for the treatment of malaria, eye pain, headache, Alopecia, Alopecia, Diabetis, burns and boils. It has antimicrobial, anti-inflammatory, antidiarrheal, antihypertensive, and anticancer	Used for treatment of skin disorders, cancer and gynecological complaints and have Antibacterial, Antifungal, Analgesic, Anti-Inflammatory, Antidiabetic, Antiuric, Antidiarrheal and Antioxidant ¹⁰³ .
87	<i>Kigelia africana</i>	Bignoniaceae	Tree		Used in folkloric medicine to manage respiratory, gastrointestinal disorders ¹⁰⁴ .
88	<i>Lactuca serriola</i>	Asteraceae	Herb		Used for wounds, fever, rheumatism, and antimicrobial activity ¹⁰⁵ .
89	<i>Lantana camara</i>	Verbenaceae	Shrub		

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90	<i>Launaea nudicaulis</i>	Asteraceae	Herb	Traditionally used for liver disorders, inflammation, skin diseases, fever, pain relief, and antimicrobial applications. Reported antioxidant and cytotoxic activities ¹⁰⁶ .				obial, anti-inflammatory, and anticancer properties ¹⁰⁸ .	
91	<i>Leersia oryzoides</i>	Poaceae	Grass	Used in traditional folk medicine for fever, digestive disorders, wound healing, and ethnovesicatory remedies. Grass extracts reported to possess antioxidant activity ¹⁰⁷ .	93	<i>Leucas aspera</i>	Lamiaceae	Herb	Flowers are valued as stimulant, expectorant, aperient, diaphoretic, insecticide and emmenagogue. Leaves are considered useful in chronic rheumatism, psoriasis and other chronic skin eruptions. Bruised leaves are applied locally in snake bites. It has antifungal, antioxidant, antimicrobial, antinociceptive
92	<i>Lepidium didymum</i>	Brassicaceae	Herb	It exhibit antioxidant, antimicrobial,					

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				and cytotoxic activity ¹⁰⁹ .				activities ¹¹⁰ .	
94	<i>Lysimachia arvensis</i>	Primulaceae	Herb	Used for wound healing, lung problems, kidney stones, urinary tract infections, gout, and rheumatic conditions. It has antigenic, expectorant, anti-bacterial, diuretic, antioxidant, antimicrobial, antiviral, antifungal, antimutagenic, cytotoxic, anticancer, anti-leishmaniasis, and dermatological	95	<i>Malvastrum coromandelianum</i>	Malvaceae	Herb	Used in dysentery, gastrointestinal distress, fever, enteritis, hepatitis, cough, sore throat, arthritis, and diabetes ¹¹¹ .
					96	<i>Mangifera indica</i>	Anacardiaceae	Tree	Bark extracts are used for diarrhea, dysentery, and throat disorders, while fruits are rich in vitamins and antioxidants. The leaves possess antidiabetic, antioxidant, and antimicrobial properties. Seeds are reported to exhibit anti-inflammatory

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				atory and antiparasitic activities ^{112,113} .					exhibits significant antimicrobial, antifungal, antiparasitic, anti-inflammatory, and insecticidal properties. The plant also shows potential antioxidant and anticancer activities ¹¹⁶ .
97	<i>Markhamia stipulata</i>	Bignoniaceae	Tree	Used for the treatment of inflammation, wounds, skin infections, and fever. Bark and leaf extracts possess antimicrobial and antioxidant activities. In folk medicine it is used for pain relief and treatment of respiratory ailments ^{144,115} .					
					99	<i>Mentha arvensis</i>	Lamiaceae	Herb	Used as digestive stimulant, antispasmodic, antimicrobial, and cooling agent ¹¹⁷ .
98	<i>Melia azedarach</i>	Meliaceae	Tree	Leaves and fruits are used traditionally for skin diseases, fever, intestinal worms, and rheumatism. It	100	<i>Merremia aegyptia</i>	Convolvulaceae	Climber	Traditionally used for fever, inflammation, rheumatism, skin diseases, wound healing, and gastrointestinal

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				disorders. Reported antioxidant and antimicrobial activities ¹¹⁵ .					cough, fever, and liver disorders. Reported antioxidant, antimicrobial, anti-inflammatory, neuroprotective, and antidiabetic activities ¹²⁰ .
101	<i>Merremia hederacea</i>	Convolvulaceae	Climber	Used traditionally in cough, fever, neural disorders, inflammation, and skin diseases. Extracts have shown antioxidant and antimicrobial properties ¹¹⁸ .					
102	<i>Moringa oleifera</i>	Moraceae	Tree	Used as antioxidant, antidiabetic, anti-inflammatory, and nutritional supplement ¹¹⁹ .					Used in diabetes, gastrointestinal disorders, antimicrobial, and antioxidant therapy ¹²¹ .
103	<i>Morus alba</i>	Moraceae	Tree	Traditionally used for diabetes, hypertension, hyperlipidemia, inflammation,					It exhibits antidiabetic, antiulcer, wound healing, antimicrobial, antioxidant activities ¹²² .
104	<i>Murraya koenigii</i>	Rutaceae	Shrub						
105	<i>Musa spp</i>	Musaceae	Herbaceous tall plant						
106	<i>Neltuma juliflora</i>	Fabaceae	Tree						It exhibits antimicrobial, anti-inflammatory,

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				atory, antidiabetic, wound healing activity ¹²³ .				applicati ons ¹²⁷ .	
107	<i>Neolamarckia cadamba</i>	Rubiaceae	Tree	It exhibit antidiabetic, analgesic, antimicrobial, hepatoprotective activities ¹²⁴ .	111	<i>Parkinsonia aculeata</i>	Fabaceae	Tree	Antipyretic, analgesic, antimicrobial, antidiabetic and anti-inflammatory uses ¹²⁸ .
108	<i>Nerium oleander</i>	Apocynaceae	Shrub	Traditionally used in cardiac disorders, skin diseases, inflammation, and antimicrobial applications ¹²⁵ .	112	<i>Parthenium hysterophorus</i>	Asteraceae	Herb	Used traditionally for fever, inflammation, neuralgia, skin disorders and wounds ¹²⁹ .
109	<i>Oxalis corniculata</i>	Oxalidaceae	Herb	Used in dysentery, diarrhea, fever, wound healing, and antimicrobial treatments ¹²⁶ .	113	<i>Persicaria glabra</i>	Polygonaceae	Herb	Used for wound healing, diarrhea, dysentery, anti-inflammatory and antimicrobial purposes ¹³⁰ .
110	<i>Panicum maximum</i>	Poaceae	Big Grass	Anti-inflammatory, antimicrobial, antioxidant, and ethnoveterinary	114	<i>Phalaris minor</i>	Poaceae	Grass	Ethnomedicinally used in fever and livestock-related herbal remedies; reported antioxidant

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				properties ⁶⁰ .					
115	<i>Phoenix sylvestris</i>	Arecaeae	Tree	Used in diarrhea, fatigue, cardiac weaknesses, inflammation and as nutritive tonic ¹³¹ .	119	<i>Physalis peruviana</i>	Solanaeae	Herb	Exhibits antioxidant, antidiabetic, anti-inflammatory, antimicrobial, hepatoprotective, and anticancer activities. Traditionally used in liver disorders, malaria, asthma, and dermatitis ¹³⁵ .
116	<i>Phragmites australis</i>	Poaceae	Reed	Used in fever, vomiting, urinary disorders, anti-inflammatory and diuretic preparations ¹³² .					
117	<i>Phragmites karka</i>	Poaceae	Reed	Used traditionally for fever, gastrointestinal disorders, diuretic and antimicrobial applications ¹³³ .	120	<i>Polytrias indica</i>	Poaceae	Grass	Traditionally used in ethnomedicine for fever, inflammation, wound healing, and fodder-related ethnoveterinary applications; reported antioxidant and antimicrobial potential in grass phytochemical
118	<i>Phyllanthus emblica</i>	Phyllanthaceae	Tree	Used as antioxidant, immunomodulatory, antidiabetic, and hepatoprotective medicine ¹³⁴ .					

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				studies ⁶⁰ .					diseases, ulcers, fever, diarrhea, and wound healing. Reported antioxidant, antimicrobial, and anti-inflammatory activities ¹³⁹ .
121	<i>Pongamia pinnata</i>	Fabaceae	Tree	Used in skin diseases, wound healing, anti-inflammatory, and antimicrobial therapy ¹³⁶ .					
122	<i>Pontederia crassipes</i>	Pontederiaceae	Herb	Used in treatment of skin disorders, boils, and eczema. Its anti-inflammatory properties useful in traditional folk medicine ¹³⁷ .					Used traditionally for asthma, bronchitis, dysentery, skin diseases, leprosy, fever, rheumatism, and wound healing. Exhibits antimicrobial, antioxidant, antidiabetic, and anti-inflammatory activities ¹⁴⁰ .
123	<i>Portulaca oleracea</i>	Portulacaceae	Herb	Used as antidiabetic, antioxidant, anti-inflammatory, and hepatoprotective plant ¹³⁸ .					
124	<i>Portulaca quadrifida</i>	Portulacaceae	Herb	Traditionally used for inflammation, skin					Used in diarrhea, diabetes, antimicrobial, and antioxidant
125	<i>Prosopis cineraria</i>	Fabaceae	Tree						
126	<i>Psidium guajava</i>	Myrtaceae	Tree						

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				ant therapy ¹⁴¹ .
12 7	<i>Pteris</i>	Pterida ceae	Fern	---
12 8	<i>Ricinus communis</i>	Eupho rbiace ae	Shrub	Used as laxative, anti- inflamm atory, antimicr obial, and analgesi c agent ¹⁴² .
12 9	<i>Saccharum spontaneum</i>	Poacea e	Grass	Used tradition ally as diuretic, laxative, galactag ogue, and for urinary disorder s, dysenter y, and inflamm ation ¹⁴³ .
13 0	<i>Senegalia catechu</i>	Fabace ae	Tree	Used in diarrhea , sore throat, skin diseases , wound healing, antimicr obial and antioxid ant therapie s ¹⁴⁴ .
13 1	<i>Senna occidentalis</i>	Fabace ae	Herb	Used as laxative, antimala rial, antimicr obial, hepatop rotectiv e, and anti-

				inflamm atory medicin e ¹⁴⁵ .
13 2	<i>Senna tora</i>	Fabace ae	Herb	Used in skin diseases , constipa tion, liver disorder s, antimicr obial and antioxid ant applicati ons ¹⁴⁶ .
13 3	<i>Sesbania grandiflora</i>	Fabace ae	Herb	Used for fever, wounds, inflamm ation, diarrhea , antimicr obial and antioxid ant treatme nts ¹⁴⁷ .
13 4	<i>Setaria faberi</i>	Poacea e	Grass	Ethnom edicinall y reported in tradition al grass remedie s for fever and livestoc k ailments ; contains antioxid ant phytoch emicals ⁶⁰ .

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135	<i>Setaria parviflora</i>	Poaceae	Grass	Used in ethnovegetinary medicine, wound healing, and traditional fever remedies ¹⁴⁸ .				disorders ¹⁵⁰ .	
136	<i>Setaria viridis</i>	Poaceae	Grass	Traditionally used in folk medicine for fever, digestive disorders, and fodder-based ethnovegetinary applications ⁶⁰ .				Used for liver disorders, ulcers, inflammation, and anticancer applications ¹⁵¹ .	
137	<i>Sida acuta</i>	Malvaceae	Herb	Used as analgesic, antimalarial, antimicrobial, anti-inflammatory, and wound healing medicine ¹⁴⁹ .	140	<i>Solanum viarum</i>	Solana ceae	Shrub	Used traditionally for skin infections, fever, antimicrobial, anti-inflammatory, and analgesic applications. Reported to possess antioxidant and cytotoxic properties ¹⁵² .
138	<i>Sida cordifolia</i>	Malvaceae	Herb	Used in asthma, nervous disorders, pain relief, inflammation, rheumatism, and urinary	141	<i>Sonchus asper</i>	Astera ceae	Herb	Used for burns, wounds, liver disorders, kidney problems, inflammation, and antioxidant

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				therapy ¹⁵³ .					
142	<i>Sorghum halepense</i>	Poaceae	Big Grass	Traditionally used in ethnomedicine for digestive disorders, fever, diuretic applications, and livestock herbal remedies ⁶⁰ .	145	<i>Syzygium cumini</i>	Myrtaceae	Tree	Used in diabetes management, antioxidant, antimicrobial, and anti-inflammatory therapy ¹⁵⁶ .
143	<i>Swietenia macrophylla</i>	Meliaceae	Tree	Traditionally used for hypertension and malaria. Exhibits antidiabetic, antimicrobial, anti-inflammatory, antioxidant, and anticancer activities ¹⁵⁴ .	146	<i>Tabernimontana divericata</i>	Apocynaceae	Shrub	Used traditionally for pain relief, inflammation, skin diseases, wound healing, fever, hypertension, and neurological disorders. Reported antioxidant, antimicrobial, analgesic, and anti-inflammatory activities ¹⁵⁷ .
144	<i>Swietenia mahagoni</i>	Meliaceae	Tree	Used for diabetes, hypertension, malaria, inflammation, antimicrobial and antioxidant treatments ¹⁵⁵ .	147	<i>Tecoma stans</i>	Bignoniaceae	Shrub	Used in diabetes management, digestive disorders, antimicrobial

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				therapy, antioxidant and anti-inflammatory treatments. Traditionally employed for urinary disorders and gastrointestinal ailments ¹⁵⁸ .					gastrointestinal ailments. Reported hepatoprotective, antimicrobial, antioxidant, and anti-inflammatory activities ⁸¹ .
148	<i>Terminalia arjuna</i>	Combr etaceae	Tree	Used as cardioprotective, antihypertensive, antioxidant, and wound healing agent ¹⁵⁹ .	151	<i>Tribulus terrestris</i>	Zygophyllaceae	Herb	Used for urinary disorders, aphrodisiac activity, hypertension, and anti-inflammatory purposes ¹⁶¹ .
149	<i>Tinospora cordifolia</i>	Menispermaceae	Lianas	Used as immunomodulatory, antidiabetic, antipyretic, and hepatoprotective medicine ¹⁶⁰ .					Used traditionally for wound healing, burns, bleeding disorders, diuretic applications, and anti-inflammatory treatments. Pollen and rhizomes are also employed
150	<i>Trianthema portulacastrum</i>	Aizoaceae	Herb	Traditionally used for jaundice, liver disorders, edema, inflammation, asthma, wounds, and	152	<i>Typha angustifolia</i>	Typhaceae	Reed	

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				Used in traditional medicine for hemorrhage control ¹⁶² .					ns, inflammation, wound healing, and antimicrobial applications. Reported antioxidant and cytotoxic properties ¹⁶⁵ .
153	<i>Urena lobata</i>	Malvaceae	Shrub	Used in fever, rheumatism, wound healing, antimicrobial therapy, inflammation, and gastrointestinal disorders. Reported antioxidant and analgesic activities ¹⁶³ .	156	<i>Veronica anagallis-aquatica</i>	Plantaginaceae	Aquatic herb	Used in traditional medicine for respiratory disorders, wound healing, fever, antimicrobial and anti-inflammatory applications ¹⁶⁶ .
154	<i>Vachellia nilotica</i>	Fabaceae	Tree	Used in diarrhea, diabetes, skin diseases, sore throat, wound healing, antimicrobial and anti-inflammatory therapies ¹⁶⁴ .	157	<i>Xanthium strumarium</i>	Asteraceae	Shrub	Used in sinusitis, headaches, skin diseases, and anti-inflammatory therapy ¹⁶⁷ .
155	<i>Verbesina encelioides</i>	Asteraceae	Herb	Used traditionally for skin infection	158	<i>Ziziphus mauritiana</i>	Rhamnaceae	Tree	Used traditionally for digestive disorder

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				s, fever, wound healing, skin diseases, diabetes, inflammation, and antimicrobial applications. Fruits and leaves possess antioxidant and hepatoprotective properties ¹⁶⁸ .
159	<i>Ziziphus nummularia</i>	Rhamnaceae	Shrub	Used in cough, asthma, fever, gastrointestinal disorders, wounds, ulcers, inflammation, and antimicrobial treatments. Traditionally employed as analgesic and sedative medicine ¹⁶⁹ .

pharmacological activities. Among these, anti-inflammatory activity was the most dominant, reported in approximately 60% of the documented plant species. Antimicrobial, antibacterial, and antifungal properties were observed in 57% of the species, followed by applications in skin diseases and wound healing (52%). Antioxidant activity was recorded in 44% of the plants, while 42% were traditionally used for digestive disorders. About 31% of the species were employed in fever management, and 23% exhibited antidiabetic potential. Furthermore, 18% of the plants were used for respiratory disorders, 17% for pain relief, 14% for urinary disorders, and 13% for liver-related ailments. Anticancer activity was comparatively less represented, being reported in nearly 8% of the studied species. Comparable observations have been reported in ethnobotanical studies from Punjab and neighboring Himalayan regions, where a single plant species is often utilized for multiple ailments depending upon the plant part used and method of preparation^{15,16}

The present findings are in close agreement with several ethnobotanical and pharmacological studies conducted in different regions of India. Similar investigations have reported that anti-inflammatory, antimicrobial, antioxidant, and wound-healing properties are among the most frequently documented therapeutic applications of medicinal plants used in traditional healthcare systems. Studies from Odisha¹⁴, the Indian Himalayan region¹⁵ and Darjeeling hills¹⁶ also highlighted antimicrobial and anti-inflammatory activities as dominant pharmacological traits among ethnomedicinal plants. Likewise, antimicrobial, antibacterial, and antifungal activities recorded in 57% of the studied species correspond well with previous Indian ethnomedicinal surveys, where plant extracts were extensively used against skin infections, gastrointestinal diseases, and microbial ailments^{17,18,19}.

The high proportion of plants used for skin diseases and wound healing (52%) further supports traditional Indian medicinal practices, where leaves, latex, bark, and whole plant extracts are commonly applied as poultices, pastes, and decoctions for cuts, burns, wounds, eczema, and other dermatological disorders¹⁷. Antioxidant activity reported in 44% of the documented species also agrees with previous pharmacological investigations indicating that Indian medicinal plants are rich sources of natural antioxidants capable of scavenging free radicals and reducing oxidative stress²⁰. Such antioxidant-rich plants are increasingly recognized for their role in preventing chronic diseases including diabetes, cardiovascular disorders, ageing-related complications, and cancer^{21,22}.

Sources of all medicinal use is shared in separate supplementary file
 Analysis of the 159 plant species presented in table 3 revealed a total of 12 major ailments and

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Table 3. Ailment / Pharmacological activity with number of plant species used

S. No.	Ailment / Pharmacological Activity	Number of Plant Species Used	Percentage
1	Anti-inflammatory activity	95	60
2	Antimicrobial / Antibacterial / Antifungal uses	90	57
3	Skin diseases & wound healing	82	52
4	Antioxidant activity	70	44
5	Digestive disorders (ulcer, dysentery, diarrhea etc.)	66	42
6	Fever management	50	31
7	Antidiabetic use	37	23
8	Respiratory disorders (asthma, cough, bronchitis)	28	18
9	Analgesic / Pain relief	27	17
10	Urinary disorders / Diuretic uses	22	14
11	Liver disorders / Hepatoprotective uses	20	13
12	Anticancer activity	12	8

The most frequently utilized plant parts included leaves, seeds, bark, fruits, whole plants or aerial parts, latex, rhizomes, and flowers. These plant materials were commonly prepared and administered in the form of decoctions, pastes, powders, extracts, juices, infusions, poultices, and latex applications for the treatment of various ailments (table 4).

Table 4. Herbal formulations used in common ailments

S. No.	Herbal Formulation	Common ailments
1	Decoction	Fever, digestive disorders, diabetes
2	Paste	Skin diseases, wound healing
3	Powder	Antidiabetic and antimicrobial remedies

4	Extracts	Antioxidant, anticancer, anti-inflammatory studies
5	Juice	Respiratory and urinary disorders
6	Infusion	Gastrointestinal ailments
7	Poultice	Wounds and inflammation
8	Latex application	Skin infections and cuts

The recorded diversity of 159 medicinal plant species demonstrates that the Malwa region still possesses considerable phytodiversity despite increasing anthropogenic pressure, agricultural intensification, and habitat disturbances. Similar studies conducted in Punjab and adjoining northwestern states have also emphasized that rural communities continue to depend upon locally available medicinal flora for primary healthcare needs^{23,24}. The occurrence of several medicinally important species such as *Mangifera indica*, *Morus alba*, *Prosopis cineraria*, *Trianthema portulacastrum*, *Convolvulus arvensis*, and *Fumaria parviflora* demonstrates the pharmaceutical significance of the medicinal flora of the Malwa region. Many of these species are already recognized for their antioxidant, antimicrobial, antidiabetic, hepatoprotective, and anti-inflammatory activities in modern pharmacological studies^{25,26}. Therefore, the medicinal plant diversity documented in the present study represents an important reservoir of bioactive compounds with potential applications in herbal drug development, nutraceuticals, and pharmaceutical industries.

CONCLUSION

The recorded flora exhibited significant pharmacological potential, particularly anti-inflammatory, antimicrobial, antioxidant, wound healing, digestive, antidiabetic, and hepatoprotective activities, demonstrating their importance in traditional healthcare systems and their potential value for pharmaceutical and nutraceutical applications. However, increasing agricultural intensification, habitat degradation, and overexploitation may threaten the survival of several medicinally important species. Therefore, systematic conservation strategies, sustainable utilization, cultivation of medicinal plants, awareness among local communities, and further phytochemical and pharmacological investigations are recommended to preserve and scientifically validate the medicinal plant wealth of the Malwa agro-climatic zone of Punjab.

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Ethical Issue

Not Applicable

Conflict of Interest

The authors declare no conflict of interest.

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