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An ethnobotanical study of medicinal plants used to treat skin diseases by the native communities of Murree, Pakistan

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Abstract

The objective of this study was to document traditional medicinal plants (including their applications and associated procedures) used to treat skin diseases by native communities of Murree Hills (Pakistan). Data was collected from 5 different sampling sites and 138 informants were interviewed. Respondents were queried in their local language for the type of herbal treatment, famous to that area. It was observed that elderly people and health practitioners of the study area possessed more knowledge about herbal remedies in contrast to young aged people. Results reported that total 56 plants belonging to 36 families and 54 genera were in use by local communities for treatment of multiple skin diseases. It was detected that herbs (41%) constituted the highest proportion of medicinal plants followed by shrubs. Leaves were most reported plant part (43 %) followed by fruits (20%), whereas infusion (30%) was a widely used mode of preparation of traditional remedies and direct application on skin was the dominant route of administration. Relative frequency citation (RFC) was recorded highest for *Mentha royleana* (0.913) and least for *Ajuga bracteosa* (0.369). Cluster analysis grouped these medicinal species into high, medium and low-ranking groups. High ranking group comprised of 18 medicinal plants, which reflected the popularity and trust of local communities of these plants. Therefore, further pharmacological studies are highly recommended. This study is first proper documentation based on the valuable information attained by the local tribes and it can be utilized by scientific community for further validation and characterization.

Introduction

Ethnobotany is multidisciplinary science that studies the relationship between people and their environment in a particular area. The basic aim of ethnobotanical studies is to collect information about plant uses from tribal communities [1, 2]. The ancient tribe are great reservoir of useful information in an ecofriendly way. The ethno-botanist can acquire the acquaintance regarding the uses of plants. This knowledge is specific to particular region and culture [3]. Pharmaceutical industries have developed huge diversity of medical agents; however, crude plants using treatments are still handed down from centuries. Medicinal plants are considered as wealthy methods of traditional medicines and from these plants many of the new medicines are formed [4]. Thus, the relation between plants and humans may be very wide, surrounding economic, social, commercial, religious, symbolic and arty relationships [5]. In Pakistan mostly tribes depend on medicinal plants for treatment of their major and minor ailments. [6]. Most of these plants are natural sources of important ethno medicinal organic and inorganic ecofriendly metabolic components. Those are being used as remedies and probes agents since ancient times for native treatments [7]. There are about half million medicinal plants around the world, and most of them are not explored until now for their medical actions. Their hidden prospective of medical activities could be significant in the treatment of present and future studies [8]. The most commonly used parts of plant in cure of remedies are aerial parts, leaves, ovule as well as, whole plant [7]. Some medicinal plants also utilized as amiable condiments, to flavor, dye, preserve food etc. Almost every part of the plant has individual medicinal properties [8]. Like other parts of the developing world, a considerable portion of the population in Pakistan uses medicinal plants conventionally for treating ailments and health disorders.

Skin is outer protective covering of body and is the largest organ of our body. It performs variety of task as: percutaneous absorption, thermoregulation, maintenance of body fluid, sensory adjustments and other microbial disease control [9]. People of all ages are affected by skin disorders. According to an estimate, skin diseases hold about 34% of all occupational diseases. [10]. Plants have great applications in managements of subcutaneous conditions [11]. Plants are the reservoir of natural esthetic beauty. These natural resources help human beings in preservation or enhancement of their beauty. A universal term 'Natural cosmetics" is applied to the certain items which can be used for cleansing, beautifying, promoting attractiveness, coloring, softening or altering the appearance. These natural cosmetics can be rubbed, poured, sprinkled, introduced into or otherwise applied to the human body or any part. The history of natural cosmetics dates back as long ago as 6000 BC [9, 12-15].

Skin diseases present a major threat to human population around the globe [16]. Skin illnesses including leprosy, eczema, boils, ringworm, itching, dermatitis, psoriasis, and skin allergies are caused by range of microorganisms. It has been confirmed from previous studies that several plants have been used to cure skin infections such as boils, leprosy, psoriasis, scabies, etc. [17]. Skin problems are also increasing day by day in Pakistan. Ethno-medicinal studies showed that herbal medicine is an alternative therapy for treatment and control of skin ailments. It has been observed from previous studies that the knowledge about use of medicinal plant for skin care is limited in Pakistan [18]. In addition, the plants used for skin ailments of study area are not yet documented. Therefore, the present study was focused to explore different plant species that are used against skin treatment.

Material and Method

Site of study

Murree is a mountain resort town, located in the Galyat section of the Pir Panjal series. It is located within the Rawalpindi district of Punjab, Pakistan, its normal height is 2.291 kilometers. The sanatorium of Murree lies in north latitude 33° 54′ 30″, east longitude 73° 26′ 30″and it has an elevation of 7,517 feet (2,291 m) above sea level [16]. It is about 30 km Northeast of Islamabad, located in the external Himalayas, having high elevation and comprised of an eminence population of 1,768 individual [17]. Murree hills receives rainfall in both in winter and monsoon season with average rainfall from mid of July to early August, is 120-130 mm [18], whereas total annual mean rainfall is 1,789 mm [19]. This area has chilly, snowy winters with comparatively cool summers and in this area subtropical forest (blue pine) and moist temperate forest i.e., chirr pine are copious [17]. Most of the countryside areas of Murree hills have been occupied by Dhund (Abbasi) tribe. Dhund (Abbasis) have significant occurrence in all areas of Murree Hills.

Other tribes are Kethwal, Satti, Danial with minor variations. The popular spoken languages are Punjabi and Potohari (**Table 1**).

Table 1: Elevation, latitude and Longitude of study sites

Sr. #	Locality	Latitude(N)	Longitude (E)	Elevation
1	Bansra Gali	073◦22'12.6"	33◦53'91.8"	1781
2	Ghora Gali	073◦20'89.5"	33◦52'80.7"	1636
	Kurung	073◦21'80.5		
3	Nallah	"	33◦52'70.7"	1566
4	Chara Gali	073◦20'81"	33◦52'83"	1601
5	Jhikka Gali	073◦24'95.6"	33◦55'25.9"	2044

Data collection

Data was collected between March 2018 and January 2019. The present study was conceded out by taking interviews of individuals in 5 different sites including Bansra Gali, Chara Gali, Ghora Gali, Jhinka Gali and Kurung Nullah (**Fig. 1**). The informants were comprised of both men and women of different age groups. Questionnaires and interview methods were applied to collect data about ethnomedicinal plant used for skin diseases [20]. The data regarding socioeconomic information about the informants were collected, such as education level, age, occupation, level of knowledge on the use of local plant species for medicinal point of view, and information on modes of preparation and plant parts used. These plants are used by many tribes for different diseases. According to local people, the herbal treatment is useful as compared to chemical medicines. Indigenous names of the plants were recorded during the interviewees. Respondents were queried in their local language for the kind of herbal treatment are famous in that region for skin diseases and cosmetics. The questionnaire comprises of; tribe (name gender locality, occupation), experience, knowledge gained from, name of plant, name of disease cured, and number of diseases cured. Before the conduction of this survey the design was approved by Ethical review committee of Rawalpindi Women University and written informed consents were also taken from informants.

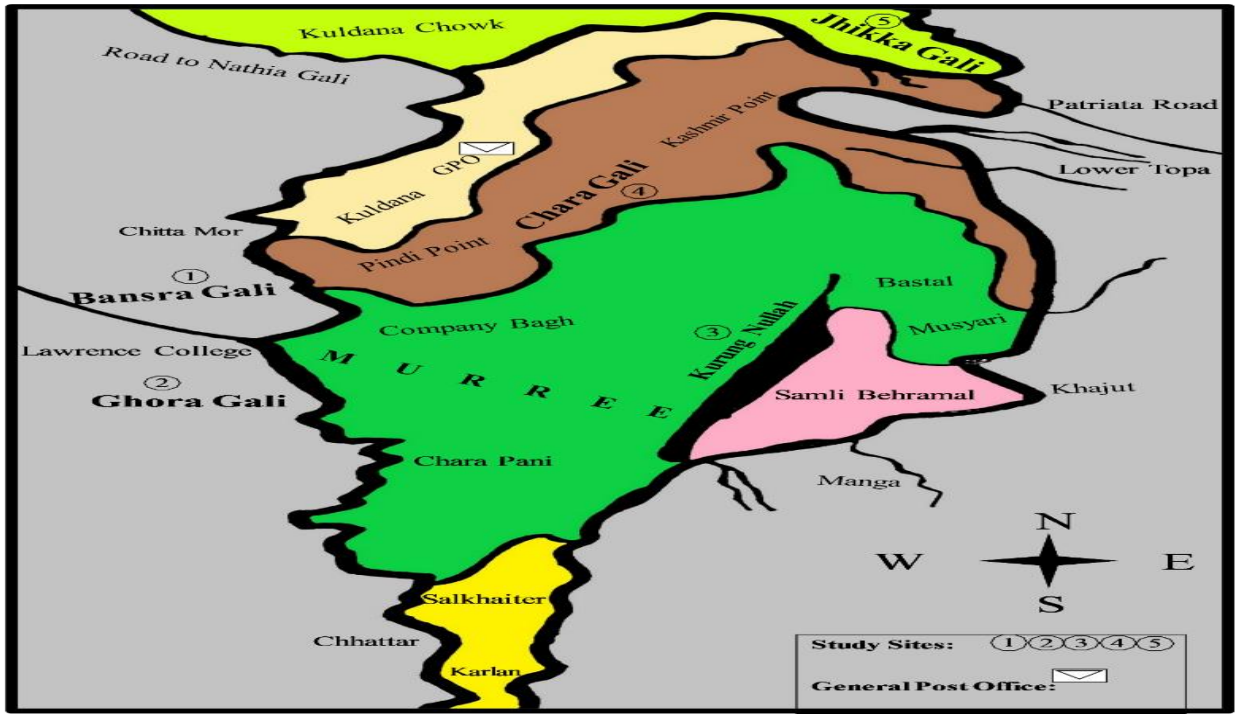

Fig. 1: Map Highlighting the study sites

Plant collection and identification

Plants were collected in flowering and fruiting condition with the help of local inhabitants. Specimens were dried, pressed and mounted on herbarium sheets. All collected specimens were identified by taxonomist in Department of Plant Sciences, Quaid-i-Azam University (Islamabad). In addition, Flora of Pakistan was also used for identification purposes. Ultimately, the identified

specimens were stored at the Herbarium of University of Gujrat sub-campus Rawalpindi, Pakistan and voucher numbers were allotted to new specimens.

Data Analysis

The gathered ethnobotanical data were entered into Excel spreadsheet 2016 and summarized using descriptive statistical methods such as frequency, percentage and table. SPSS 25 software was applied for descriptive statistical analysis of different qualitative parameters of the survey [21].

Results and Discussion

Socio-Demographic characteristics of study area

A total of 138 local informants including 79 males and 59 females were interviewed during the data collection. Number of male participants was comparatively higher than females (**Fig. 2**). This shows the cultural dynamics of study area, as the females of this area are reluctant or not authorized to participate in such kinds of surveys. Most of the informant were in between 40-60 age group (49%), followed by 60 above (34%) and 20-40 age groups (16%) (**Table 2**).

Table 2: Demographic observations from the study area

Social variables	Description	Number	%age
Respondents	Total	138	
	Women	59	42.75
Gender	Men	79	57.25
	Between 20 - 40 years	23	16.67
	Between 40 - 60 years	68	49.28
Age Groups	Above 60	47	34.06
	Illiterate	23	16.67
	Primary	29	21.01
	Middle	41	29.71
Education Level	Graduate or above	45	32.61
	Farmers	37	26.81
	Herdsmen	33	23.91
	Craftsmen	11	7.97
	Shopkeepers	9	6.52
	Teachers	21	15.22
Social Livelihoods	Housewives	27	19.57
	Abbaasi	83	60.14
	Satti	22	15.94
	Kethwal	18	13.04
	Danial	12	8.70
Ethnicity	Other	3	2.17

It was observed from the result obtained that there is a considerable decrease in acquaintance of medicinal plants in the age group 20-40 when compared with other age groups. This showed that the newer generations have very little knowledge about practice of traditional medicine. This showed the alarming situation that this knowledge is not documented and preserved it can be lost in near future. In concern to informant's occupations, diversity had been observed i.e. farmers, foresters or herdsmen, craftsmen, shopkeepers, teachers and housewives. However, the major number of respondents was either farmer (26%) or herdsman (23%). Results showed most people of this area were literate i.e. 70 % (Primary 21%, Middle 29%, graduate and above 32%). This is because of higher literacy rate of the area (Government of Punjab, 2017). Although the smaller number of informants were illiterate (29%) but interestingly they shared more information about traditional use of medicinal plant species in comparison to literate ones. This may be due to changing lifestyle, more use of allopathic medicine and urbanization. Similar findings have also been reported from Bangladesh and Turkey [22].

Diversity of medicinal plants

Outcome of current assessment are shown in **Table 3**, where plant species are ordered alphabetically in conjunction with their common names, scientific names, part collected, uses, preparation and application of collected medicinal plants. Total 56 plant species were documented for their ethno-pharmacological uses to cure skin infections by the natives of study area (**Fig. 3**). These 56 medicinal plants belonged to 54 genera and 36 families. The dominant families were Lamiaceae(5 taxa) and Asteraceae(5 taxa) followed by Rutaceae(3 taxa), Cucurbitaceae(3 taxa), Solanaceae(3 taxa) and Rosaceae(2 taxa) (**Fig. 4**). Previously it was observed that Lamiaceae and Rosaceae are dominant families in ethnobotanical study [23]. Several prominent plant species which showed immediate reaction to treat skin infections and in folk cosmetics are: *Otostegia limbata*, *Pimpinella diversifolia*, *Alobarba densis*, *Ajuga bracteosa* and *Mentha piperali*.

Skin infections (medicinal aspects)

Skin infection is caused by bacteria, viruses, fungus and parasites. It has been found that one fourth of us suffer from skin disease, a situation that constitutes a significant global burden of disease

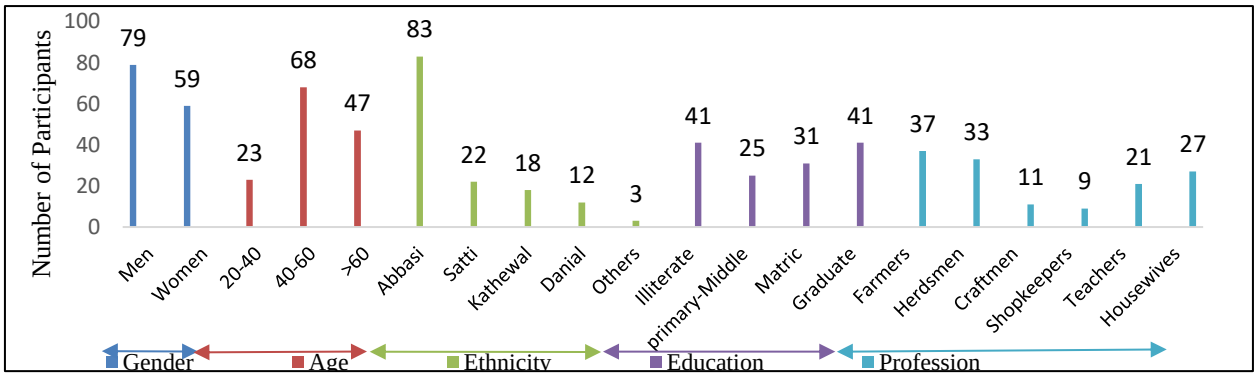

Fig. 2: Demographic attributes of participants from study area

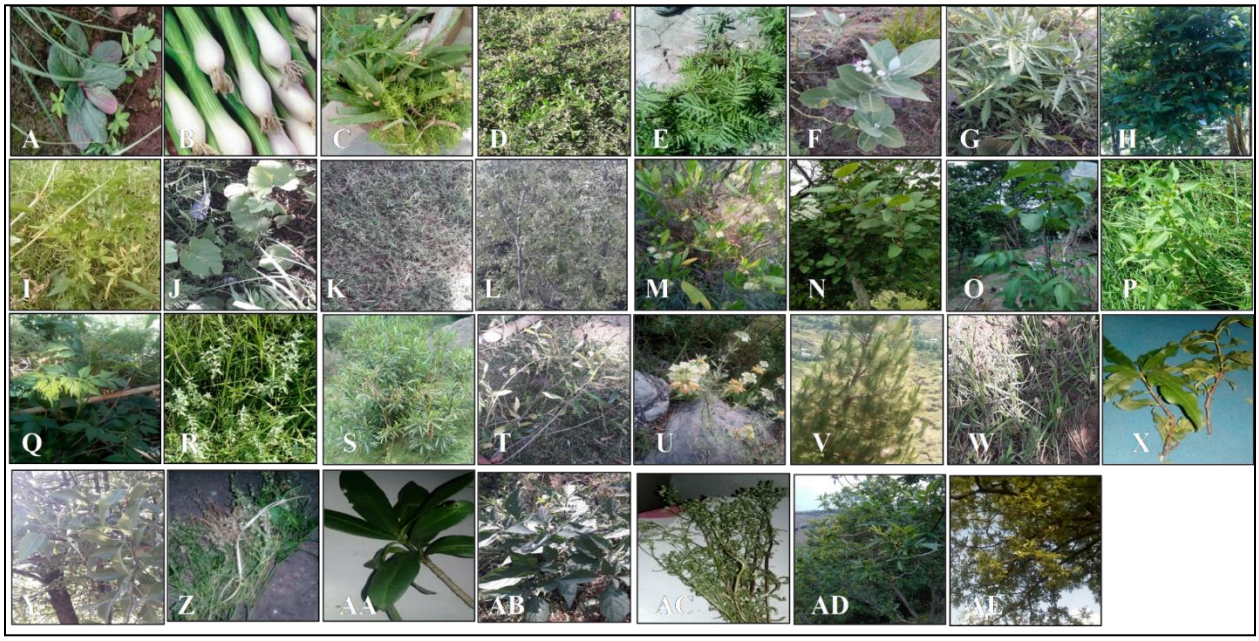

Fig. 3: Some plants specimens photographed from study area: A.*Ajuga bracteosa* **B.** *Allium cepa* **C.** *Aloe barbadensis* **D.** *Berberis lycium* **E.** *Calendula arvensis* **F.** *Calotropis poraca* **G.** *Cannabis sativa* **H.** *Citrus limon* **I.** *Clematis grata* **J.** *Cucurbita maxima* **K.** *Cynodon dactylon* **L.** *Dalbergia sissoo* **M.** *Dodonaea viscosa* **N.** *Ficus virgata* **O.** *Juglans regia* **P.** *Melia azedarach* **Q.** *Mentha piperita* **R.** *Mentha royleana* **S.** *Nerion oleander***T.** *Olea ferruginea* Royle **U.** *Otostegia limbata* Benth **V.** *Pinus roxburghii* Sargent.**W.** *Plantago lancelata* **X.** *Prunus persica* **Y.** *Pyrus pashia* **Z.** *Rumex acetosella* **AA.** *Skimmia laureola* **AB.** *Solanum nigrum* **AC.** *Swertia chirata* **AD.** *Zanthoxylum armatum* **AE.** *Ziziphus sativa.*

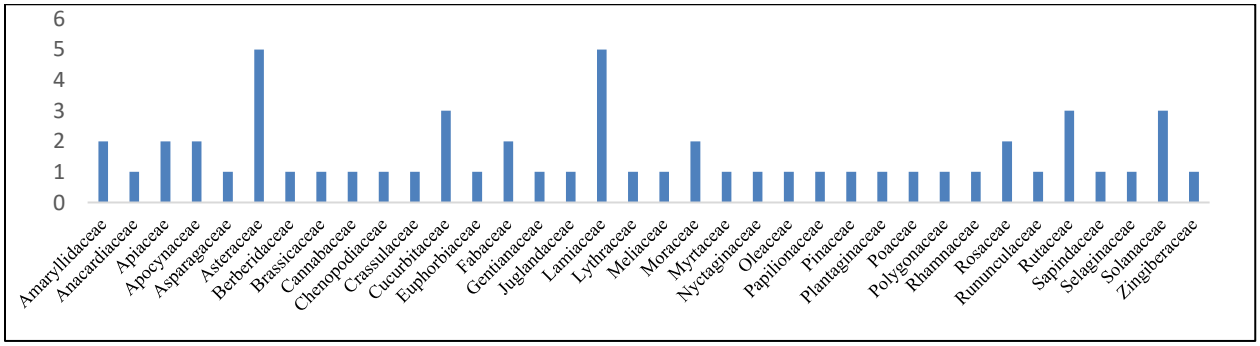

Fig. 4: Population of Botanical Families reported from study area

[66]. The informants recognized 30 various skin diseases containing, bleeding of gums, boils on skin, scars, warts, skin burn, pimples, acne, chronic wounds, eczema, swellings, itching, mumps, leprosy, ringworms, toothache, mouth infections, swelling and smallpox (**Table 3**). However, the most prevailing skin disease was acne in the study area, followed by boils, pimples and itching (**Fig. 5A**).

Growth Form of Medicinal Plants

The growth form analysis of medicinal plants showed that herbs represent the highest proportion being represented by 24 species (41%), shrubs represented by 16 species (29%) while trees represented by 13 species (23%) and climbers 3 species (7%) (**Fig. 5B**). This finding shows that the most represented life forms of medicinal plants in the survey area were herbs followed by shrubs [26].

It was revealed from medicinal plant data collected from the study area that the majority of the medicinal plants were wild (45%) followed by from home gardens (41%) while few belongs to both types (14%) (**Fig. 5C**).

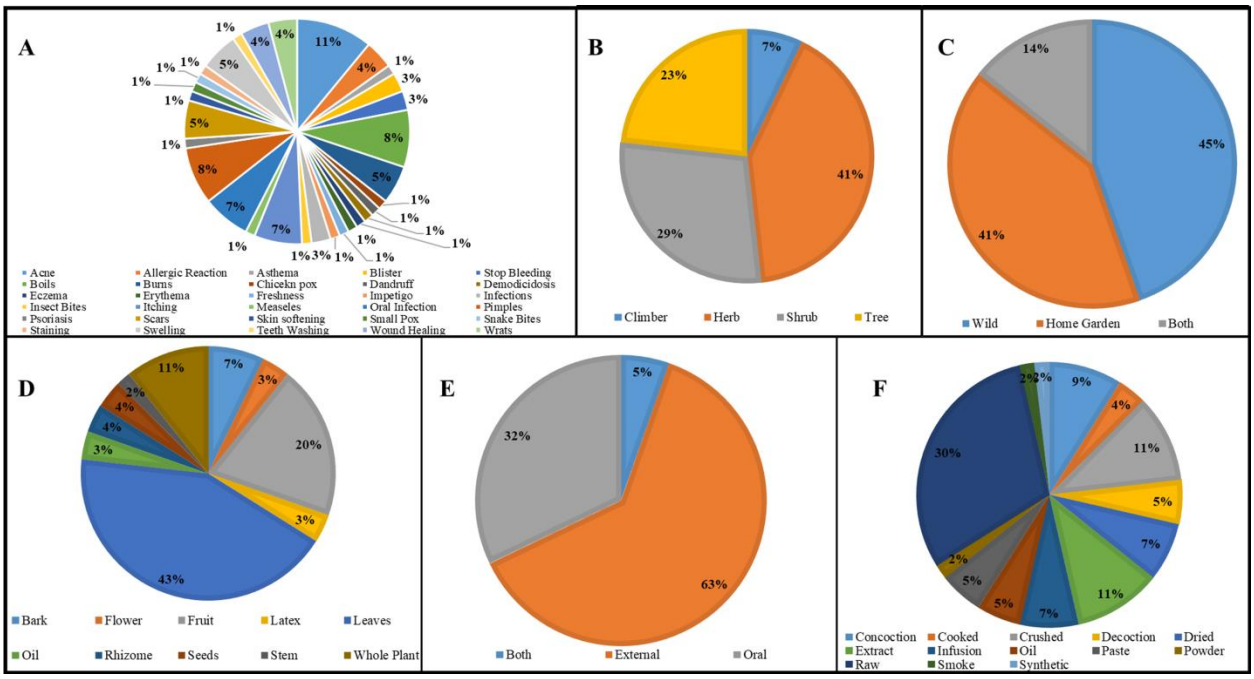

Fig. 5: A: Percentage of plant utilization for various skin diseases from study area; **B:** Percentage of growth forms of plants; **C:** Percentage of cultivation status of plants; **D:** Percentage for plant part utlization for different skin ailments; **E:** Mode of adminstration; **F:** Recipes of reported medicinal plants.

Plant part used, preparation and application

People of the study area yield different plant parts for the making of traditional medicines (e.g., leaves, roots, seeds, barks, and fruit). Among the part of plant used, leaves were found extremely used (43%) followed by fruits (20%), whole plant (11%), bark (7%), flowers (3%), rhizome (2%), latex (2%) and seed (2%) (**Fig. 5D**). Similar findings were found in previous study [24]. As this study dealt with skin problems therefore most of plants were reported for their external application i.e. 63%. Nevertheless, many of them also in use through oral route (32%) and few can be consumed in either way (5%) (**Fig. 5E**). Depending upon the skin situations either swelling, wound, itching boils or warts, the preparations were applied three times every day until healing become visible. Several medications were found to be prepared by local people from one plant or from combination of plants. Methods of preparation of drugs from these plants are comprised of eight different forms such as crushed, or powdered, paste, fresh part (raw), decoction, extract, latex, and resins. However, majority of the people preferred their use in raw form, *i.e.*, 30% (**Fig. 5F**).

Priority ranking of medicinal plants used against skin diseases

The order of priority among reported medicinal plants was established by employing the RFC and PC data analysis tools. Results showed that RFC ranged from 0.917 to 0.369. However, it was observed that some medicinal plants were in the same ranking group with similar RFCs. Hence, their actual priority ranking was determined with the application of PC (**Table 3**). The medicinal plants were clustered into High-ranking group (HRG), medium ranking group (MRG) and low-ranking group (LRG) medicinal plants against skin complications (**Fig. 6**). The RFC of high-ranking group ranged from 0.913 to 0.797 and this group comprised of 18 Plants (Fig. 11). However, the medium raking ranged from 0.768–0.514 with 37 species, whereas low ranking group was comprised of only 1 species with 0.369 RFC. It can be assumed that high ranking group of medicinal plants (n=18) were more preferably utilized by natives of study area. Moreover, these medicinal plants perhaps more abundant in the study area or natives are more familiar with them [24]. Despite the fact that local people are using them from centuries, however their pharmacological evidence is required for their safe and sustainable use.

Pharmacological review of studied plants

Local people use various plants products to cure skin diseases due to their antimicrobial action. In the literature it was found that some plant species like: *Calotropis procera, Vitex negundo, Tagetes minuta, Allium cepa, Emblica officinalis, Zingiber officinale, Dodonaea viscosa, Mallotus philippensis, Punica granatum,* and *Solanum miniatum* were thought to be dynamic against various bacterial strains [25, 26]. Leaves and Roots extracts possess Terpenoids and tannins which are analgesic and have anti-inflammatory activities. Moreover, tannins help in faster healing of wounds and also in inflamed mucous membrane [27].

Recommendations for conservation of Medicinal Plants of Study Area

The effects of human on the natural habitat of medicinal plants are the trouble for the protection of medicinal plants and related facts. The effort to conserve medicinal plants was observed to be very pathetic. From a preservation point of view, in the initial phase, it would be urgent and appropriate to establish conservation plan of plenty dimensions to protect the medicinal and aromatic plants. Establishment of community-based small-scale enterprise is necessary to local conservation. Profit sharing within the community will increase the feeling of ownership concerning common property resource. This part leads to creating awareness and inculcates knowledge regarding potential medicinal and aromatic plant resources, in particular, and forest resources.

Conclusion

There was large number of important resources, practices and knowledge of medicine which can solve problems of shortage of drugs at rural areas as well as drug resistance in different diseases. Some plants are also used in cosmetics. The obtained result provides a baseline data to establish a relation between the traditional health practitioners and scientific communities, which could be substantial in novel drug discovery. In addition, ethnobotanical data is very important for conservation managers and policy makers for sustainable management of medicinal plant species, which are under threat due to over exploitation. Total 56 plants species used to cure skin diseases were recorded in Murree. Several communities use these plants to cure skin diseases due to higher price and difficult approach to allopathic medicines. Most recorded species are wild and uncommon. To our knowledge no record is available for *Clematis grata* and *Rumex acetosella* for treatment of skin diseases. For conservation of such vital resources urgent attention is needed so as to optimize their use in the primary health care system. The conservation of indigenous traditional and cultural heritage is essentially required. However, scientific validation of reported therapeutic values of plant is also mandatory. Therefore, popular plant species are recommended further for analysis of bioactive constituents, *in vivo/in vitro* biological activities, which may lead to new and potential drugs.

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Table 3: Taxonomic diversity and ethnomedicinal utilizations observed from study area.

Taxonomical Diversity										Ethnomedicinal Observation			
Family	**Genus**	**Specimen No.**	**Botanical name/voucher numbers**	**Plant Vernacular**	**Habit**	**Part**	**Mode of Administration**	**Type of Formulation**	**Category**	**Recipe**	**Other Uses from Literature**	**FC**	**RFC**
Amaryllidaceae	Allium	BGM-01	*Allium sativum* L.	Garlic	H	L	E	Extract	Boils-Blisters	Leaf extract is applied externally on boils and blisters.	Garlic have anti-diabetic, antioxidant, antifungal and anti-inflammatory activities [28]	119	0.862
	Allium	BGM-02	*Allium cepa* L.	Onion	H	L	E	Cooked	Scars	Foliage leaves are fried and apply on scars	onion extract gel is applied to remove the scars [29]	114	0.826
Anacardiaceae	Pistacia	BGM-03	*Pistacia integerrima* J.L. Stewart ex Brandis /UG 044	Kangher	T	F	B	Dried	Boils-Blisters	Dried fruit is applied on burn skin. Mixed with sugar and eaten for cough and chronic wound.	Pertussis, asthma, jaundice, dysentery, cure to snake venom and scorpion bite, intestinal pain [30]	88	0.637
Apiaceae	Daucus	BGM-04	*Daucus carota* L.	Carrot	S	F	O	Raw	Acne	Fruit is eaten to treat acne	It has anti-inflammatory effect [31]	101	0.732
	Pimpinella	BGM-05	*Pimpinella diversifolia* DC. /UG 005	Tarpakhi	H	W	E	Decoction	Swelling	Plant material is boiled in water and used to cure swelling of hands and feet	To treat sore of mouth and throat (based on locally available information)	94	0.681
												96	**0.696**
Apocynaceae	Calotropis	BGM-06	*Calotropis procera* L .	Aaq	S	L	E	Extract	Scars-Snake Bites	Leaves are applied on scars. Exudate of *Calotropis procera* is mixed with seeds of *Prunus armeniaca* and mustard oil. This paste is used against scars on skin and snake bite	Purgative, skin infection, expectorant, anthelmintic, diaphoretic [32, 33]		
	Nerion	BGM-07	*Nerion oleander* L./UG 022	Ganeera	S	B	E	Oil	Scars	Oil from root bark is used for treatment of warts. Branches are used as siwak for scars at gums and toothache.	Antibacterial and antifungal activities [34]	101	0.732

Asparagaceae	Aloe	BGM-08	*Aloe vera* (L.) Burm.f. /*UG 011*	Alovera	S	Lt	E	Raw	Acne-Itching	Latex of areal parts is applied on skin for acne treatment and also for itching relief between fingers of feet	It decreases blood sugar level in hyperglycemic patients [35]	121	0.877
Asteraceae	Sonchus	BGM-09	*Sonchus arvensis L.*	Hand	H	W	O	Decoction	Acne	Plant material is mix with water, boiled and orally taken for Acne	Used against Typhoid (based on locally available information)	81	0.587
	Matricaria	BGM-10	*Matricaria chamomilla* L.	Chamomile	H	W	E	Raw	Itch-Softening	Used for skin softening and to relieve from itching	To reduce labour pain (based on locally available information)	79	0.572
	Vernonia	BGM-11	*Vernonia anthelmintica* L.	Kalijeri	H	S	O	Raw	Itching	Seeds are eaten for treatment of itching	Diarrhea, cataplasm on wounds, cold, coughing [36, 37]	94	0.681
	Calendula	BGM-12	*Calendula arvensis* L. /UG 038	Satbarga	H	Fl	O	Raw	Itching	Flower is eaten for treatment of itching	Anti-inflammatory, broncho-dilatory, disinfectant, microbicidal [26]	91	0.659
	Calendula	BGM-13	*Calendula officinalis* L.	Marigold	S	Fl	E	Raw	Scars	The flowers of marigold have long been employed in folk therapy	for treating wounds, ulcers, herpes, scars, skin damage [38]	93	0.674
Berberidaceae	Berberis	BGM-14	*Berberis lycium* Royle./UG 021	Sumbal	S	B	O	Dried	Boils-Pimples	Before breakfast powder of dried or fresh bark is taken orally for treatment of pimples and boils.	Eye diseases, antipyretic, jaundice, diarrhoea, metrorrhagia, piles, back pain, earache, fracture, eye ache [33, 39-42]	89	0.645
Brassicaceae	Brassica	BGM-15	*Brassica rapa* L. var. *trilocularis* UG 017	Sarsun	H	S	E	Concoction	Boils-Wrats	Seeds are ground with powder of sulphur and paste is used for warts and boils on skin	Antiscorbutic, gastric, weakness, gleets, leucorrhoea [41, 42]	124	0.898
Cannabaceae	Cannabis	BGM-16	*Cannabis sativa* L. /UG 053	Bhang	H	L	E	Crushed	Burn	Fresh leaves are crushed with fresh scales of *Allium cepa* and applied for treatment of skin burn	Narcotics, anti-spasmodic, boils, antiepileptic, anti-diarrheal, sedative, tonic, astringent [39, 43, 44]	115	0.833
Chenopodiaceae	Beta	BGM-17	*Beta vulgaris* L.	Beet root	H	F	O	Raw	Acne	Fruits are eaten to treat acne	Antioxidant and antimicrobial activity [45]	79	0.572

Crassulaceae	Bryophyllum	BGM-18	*Bryophyllum pinnatum* (Lam.) Oken./UG 007	Zakhm-e-hayat (batpeya)	H	R	E	Powder	Wound Healing	Dried rhizome is crushed, and powder is sprinkled on wounds for healing.	antifungal, analgesic, antihypertensive, anti-diabetic and anti-mutagenic activities [46]	89	0.645
	Momordica	BGM-19	*Momordica charantia* L.	Karela	C	F	E	Extract	Pimples	Topical application of the fruit extract	It was used as natural nutritional treatment for diabetes mellitus [47]	96	0.696
Cucurbitaceae	Cucurbita	BGM-20	*Cucurbita maxima* Duch./UG 046	Kaddu safaid	C	F	O	Raw	Eczema	Fruit is eaten for psoriasis, eczema and abdominal pain treatment.	Antidiabetic [48]	100	0.725
	Cucumis	BGM-21	*Cucumis sativus* L./UG 050	Khera	C	F	B	Raw	Freshness	fruit is used for face freshness	Jaundice, gastric [40, 49]	84	0.609
Euphorbiaceae	Euphorbia	BGM-22	*Euphorbia wallichii* Hook.f	Wallich spurge	S	W	E	Extract	Infections	Extract of *E. walachii* is used to treat warts and skin infections	Forms of Echinacea include tablets, juice and tea	71	0.542
Fabaceae	Bauhinia	BGM-23	*Bauhinia variegata* L.	Kachnar	T	B	O	Raw	Infections	The bark is internally administered for treating skin diseases, asthma, sore throat,	The root is carminative and used in dyspepsia and flatulence and as an antidote to snake poison It was used to treat cancer, diabetes, inflammation and infections [50]	89	0.645
	Tamarindus	BGM-24	*Tamarindus indica* L./UG 029	Imli	T	L	E	Decoction	Acne-Chicekn pox-Scars	Aerial part is boil in water and used to cure acne or chickenpox scars on skin	Used for hair growth (by local people)	116	0.840
Gentianaceae	Swertia	BGM-25	*Swertia chirata* Buch.-Ham. ex Wall. / *UG* 004	Chraita	H	L	E	Synthetic	Acne-Pimples	Areal parts are used to make cosmetics and medicines for treatment of acne and pimples	Used against Typhoid and as anti-microbial (based on locally available information)	86	0.623
Juglandaceae	Juglans	BGM-26	*Juglans regia* L./*UG 056*	Akhor	T	B	O	Raw	Teeth Washing	Bark and fresh leaves (Dandasa) are used instantly for teeth washing, coloring gums	Healing, helminthic, aseptic, antispasmodic agent, anti-syphilitic, astringent, sore throat, toothache, [39, 51]	120	0.869

	Lavandula	BGM-27	*Lavandula officinalis* Chaix	Lavender	H	O E	Oil	Allergic Reaction	lavender oil, inhibits immediate-type allergic reactions	(based on locally available information)	114	0.826
	Ajuga	BGM-28	*Ajuga bracteosa* Wall. ex Benth/*UG 012*	Alif buti	H	W O	Crushed	Oral Infection	Crushed and extract is taken to cure mouth infection	Headache, measles, pimples, internal colic, stomach acidity, jaundice, hypertension, constipation and sore throat [39, 43]	51	0.369
Lamiaceae	Mentha	BGM-29	*Mentha piperita* L./UG 015	Kala podeena	H	L O	Raw	Acne	Leaves are taken orally for acne	Used against cough and for digestion (based on locally available information)	115	0.833
	Otostegia	BGM-30	*Otostegia limbata* Benth /UG 003	Koi booi	S	L O	Raw	Oral Infection	Leaves are taken orally for mouth infection	Gums, wounds wounds [30, 37]	86	0.623
	Mentha	BGM-31	*Mentha royleana* Wall. ex Benth.. /UG 018	Safaid podeena	H	L O	Infusion	Inflammation	Leaves are orally taken for inflammation	Used against vomiting and abdominal pain (based on locally available information)	126	0.913
Lythraceae	Lawsonia	BGM-32	*Lawsonia inermis* L.	Henna	S	L E	Paste	Impetigo	leaf paste is applied twice a day, on the affected parts to cure impetigo. In a study, clinical improvement in the patients suffering from hand and foot disease due to use of capecitabine, an anti-cancer drug, with use of henna revealed anti-inflammatory, antipyretic and analgesic effects of henna	Anti-microbial and anti-inflammatory [52]	106	0.768
Meliaceae	Melia	BGM-33	*Melia azedarachL./UG 060*	Darek	T	F E	Infusion	Insect Bites	Fruit is boiled in water and this water is use for hair growth and this water is also use to cure itching on body caused by insects	Headache, painful joints, roundworms, carminative, glandular swelling, emmenagogues, agitation, blood purifier, itching, piles, diabetes [39, 49]	91	0.659

Moraceae	Ficus	BGM-34	*Ficus carica* L./UG 037	Injeer	T	F	O	Dried	Asthema	Fruit is dried and eaten for treatment of asthma (hansen's disease)	Some of phytoconstituents of *Ficus carica* are used in the production of sunscreen and coloring agents [53]	101	0.731
	Ficus	BGM-35	*Ficus virgata* Roxb./UG 057	Phgwar	S	L t	E	Concoction	Burns-Pimples	Latex is mixed with milk and used for treatment of pimples and skin burns	Constipation, softening, laxative, bladder and lung diseases, piles, helminthic [37, 39]	77	0.558
Myrtaceae	Eucalyptus	BGM-36	*Eucalyptus globulus* Labill.	Blue gum, Camphor oil	T	O	E	Concoction	Demodicidosis	facial demodicidosis when treated with freshly prepared camphor oil with or without glycerol dilutions gave complete cure	It is antiseptic and used for treatment of respiratory tract diseases [53]	78	0.565
Nyctaginaceae	Mirabilis	BGM-37	*Mirabilis jalapa* L.	Four o'clock flower, Marvel of Peru	H	W	E	Raw	Allergic Reaction	*M. jalapa* is used traditionally in allergic skin disorders and asthma.	It is extensively using for muscular pain, diarrhea, and abdominal colic by people from other different countries [54]	81	0.587
Oleaceae	Olea	BGM-38	*Olea ferruginea* Royle/UG 033	Kahu	T	L	O	Infusion	Oral Infection-Acne	Fresh leaves are boiled in water and taken orally for mouth infection, bleeding gums and Acne.	Antiperiodic, antiseptic, astringent, acrimonious, diuretic, gonorrhea, tonic, rubefacient, dentalgia, rheumatism, mouth ulcer and sore throat [39, 55, 56]	79	0.572
Papilionaceae	Dalbergia	BGM-39	*Dalbergia sissoo* Roxb./UG 058	Tali	T	L	E	Concoction	Dandruff	Fresh leaves are crushed, mixed with egg and applied on hairs to remove dandruff	Antiemetic drug, styptic, bitter, gonorrhea, leprosy, simulative [32, 33, 55]	121	0.877
Pinaceae	Pinus	BGM-40	*Pinus roxburghii* Sargent. */UG 061*	Chir	T	L	O	Infusion	Boils-Wrats-Measeles	Infusion of fresh leaves is orally taken to cure measles, boils and warts	Aseptic, fragrant, carminative, deodorant, diaphoretic, refrigerating[37, 55]	99	0.717
Plantaginaceae	Plantago	BGM-41	*Plantago lancelata* L. /UG 030	Bhatti	H	L	E	Dried	Burns	Areal part is dried, crushed and mixed with oil and applied on burned skin	Anti-inflammatory[57]	101	0.732

Poaceae	Cynodon	BGM-42	*Cynodon dactylon* (L.)Pers./UG 054	Khabal	H	L	E	Crushed	Wound Healing	Leaves and stem are crushed and used directly for healing of wounds.	Styptic, diuretic, softening, dysentery, astringent, laxative, leprosy, pain, wounds, cuts, acute rhinitis, eye pain [32, 55, 58]	94	0.681
Polygonaceae	Rumex	BGM-43	*Rumex acetosella* L./UG 013	Khatimal	H	L	E	Extract	Blood Stopper	Leaves extract is applied on skin to stop skin bleeding	Anti-ulcerogenic and anti-inflammatory activities [59]	103	0.746
Rhamnaceae	Ziziphus	BGM-44	*Ziziphus jujuba* Mill. */UG 010*	Anab	T	F	E	Concoction	Acne	Fruit is used with some other plants to make cosmetics and medicines to treat acne	The juice of leaf is used in dysentery [60]	101	0.732
Rosaceae	Prunus	BGM-45	*Prunus persica* (L.) Batsch/UG 026	Arru	T	L	E	Raw	Oral Infection	Leaves are used for acne therapy and toothache.	Antimicrobial activity [61]	89	0.645
Rosaceae	Pyrus	BGM-46	*Pyrus pashia* Ham. ex.D. Don./UG 047	Batngi	T	L	E	Crushed	Staining	Crushed leaves are used for staining of palms, feet, nails and extract is used for hairs dying.	Astringent, antipyretic, laxative, sedative drug [37]	96	0.696
Rununculaceae	Clematis	BGM-47	*Clematis grata* Wall./UG 027	Dhandbuti	C	L	E	Extract	Psoriasis-Wounds	Extract of areal parts is applied on wound, and leave extract is use against psoriasis (Chambal) disease.	Skin infections [37]	76	0.551
Rutaceae	Citrus	BGM-48	*Citrus limon* L./UG 040	Lemon	S	F	E	Oil	Allergic Reaction	Fruit is mixed in oil and used for allergy and itching on face.	Anti-scorbutic, antiseptic, stomachic, vomiting, appetizer [62]	119	0.862
	Skimmia	BGM-49	*Skimmia laureola* (DC.) Siebold & Zucc. ex Walp. /UG 001	Ner	S	L	E	Smoke	Small Pox	Leaves are used for toothache. Leaves are burned and smoke is collected as useful to cure small pox, qlatru	Antibacterial [63]	114	0.826
	Zanthoxylum	BGM-50	*Zanthoxylum armatum* DC./UG 035	Timber	S	St	E	Raw	Oral Infection	Branches are used to clean teeth and to. Stop bleeding of gums,.	Toothache, carminative, preservative, gastric, tonic fragrant [37, 55, 58]	124	0.898
Sapindaceae	Dodonaea	BGM-51	*Dodonaea viscosa* (L.) /UG 051	Snatha	S	L	E	Paste	Swelling	Paste of fresh leave is used for treatment of swelling	Hemostatic, odontalgia, burns, antipyretic, gouty arthritis, rheumatism, swelling, wounds [36, 55, 58]	116	0.840

Selaginaceae	Selaginella	BGM-52	*Selaginella bryopteris* L.	Rarra buti	H	L	O	Crushed	Burns	Aerial parts are crushed and taken with water for burning sensation	Used to treat wounds (based on locally available information)	71	0.514
	Lycopersicon	BGM-53	*Lycopersicon esculentum* Mill.	Tomato	S	F	B	Paste	Erythema	tomato paste, protection against UV light-induced erythema.tomato paste containing lycopene provides protection against acute and potentially longer-term aspects of photo damage.	It has anti-proliferative activity [64]	110	0.797
Solanaceae	Solanum	BGM-54	*Solanum nigrum* L./UG 025	Kachmach	S	L	O	Cooked	Swelling	Aerial parts are cooked and eaten against swelling on skin	Carminative, cleaning and wounds washing, skin diseases, tonic, therapeutic, diuretic, dropsy, emollient, gonorrhea, liver enlargement, swellings [41, 43, 56]	119	0.862
	Datura	BGM-55	*Datura stramonium* L./UG 059	Tatura	H	L	E	Crushed	Boils-Warts	Fresh leaves are crushed and used directly for warts and boils remedy.	Antiseptic, intoxicant, narcotic, sedative, sore, asthma, cough, boils, antidandruff, earache [30, 36, 39]	88	0.637
Zingiberaceae	Curcuma	BGM-56	*Curcuma longa* L.	Turmeric	H	R	E	Raw	Blood Stopper	rhizomes of *C. longa* are used to stop bleeding from wounds	gastrointestinal disorders and neurological diseases [65]	111	0.804

Growth form: H; Herb**, S**; Shrub**, T;** Tree, **C;** Climber
Part utilized: L; Leaves, **F;** Fruit**, Fl;** Flower**, S;** Seed**, St;** Stem, Lt; Latex, **W;** Whole Plant, **O;** Oil, **B;** Bark
Mode of Administration: E; External**, O;** Oral**, B;** Both
FC; Frequency Citation, **RFC;** Relative Frequency Citation

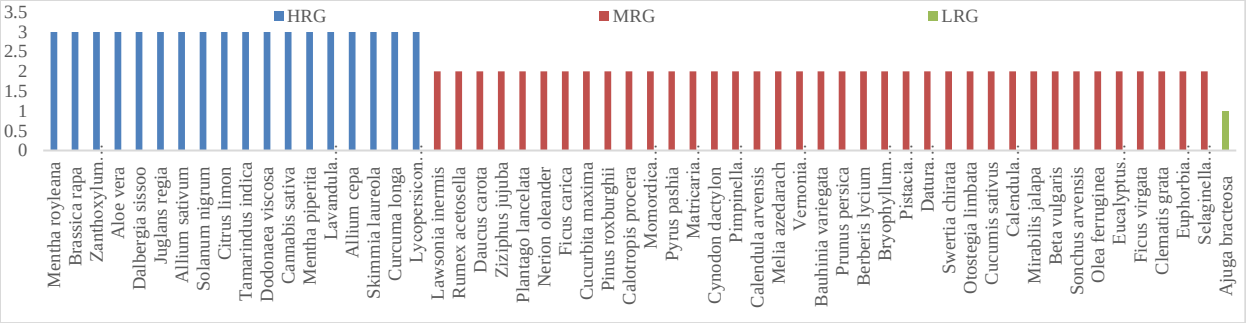

Fig. 6: Cluster analysis showing High, medium and low priority groups of medicinal plants

List of symbols or abbreviations

H; Herb, S; Shrub, T; Tree, C; Climber
Part utilized: L; Leaves, F; Fruit, Fl; Flower, S; Seed, St; Stem, Lt; Latex, W; Whole Plant, O; Oil, B; Bark
Mode of Administration: E; External, O; Oral, B; Both
FC; Frequency Citation, RFC; Relative Frequency Citation, PC; Paired Comparison

Conflict of interest

The authors declare no conflict of interest.

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