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Ethnobotanical study on useful indigenous plants in Mahasheer National Park, AJK

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ABSTRACT

Objective: To derive the indigenous ethnobotanical data of herbal medicines and plant resources from Mahasheer National Park, AJK during 2015.
Methods: The data was collected through direct field observations, from native people by oral interviews, by semi-structured questionnaires and guided field walks. Ethnobotanically significant plant specimens were collected from the field, identified with the help of floristic literature. Then the specimens were dried and pressed, mounted on herbarium sheets. The voucher specimen numbers were award and deposited in a recognized herbarium.
Results: A total of 93 plant taxa belonging to 42 families were documented, which were being used by local inhabitants to fulfill their daily needs. Among them, 50 plant species were used to treat various human ailments *e.g.* rheumatic disorders, respiratory illnesses, gastrointestinal ailments, skin and oral infections, hepatic diseases *etc*. Some novel ethnomedicinal uses of *Acacia modesta* (urinogenital disorders), *Adhatoda zeylanica* (diabites and asthma), *Bombax ceiba* (nervous illness), *Punica granatum* (anthelminthic) and *Arisaema flavum* (antitoxic) were also reported from the area. Leaves were the mainly used plant part (17 spp.) to prepare herbal formulations, followed by fruit (10 spp.), whole plant (9 spp.), and root (5 spp.) *etc*.
Conclusions: Plants with high medicinal values are preferred for biological screening to get valuable pharmacological products, so these novel uses can be a breakthrough to explore active ingredients in these plants in order to prepare herbal formulations at industrial level.

1. Introduction

Ethnobotany is the scientific study of the relationships between peoples and plants. The usage of plants by human is dated back to the start of natural life on earth. In the beginning, use of plant was limited to diet, treatment and lodging, but with the passage of time human explored the prospective use of plants for a number of other purposes[1,2]. Hence, their reliance on plants increased both directly and indirectly. Wild plants have always been the substance of high concern regarding human welfare[3,4].

Modern ethnobotany is an interdisciplinary field involving knowledge of geology, anthropology, botany, archaeology, geography, medicine linguistics, economics, landscape architecture, taxonomy, biochemistry and taxonomy, *etc*.[5]. New development in the field of ethnobotany includes the use of quantitative approaches such as multivariate statistical analysis, use value indexation *etc*. [6]. In recent years, one can notice a worldwide drift in herbal medicines and ethnobotanical studies have become valuable in the development of these medicines. Currently, folk medicine is recognized throughout the world and about 80% of the world's inhabitants depend on traditional medicine for the treatment of different ailments[7]. Effort to cure the illnesses by means of traditional phytotherapy has been made in all parts of the world[8,9]. Presently, ethnobotanical and ethnopharmacological skills of certain nations are used in the treatment of wide variety of diseases including cancer, AIDS, Alzheimer's disease, alcoholism, *etc*.[10-12].

A lot of researches have been published from Pakistan[13-17] as well as from various territories of the Azad Jammu and Kashmir State[18-22]. However, no up-to-date and comprehensive ethnobotanical study on Mahasheer National Park, AJK has been carried out so far. The present study reported the ethnobotanically important resources from Mahasheer National Park, AJK and recorded the indigenous customary information on the consumption of the most commonly used plants. The present research would provide baseline information for the future researchers *i.e*. phytochemists, taxonomists, environmentalists, ecologists *etc*.

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2. Materials and methods

2.1. Study area, climate and vegetation

The study area was located in Poonch, Kotli and Mirpur Districts of AJK State. Due to its ecological significance, it has been declared as Mahasheer National Park by AJK Fisheries and Wildlife Department for Conserving Wildlife in 2010.

The Poonch River originates from the western foothills of Pir Panjal range in Indian occupied Kashmir. It is also called 'Siran' in this area and flows to the northwest and enters in Azad Kashmir (62 km). It empties into Mangla Lake near Chomukh. The towns of Poonch, Sehra, Tatta Pani, Kotli, Gulpur, Nar, Rajdhani and Holar are situated on the banks of this river in AJK.

The climate of the Park is subtropical type in which *Dalbergia sissoo* (*D. sissoo*) is the most dominant tree species. Due to cool and humid environment for most of the year, the vegetation in the area comprises a broad diversity of trees, herbs, shrubs and climbers. Ground cover comprises a wide variety of angiosperms along with ferns and mosses.

2.2. Field work and data collection

The ethnobotanical data were collected from indigenous people by interviews, direct observations, semi-structured questionnaires and guided field walks[23].

2.3. Plant identification

Plant specimens were collected, pressed, dried and mounted on herbarium sheets and identified with the help of floristic literature[24,25]. The correctly identified specimens were deposited as voucher specimens in the herbarium of the Department of Botany, Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi, Pakistan.

3. Results

3.1. Description of the plant species used by local inhabitants

Poaceae family was found to be dominant comprising of 15 species, which were used by local inhabitants of the study area for their daily requirements followed by Moraceae and Lamiaceae (6 spp. each), Solanaceae (5 spp.), Asteraceae and Rosaceae (4 spp. each), Amaranthaceae, Cyperaceae, Euphorbiaceae and Mimosaceae (3 spp. each). Plant species from remaining 32 families were rarely used by the native people. The most dominant life form of the reported species included herbs (37%) followed by trees (24%), shrubs (21%) and grasses (18%).

Ethnobotanical use categories indicated that major proportion of the species were used as fodder (47 spp.) followed by miscellaneous uses (44 spp.), fuel (31 spp.), edible (22 spp.), ornamental (14 spp.), and for construction (12 spp.), while only one fiber yielding taxa was recorded from Mahasheer National Park, AJK. The maximum use value index (UVI) recorded for *Morus alba* (*M. alba*) and *Morus nigra* (*M. nigra*) was 6, while 28 species had UVI of 1. Local inhabitants stored various products *e.g.* dry powder, bark, preserve wood, essential oil *etc.* obtained from these plants and utilize them when fresh material in wild is unavailable (Table 1).

3.2. Medicinal uses

Medicinal plants are the valuable and cheap resource of unique phytochemicals which are frequently used in the development of modern drugs against various diseases. Due to unavailability of the modern drugs, in various underdeveloped and developing countries the natural medicinal plants containing phytochemicals are directly used by indigenous people to cure various diseases. Some novel and peculiar ethnomedicinal uses of forty five plants were recorded from Mahasheer National Park, AJK. Their active phytoconstituents, ethnopharmacological significance and biological activities are presented in Table 2. Herbal preparations made from these plants were mostly administered against gastrointestinal ailments (22.22%), skin and oral infections (18.51%), cardiovascular disorders (16.66%), respiratory illnesses (14.81%), hepatic diseases (9.25%), rheumatic disorders (7.4%), urinogenetal disorders (5.55%), eye infections (3.7%) and snake venom (1.85%). Leaves were found to be the major plant part used medicinally in treating these illnesses followed by whole plant, fruit, root *etc.* (Table 2).

3.3. Some novel medicinal folk recipes used as traditional phytotherapies

3.3.1. Acacia modesta

Fresh collected flowers and gum of this plant were kept under sunlight until both of the items get dehydrated completely. Subsequently, the flowers were pulverized and mixed in desiccated gum and then used to regulate menstrual period of women. The pickle made from fruiting body of this plant was administrated to cure thick, whitish or yellowish vaginal discharge, the leucorrhoea.

3.3.2. Adhatoda zeylanica

About 2 kg of fresh leaves were minced on a stone of 15–20 cm in length and 5–10 cm in width with a small round stone (locally called "Sil and Salata"). The entire stuff was then soaked in 3–5 L of water. After a full day the liquor was separated via silk cloth and sealed in a plastic container. About half liter of this liquor was then administrated orally to patients with diabetes and asthma early in the morning before breakfast on daily basis.

3.3.3. Bombax ceiba

Ripen capsule of this tree is surrounded by white fiber-like cotton which was gathered by local women and complied into a soft pillow. Daily usage of this pillow in night was found to be essential to a person with nervous disorders. The powder made by crushing dried roots was used to enhance sexual power of men.

3.3.4. Punica granatum

Indigenous people of the area peeled off the fruit bark and dried

Table 1

Ethnobotanical use categories and use value index of the flora of Mahasheer National Park, AJK.

Botanical name/voucher specimen number	Family	Habit	Common name	Flowering period	Use categories								
					Strg	Ed	Fd	Or	Co	Fi	Fu	Mi	UVI
Acacia modesta Wall./15482	Mimosaceae	Tree	Palai	Mar-May	-	-	+	-	-	-	+	+	3
Acacia nilotica (Linn.) Delile/15483	Mimosaceae	Tree	Kikar	Feb-Mar	+	-	-	+	+	-	+	+	4
Achyranthes aspera Linn./15495	Amaranthaceae	Herb	Puth Kanda	Sep-Apr	-	-	-	-	-	-	-	+	1
Adiantum venustum D. Don/15499	Pteridaceae	Fern	Kakwa	May-Aug	-	-	-	+	-	-	-	+	2
Ailanthus altissima Mill./15287	Simaroubaceae	Tree	Drave	July-Aug	-	-	+	-	-	-	+	+	3
Ailanthus excelsa Roxb./15478	Simaroubaceae	Tree	Punjabi Toon	Mar-Oct	-	-	-	-	+	-	+	+	3
Ajuga bracteosa Wall./15510	Lamiaceae	Herb	Kori Boti	Mar-Sep	+	-	-	-	-	-	-	+	1
Albizia chinensis Osbeck./15460	Mimosaceae	Tree	Shree	Sep-Oct	+	-	+	+	-	-	-	-	2
Agave sisalana (L.) Burm./15469	Liliaceae	Herb	Kanwar Gandal	June-Sep	+	-	-	+	-	-	-	+	2
Alternanthera sessilis Linn./15477	Amaranthaceae	Herb	Grundi	Apr-Aug	+	+	+	-	-	-	-	+	3
Amaranthus viridis Linn./15501	Amaranthaceae	Herb	Ghanari/Cholai	Mar-May	+	+	-	-	-	-	-	-	1
Anisomeles indica (L.) O. Kuntze./15502	Lamiaceae	Herb	Sankhia	Oct-Jan	-	-	+	-	-	-	-	-	1
Artemisia maritima (Huds.) L./15506	Asteraceae	Herb	Chaoo	June-Aug	-	-	-	-	-	-	-	+	1
Asparagus filicinus Ham ex D. Don./15503	Asparagaceae	Herb	Shatavari	May-July	-	-	-	+	-	-	-	-	1
Barleria cristata L./15505	Acanthaceae	Herb	Bans Siya	Apr-May	-	-	+	-	-	-	-	-	1
Berberis lycium Royle./15507	Berberidaceae	Shrub	Simblu	Apr-June	+	+	+	-	-	-	+	-	3
Bombax ceiba Linn./15508	Malvaceae	Tree	Sumbal	Dec-Mar	+	-	-	-	-	-	-	+	1
Brachiaria ramosa Linn./15509	Poaceae	Grass	Sair	May-July	-	-	+	-	-	-	-	-	1
Brachiaria reptans Linn./15461	Poaceae	Grass	Sair	May-Aug	+	-	+	-	-	-	-	-	1
Broussonetia papyrifera Vent./15462	Moraceae	Tree	Jangli Toot	Jul-Aug	-	-	+	-	-	-	+	-	2
Calamintha umbrosa M. Bieb/15771	Lamiaceae	Herb	-	July-Sep	-	-	-	-	-	-	-	-	-
Cannabis sativa Linn./15464	Cannabaceae	Herb	Bhang	June-Sep	+	+	-	-	-	-	-	+	2
Carex filicina Nees/15465	Cyperaceae	Grass	Chaa	Apr-Nov	+	-	-	-	+	-	-	+	2
Carissa carandas Linn./15466	Apocynaceae	Shrub	Granda	Oct-Mar	+	-	+	-	-	-	+	-	2
Carissa opaca Stapf ex Haines/15467	Apocynacea	Shrub	Granda	Apr-June	-	-	+	-	-	-	+	-	2
Cedrela toona Roxb. ex Willd./15468	Meliaceae	Tree	Toon	Mar-Apr	+	-	-	-	+	-	+	+	3
Celtis australis L./15470	Ulmaceae	Tree	Khirk	Feb-Apr	-	-	+	-	-	-	+	-	1
Cerastium cerastoides (L.) Britton/15479	Carryophylaceae	Herb	Guldar / Tendwa	May-July	-	-	-	-	-	-	-	+	1
Chenopodium album L./15476	Chenopodiaceae	Herb	Bathoon	Mar-Apr	+	-	+	-	-	-	-	-	1
Chrysopogon aucheri (Boiss.) Stapf./15475	Poaceae	Grass	Bari Ghaa	July-Nov	-	-	+	-	-	-	-	+	2
Cotoneaster microphylla Wall./15473	Rosaceae	Shrub	Luni	May-July	-	-	-	-	+	-	+	-	2
Cymbopogon jwarancusa (Jones.)/15470	Poaceae	Grass	Khawi	June-July	-	-	+	-	-	-	-	+	2
Cymbopogon schoenanthus Su. & St./15480	Poaceae	Grass	Klansar Ghaa	Aug-Sep	-	+	-	-	-	-	-	+	2
Cynodon dactylon L./15481	Poaceae	Grass	Khabal	Jan-Nov	-	-	+	-	-	-	-	+	2
Cyperus compressus Linn./15484	Cyperaceae	Grass	Motkupra Ghaa	May-Oct	-	-	+	-	-	-	-	+	2
Cyperus rotundus Linn./15485	Cyperaceae	Grass	Muthri / Deela	Mar-May	-	-	+	-	-	-	-	-	1
D. sissoo Roxb./15486	Paplionaceae	Tree	Tahli	Mar-Apr	+	-	-	-	+	-	+	+	3
Datura alba Rumphius ex Nees./15779	Solanaceae	Herb	Dhatura	Jully-Sep	+	-	-	-	-	-	-	-	-
Datura innoxia Miller/15489	Solanaceae	Herb	Black Dhatura	June-Oct	-	-	-	-	-	-	-	+	1
Debregeasia salicifolia D.Don./15490	Urticaceae	Shrub	Sandhari	Mar-June	-	-	-	-	-	+	+	-	2
Dichantium annulatum (Forsk.) Stapf/15491	Poaceae	Grass	Murgha Ghass	Whole year	+	-	+	-	-	-	-	-	1
Digitaria ciliaris (Retz.) Koe./15492	Poaceae	Grass	Chaa	July-Sep	-	-	+	-	-	-	-	+	2
Dodonaea viscosa (Linn.) Jacq./15493	Sapindaceae	Shrub	Sanatha	Jan-Mar	-	-	-	-	-	-	+	+	2
Dryopteris ramosa (Hope) C. Chr./15494	Dryopteridaceae	Fern	Ateer	Dec-Mar	+	+	-	-	-	-	-	-	1
Echinochloa crus-galli Linn./15498	Poaceae	Grass	Chiro Ghaa	Aug-Oct	+	-	+	-	-	-	-	+	2
Elaeagnus parviflora Wall./15450	Elaeagnaceae	Shrub	Kankoli	Mar-Apr	-	+	-	-	-	-	+	-	2
Eucalyptus lanceolatus Honey/15452	Myrtaceae	Tree	Sufaida	Jan-Apr	-	-	-	+	-	-	+	+	3
Euphorbia hirta L./15557	Euphorbiaceae	Herb	Lambi Doodhi	April-Aug	-	-	-	-	-	-	-	-	-
Ficus benghalensis L./15454	Moraceae	Tree	Bohar	Whole year	-	-	-	+	-	-	-	-	1
Ficus glomerata Roxb./15455	Moraceae	Tree	Tusa	Apr-Aug	-	+	+	-	-	-	+	-	3
Ficus palmata Forssk./15456	Moraceae	Tree	Phagwar	Mar-May	+	+	+	-	-	-	+	+	4
Grewia optiva Drummond ex Burret./15457	Tiliaceae	Tree	Taman	Apr-Sep	-	-	+	-	-	-	+	-	2
Imperata cylindrica (Linn.) Raeu./15458	Poaceae	Grass	Kulfi Ghaas	Aug-Sep	-	-	+	-	-	-	-	+	2
Ipomoea pentaphylla (Linn.) Jacq./15511	Convolvulaceae	Herb	Irr / Kan Kati	Apr-Aug	-	-	-	+	-	-	-	-	1
Mallotus phillippensis (Lam.) Muell./15513	Euphorbiaceae	Shrub	Kamilaa	Mar-May	-	-	-	-	-	-	+	-	1
Medicago minima Linn./15515	Papilionaceae	Herb	Chotisari	July-Sep	+	+	+	-	-	-	-	-	2
Melia azedarach Linn./15516	Meliaceae	Tree	Draik	Mar-Apr	+	-	+	+	-	-	+	-	3
Mentha longifolia L./15517	Lamiaceae	Herb	Chita Podna	Mar-May	+	-	-	-	-	-	-	+	1
Mentha spicata L./15518	Lamiaceae	Herb	Podna	Aug-Sep	+	-	-	-	-	-	-	+	1
Micromeria biflora Ham ex D. Don/15662	Lamiaceae	Herb	Baburi	Whole year	-	-	-	-	-	-	-	-	-
M. alba L./15520	Moraceae	Tree	Sufaid Toot	Apr-July	+	+	+	+	+	-	+	+	6
M. nigra L./15440	Moraceae	Tree	Kala Toot	Apr-July	+	+	+	+	+	-	+	+	6
Nerium indicum Mill./15447	Onagraceae	Shrub	Shodevi	Mar-Aug	+	-	-	-	-	-	-	+	1
Oenothera rosea (L.) Her. ex Ait./15521	Oleaceae	Herb	Kao	Apr-June	+	-	+	-	+	-	+	-	3
Olea ferruginea Royle./15522	Cactaceae	Tree	Thor	May-Aug	-	+	-	-	-	-	-	-	1
Opuntia dilleni Haw./15523	Asteraceae	Shrub	Gandi Boti	May-Oct	-	-	-	-	-	-	-	+	1
Parthenium hysterophorus L./15441	Poaceae	Herb	Babyoon	June-Aug	+	-	+	-	-	-	-	-	1

continued on next page

Table 1 (*continued*)

Botanical Name/Voucher Specimen Number	Family	Habit	Common name	Flrw. Prd	Use categories								
					Strg	Ed	Fd	Or	Co	Fi	Fu	Mi	UVI
Phragmites karka (Retz.) Trn ex Std./15442	Solanaceae	Grass	-	Apr-Oct	-	-	+	-	-	-	-	+	2
Physalis minima Roxb./15443	Pinaceae	Herb	Chir	Mar-Apr	+	+	-	+	+	-	+	+	5
Pinus roxburghii Sargent/15445	Poaceae	Tree	Boji Ghaa	Whl. Yr	-	-	+	-	-	-	-	-	1
Poa annua Linn./15446	Polygonaceae	Grass	Polpulak	June-Oct	-	-	+	-	-	-	-	-	1
Polygonum aviculare Linn./15449	Salicaceae	Herb	Sufaida	Mar-May	+	-	-	+	+	-	+	-	3
Populus deltoidea Bartram ex Marsh./15524	Punicaceae	Tree	Daru	Apr-Aug	+	+	-	-	-	-	+	-	2
Ricinus communis L./15551	Euphorbiaceae	Shrub	Harnoli	Jully-Sep	+	-	-	-	-	-	-	-	-
Rosa brunonii Lindl./15527	Rosaceae	Shrub	Tarnari	Apr-June	+	-	+	+	-	-	-	-	2
Rubus fruticosus L./15528	Rosaceae	Shrub	Akhra	Mar-May	-	+	+	-	-	-	-	+	3
Rubus hoffmeisterianus Kth. & Bch./15529	Rosaceae	Shrub	Akhra	Apr-Aug	-	+	+	-	-	-	-	-	2
Rumex dentatus Linn./15530	Polygonaceae	Herb	Hulla	Mar-May	+	+	+	-	-	-	-	-	2
Saccharum giganteum (Walter) Pers./15539	Poaceae	Grass	Phul Chaa	Apr-Aug	-	-	+	-	-	-	-	+	2
Saccharum spontaneum L./15538	Poaceae	Grass	Kai	Aug-Oct	+	-	+	-	+	-	-	+	3
Salix alba Linn./15531	Salicaceae	Tree	Beesa	Apr-May	-	-	+	-	-	-	+	-	2
Setaria glauca (L.) Beauv./15533	Poaceae	Grass	Ghaa	June-Nov	-	-	+	-	-	-	-	+	2
Silene conoidea L./15534	Carryophylaceae	Herb	Dabbri	May-July	-	+	+-	-	-	-	-	-	2
Solanum nigrum L./15535	Solanaceae	Herb	Kach Mach	Feb-Mar	-	+	-	-	-	-	-	+	2
Solanum surattense Burm./15536	Solanaceae	Herb	Mokri	Apr-Oct	+	-	-	-	-	-	-	+	1
Sonchus asper L./15540	Asteraceae	Herb	Dodak/Hund	May-Sep	+	-	-	-	-	-	+	+	2
Typha latifolia L./15541	Typhaceae	Herb	Bach/Barya	Apr-Aug	+	-	+	-	+	-	+	-	3
Ulmus villosa Brandis ex Gamble/15545	Ulmaceae	Tree	Manoo	Feb-Apr	+	-	-	-	-	-	-	+	1
Verbascum thapsus Linn./15542	Scrophulariaceae	Herb	Gidar Tambaku	June-Aug	-	-	-	-	-	-	+	-	1
Vitex negundo Linn./15580	Verbanaceae	Shrub	Bana	Whl Yr.	+	-	-	-	-	-	-	-	-
Xanthium strumarium L./15585	Asteraceae	Herb	Chiro	May-Aug	-	-	-	-	-	-	-	-	-
Ziziphus mauritiana Lam./15546	Rhamnaceae	Shrub	Jhand Bairi	June-July	+	+	+	-	-	-	+	-	3
Ziziphus oxyphylla Edgew./15547	Rhamnaceae	Shrub	Tuk Bairi	May-July	-	+	+	-	-	-	-	-	2

Strg: Storage; Ed: Edible; Fd: Fodder; Or: Ornamental; Co: Construction; Fi: Fiber; Fu: Fuel; Mi: Miscellaneous.

Table 2

Various plant parts used against common human aliments recorded from Mahasheer National Park, AJK.

Botanical name	Human ailments treated	Active phytoconstitutents	Ethnopharmacological significance and biological activity	Part used
Acacia nilotica	Collected gum and resin of this plant is valuable against joint pain, inflammation, swelling and stiffness while massage is proved to be essential in curing arthritis.	Tannins, stearic acid, kaempferol-3-glucoside, isoquercetin, leucocyanidin, gum *etc*.	Antihypertensive, antispasmodic, antibacterial, antifungal, antioxidant *etc*.	Gum and resin
Achyranthes aspera	Whole plant is collected, dehydrated and pulverized into powder which is then applied to treating mouth ulcers and skin eruption.	Sterols, alkaloids, saponins, sapogenins, cardiac glycosides, ecdysterone *etc*.	Antimicrobial, larvicidal, antifertility, immunostimulant, hypoglycemic, hypolipidemic, anti-inflammatory, antioxidant, diuretic, cardiac stimulant, anti-anasarca, analgesic, antipyretic, antinoiceptive, prothyrodic, hepatoprotective *etc*.	Whole plant
Adiantum venustum	Dried powder made from crushed rhizome is essential to cure external cuts and wounds.	Triterpenoids, flavonoids, phenyl propanoids, steroids, alicyclic acids, lipids and long-chain compounds *etc*.	Analgesic, antinociceptive, anti-implantation, antimicrobial *etc*.	Rhizome
Ajuga bracteosa	Decoction made from leaves is administrated against stomach ulcer.	Limonene, α-humulene, β-myrcene, elemol, camphene, β-caryophellene, α-phellendrene *etc*.	Antibacterial, antioxidant, antifungal *etc*.	Leaves
Albizia chinensis	Extract of fresh leaves is used to control high blood pressure.	Triterpenoids, saponins, diterpenoids, lignins, pyridine glycosides *etc*.	Insomnia, irritability, antiseptic, antitubercular *etc*.	Leaves
Amaranthus viridis	Paste made from whole plant is externally applied to snake bite while vegetable is urinative in nature.	Tanins, saponins, alkaloids, protiens glycosides, phenolics, flavanoids *etc*.	Antioxidant, antimicrobial and antivenom *etc*.	Whole plant
Barleria cristata	Daily dose of two spoons of dried powder before breakfast is used to cure respiratory disorders.	Amino acids, carbohydrates, flavaonoids, proteins, phenolic groups, saponins, steroids, tannins and terpenoids *etc*.	Antimicrobial, cardiac stimulant *etc*.	Whole pant
Berberis lycium	Decoction made from root bark is used to treat jaundice, diabetes, mouth infections and piles.	Cardioactive glycosides, saponins, tannins, anthocyanins, vitamins, carbohydrates, proteins, lipids, fiber contents, β-carotein, cellulose, phytic acid and phosphorous *etc*.	Antidiabetic, antihyperlipidemic, hepatoprotective, antibacterial, antifungal, anticoccidial, pesticidal, antimutagenic and wound healing properties.	Root
Calamintha umbrosa	Leaves and flower soaked in water is used to produce cooling effect.	1,10-di-epi-cubenol, allo-aromadendrene epoxide, cadalene *etc*.	Phytotoxic activity.	Leaves and flower
Cannabis sativa	Extract of leaves is used to treat piles. It is narcotic in nature and relief pain.	Cannabinoids, terpenes and phenolic compounds *etc*.	Psychotropic, neuropharmacological activities.	Leaves
Carissa carandas	Berries are carminative and diuretic. Leaves are boiled in water and decoction is used to treat jaundice.	Tannins, saponins, alkaloids, proteins, glycosides, phenolic flavanoid.	Anti-cancer, anti-convulsant, anti-oxidant, analgesic, anti-inflammatory, anti-ulcer, anthelmintic activity, anti-nociceptive, anti-diabetic, antipyretic, hepatoprotective, diuretic activities, antimicrobial activities and cytotoxic potentials	Fruit and leaves
Carissa opaca	Fruits are edible and considered to be blood purifier.	Alkaloids, flavonoids, tannins and saponins.	Antienzymetic, cardiovascular, and anticancer activity.	Fruit
Cedrela toona	Bark is medicinally used as astringent. There was myth in the area that if patient with jaundice take rest under the shade of this tree he or she will recover soon.	Alkaloids, glycosides, carbohydrates, phenolics and tannins, phytosterols, fixed oils and fats, proteins amino acids, flavonoids, saponins.	Antibacterial, anti-inflammatory, antioxidant *etc*.	Bark
Chenopodium album	Whole collected plant is dried in sunlight and pulverized into powder. Specific dose of this powder is administrated to patient with anemia and constipation.	Essential oils, alkaloids, trigonelline and chenopodine *etc*.	Hypoglycemic, spasmolytic, antipruritic, hepatoprotective, antioxidant, anticancer *etc*.	Whole plant
Cotoneaster microphylla	The stolon are used as an astringent.	Phenolic contents	Antioxidant, antibacterial, anti-cholinesterase, anti-tyrosinase, anti-amylase and anti-glucosidase activity.	Stolen
Cymbopogon jwarancusa	Decoction locally called "Kava" of this plant is used to treat cough, cold, flue and asthama.	Alkaloids, flavonoids, terpenoids, glycosides and saponins *etc*.	Antioxidant and antiasthamatic activities *etc*.	Whole plant

continued on next page

Table 2 (*continued*)

Botanical Name	Human ailments treated	Active phytoconstitutents	Ethnopharmacological significance and biological activity	Part used
Cynodon dactylon	Fresh plant stuff is crushed into paste, a small amount of turmeric is added in this paste and then applied to cure invisible pains of the body.	Alkaloids, cardiac glycosides, terpenoids, steroids, saponins, phenolic compounds, flavonoids, tannins.	Antimicrobial, anti-inflammatory	Whole plant
Cyperus rotundus	Rhizome poultice of *Cyperus rotundus* is used to lower down breast swelling. It is also essential in relieving pain due to bone fracture.	Alkaloids, flavonoids, starch, glycosides, saponins, furochromes, monoterpenes, sequiterpenes, sitosterol, linilenic and stearic acid.	Antiandrogenic, antibacterial, anticancerous, anticonvulsant, antidiabetic, antidiarrheal, antigenotoxic *etc*.	Rhizome
D. sissoo	Dried leaves are soaked in water and that water is essential to cure palms rashes. This liquor is also beneficial in strengthening eyesight.	The isoflavones irisolidone, biochanin-A, muningin, tectorigenin, prunetin, genestein, sissotrin *etc*.	Anti-inflammatory, antipyretic, analgesic, and estrogen-like activities.	Leaves
Datura alba	Specific dose of dried powder made from crushing whole plant material is administrated orally to patient with kidney infection. This is also anti-inflammatory in urinogeneital tract.	Alkaloids, terpenoids, steroids, flavonoids, saponins, phenolic compounds and tannins.	Antimicrobial, antiviral and anti fungal activities.	Whole plant
Dodonaea viscosa	Fresh leaves of this plant along with bark of *Berberis lycium* are soaked in water for two full days. The liquor is then used to cure diabaties. Leaves paste is quiet helpful in healing wounds and cracked skin while twigs are used as miswak.	Flavonoids, alkaloids, triterpenoids, saponins, tannins, reducing sugar, amino acid, steroids, proteins and cardiac glycosides.	Antioxidant, antidiabatic and antifertility *etc*.	Leaves and branches
Elaeagnus parviflora	The fruit is edible and considered to be good for cancer patients. The root poultice is curative to external wounds.	Purpurin, tannic acid, quercetin, catechin, reserpine and rutin, carbohydrates, ascorbic acid, tannins *etc*.	Antioxidant, antimicrobial, antipathogenic *etc*.	Fruit
Eucalyptus lanceolatus	Leaves are used as condiments while aroma is proveed to be beneficial in curing flue. Decoction made from fruits is proved to be essential in curing cold, cough and asthama.	Eucalyptol, alpha pinene, beta pinene, alpha eudesmol and paracymene *etc*.	Antipyretic, anticancer, antidiabatic.	Leaves
Euphorbia hirta	Milky latex of this plant is used to cure sexual disorders. This is also considered poisonous in nature and cause blindness.	Carbohydrates, proteins, amino acid, tannin, phenol, steroid, saponin and anthraquinone.	Hepatoprotective, nephroprotective, antiulcer and anticoagulant *etc*.	Latex
Mallotus philippensis	Fruit powder is beneficial to treat mumps and measles.	Flavonoids, glycosides, tannins, proteins and amino acids *etc*.	Antimicrobial	Fruit
Melia azedarach	Fruit is soaked in water and liquor is used against diabetes. Dried bark of stem is boiled in water and this decoction is considered to be effective against cardiovascular diseases.	Alkaloids, tannins, saponins, phenols, glycosides, steroids, terpenoids and flavonoids.	Antimicrobial, insecticidal, nematicidal, antiinflammatory, antipyretic, antimycotic, antiulcer, spermicidal, antifertility *etc*.	Fruit, bark and root
Mentha longifolia	Leaves are administered to treat diarrhea. It is carminative and antiseptic. Tea ("Kava") of this plant is used to treat cough, asthma and cold.	Terpenoids, saponins, flavonoids, steroids, alkaloids, quinones, coumerin *etc*.	Antibacterial, antimicrobial, cytotoxic, antioxidant and anticancer *etc*.	Whole plant
Micromeria biflora	Root decoction is used for dysentery, colds and coughs. Oil is essential against microbial infections.	Alkaloids, terpenoids, flavonoids *etc*.	Antimicrobial, antifungal.	Root
M. alba	Fruit is laxative and purgative. However excessive use of fruit causes dysentery.	Hydroxycinnamic acid esters, flavonol glycosides, anthocyanins, phenolic contents *etc*.	Antioxidant and antibacterial.	Fruit
M. nigra	Fruit is laxative and purgative in nature. Decoction made from bark of this tree is administrated against dysentery and diarrhea.	Ascorbic acid, anthocyanins, phenolic contents, gallic acid *etc*.	Antioxidant and antibacterial.	Fruit and bark
Nerium indicum	This plant is thought to be highly poisonous in the area. Dried leaf powder is beneficial for stomach disorders.	Alkaloids, terpenoids, cardiac glycosides, saponins, tannins *etc*.	Antibacterial, antifungal, antifertility, cytotoxic *etc*.	Leaves
Oenothera rosea	The whole plant is considered to be effective in healing asthmatic coughs, gastro-intestinal disorders and whooping cough.	Tannins, saponins, steroids *etc*.	Antimicrobial, antiasthametic, anti-inflammatory, antioxidant *etc*.	Whole plant
Olea ferruginea	Fresh leaves are chewed to treat mouth infection while young branches used as (toothbrush) miswak.	Secoiridoids, iridoids, biophenols, triterpenes, benzoic acid derivatives, isochromans, and many other classes of secondary metabolite.	Antidiabetic, anticonvulsant, antioxidant, immunomodulatory, analgesic, antimicrobial, antiviral, antihypertensive, antihyperglycemic, and wound healing activities.	Leaves and branches
Parthenium hysterophorus	This plant is allergic in nature. However leaves are diuretic in nature and decoction is best in treating constipation.	Alkaloid, steroid, sterols, glycosides, tannin, phenolic compound, saponin, flavonoids *etc*.	Gastroprotective, cytotoxic *etc*.	Leaves
Pinus roxburghii	Resin is applied to treat skin and lips eruption while female uses it for hair removal.	α-pinene, abietic acid, quercetin, xanthone, resin and flavanoids *etc*.	Antimicrobial, anticancer *etc*.	Resin
Ricinus communis	This plant is thought to be toxic in the area but seed oil also known as castor oil is best for joint pain especially for inflammation of a joint.	Tannins, alkaloids, cardiac glycosides, terpenoids, flavonoids and steroids	Antibacterial activity, antifungal activity and cytotoxicity *etc*.	Seed
Rosa brunonii	Fresh flower is used to make Araq (oil) which is essential for skin healing.	β-citronellol, nonadecane, geraniol, nerol, kaempferol, phenyl ethylalcohol, citrenellol, nonadecane, geraniol, ethanol, heneicosane *etc*.	Anti-HIV, antibacterial, antioxidant, antitussive, hypnotic, antidiabetic, and relaxant effect on tracheal chains *etc*.	Flower
Rubus fruticosus	Decoction of root is essential against cough and cold. Fruit is taken for sore throat.	Phenols, flavonoids, cyanidin and ellagic acid.	Cytotoxic potential, immunomodulatory, antioxidant potential *etc*.	Root and fruit
Rumex dentatus	Fresh leaves extract is used to treat dysentery and diarrhea.	Saponins, anthraquinones, tannins, flavonoids *etc*.	Antibacterial, antifungal, cytotoxic, antitumor and allopathic potential *etc*.	Leaves
Solanum nigrum	Leaves are cooked as vegetable which is digestive in nature while fruit (berries) is edible which is thought to be best for cardiovascular and hepatic disorders	Alkaloids, glycosides, coumarins, terpenoids, flavonoids and volatile oils *etc*.	Antidiarrheal, antigenotoxic, antilipidemic, antiobesity, anti-uropathogenic, hepatoprotective, cardioprotective *etc*.	Leaves and fruit
Solanum surattense	Fresh seeds of *S. surattense* are boiled in cow milk, then the whole stuff are administrated orally to treat stomach ulcer.	Fixed oils and fats, saponins, tannins, phenols, gum, mucilage *etc*.	Antioxidant, antibacterial, anti-inflamatory *etc*.	Seeds
Vitex negundo	Fresh twigs are used as tooth brush (miswak) while fresh leaves are chewed to treat mouth infections and ulcer.	Alkaloids, cardiac glycoside, flavonoids, glycoside, resins, saponins, tannins *etc*.	Antiseptic, antioxidant, anti-infectious and antidiabetic *etc*.	Leaves and branches
Xanthium strumarium	Yellow fever *i.e*. jaundice is treated by powder made from dried leaves of this herb.	Limonene, borneol, bornyl acetate, sabinene, phytol, β-selinene, camphene, α-cubebene, β-caryophyllene, α-pinene, xanthinin *etc*.	Antibacterial, antifungal, antitumor, antinociceptive, antioxidant *etc*.	Leaves
Ziziphus mauritiana	Berries are edible and digestive in nature while paste made from fresh leaves is used to treat secondary skin infection *i.e.* scabies.	Secondary metabolites such as alkaloids, flavonoids, terpenoids, saponin, pectin, triterpenoic acids and lipids. Jujubosides (saponin) and cyclopeptide alkaloids *etc*.	Anti-infectious, diuretic, anti-inflammatory *etc*.	Leaves and fruit
Ziziphus oxyphylla	Indigenous people collect fresh leaves and roots of this plant and dehydrate in shade. The whole stuff is then minced into powder, and two spoons of this powder, thrice a day are administered to patient with diabetes. This powder is also essential in enhancing men's sexual power.	Alkaloids, phenolic compounds, phenothiazines,aromatic compounds, amino acids, sulfur compounds *etc*.	Antidiabetic, antifertility, aphrodisiac, antiseptic, anticancer (Melanoma cells), antifungal, antibacterial and wound healing properties *etc*.	Root and leaves

it under sunlight and then pulverized. They also crushed *Mangifera indica* seed into powder and mixed both of them. Two full spoons of this dry powder along with honey were proved to be effective against intestinal worms. The local people used fruit of this plant to purify blood. It was wild variety and bitter in taste, and people thought extensive usage may cause sexual instability in males.

3.3.5. Arisaema flavum

It was superstitious myth in the area that this plant originates from snake saliva and is considered very venomous. The indigenous people collected the roots from field by using polythene bags and dried in shade. They crushed it into powder and made a paste which is used against snake bite.

4. Discussion

4.1. Comparison of current research work with literature

There are around 300 000 species of vascular plants in the world today and about 30% of world population depend on plant based remedies. Millions of traditional rural people still use plants as sources of food, clothing, shelter, fuel and medicine and more or less 80% of world inhabitants still rely on herbal medicine[26]. In the same way the whole area of Mahasheer National Park, AJK is rural in nature; hence local inhabitants depend on native plants for acquiring medicines, fruits, vegetables, fuel, furniture, fodder, roof thatching *etc*.

The general ethnobotanical investigations of a specific area is actually indicator of specific culture. Results of current study depicts a pure culture in Mahasheer National Park, AJK and more indigenous community which is in accordance with the studies of [10,23,27].

The higher number of species used as fodder are due to the reason that the main source of income of the local inhabitants is cattle rearing. Species used as fuel wood indicates the weather of the region as well as vegetation which is of shrubby type, and at homes shrubs are mostly used for general fire. Maximum number of miscellaneous uses of reported plant species, showed isolation of the area, from cities and markets as said by Ahmad *et al*.[28]. The most dominant vegetation form of the reported species was herbs (37%) followed by trees (24%) and shrubs (21%). A similar pattern of vegetation form was reported by Ayyanar and Ignacimuthu[29].

Indigenous people use 50 medicinal species in health care system. The promising species include *Berberis lycium*, *D. sissoo*, *Acacia modesta*, *Melia azedarach*, *M. alba*, *M. nigra*, *Mallotus phillipensis*, *Adhatoda zylenica*, *Achyranthes aspera*, *Datura alba etc*. The results agree with the findings of other researchers[30-32]. The present study depicted that gastrointestinal ailments (22.22%) were the most frequent disorders treated by local inhabitants by means of utilizing ethnomedicinal plants. It is in accordance with an ethnobotanical study on some medicinal plants of union council Bangoin, Tehsil Rawalakot, AJ&K carried out by Shaukat *et al*.[33]. The current investigation also showed that leaves were the most collected plant parts for medicinal purposes, and similar results were also reported by Khan *et al*.[32] in an ethnobotanical study about medicinal plants of Poonch Valley Azad Kashmir.

The collected data was also compared with Indo-Pak medicinal plant literature and it was observed that out of 50 medicinal plants, 34 have new medicinal uses reported for the first time ever and is an addition in the folk herbal medicinal literature.

4.2. Threats to ethnobotanical knowledge in Mahasheer National Park, AJK and recommendations for its conservation

Being a remote border area so far, no effective measures have yet been taken by the government agencies for the conservation of traditional ethnobotanical knowledge as well as for medicinally important plants in Mahasheer National Park. Although it has been declared as a national park to protect Mahasheer fish which is declared as endangered, there is still not a single effort made so far concerning potentially important plant resources conservation. Domestic animal grazing is severe threat and great ecological setback to the natural plants of the park. Therefore, it is strongly recommended to take initiatives for conservation of medicinally important plants of the park involving government agencies and local communities to obtain sustainable yield of the medicinally important plants.

The current research work is the first ethnobotanical report from Mahasheer National Park, AJK. A total of 93 plant species belonging to 42 families are reported, of which Poaceae, Lamiaceae and Moraceae are the dominant families used by local inhabitants in their daily life. This report provides important ethnobotanical information and demonstrates close relationship between human and plant. Phytochemical analysis, taxonomic description and biomass estimation of existing plant resources of the area are needed. The recorded data are proved to be a key for conserving the ethnobotanical knowledge and to build up an ethnobotanical inventory of the species diversity.

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