A comparative ethno-botanical study of Cholistan (an arid area) and Pothwar (a semi-arid area) of Pakistan for traditional medicines

Sadia Malik1, Saeed Ahmad2, Alia Sadiq1, Khurshid Alam3, Hafiz Muhammad Wariss3, Imitiaz Ahmad3, Muhammad Qasim Hayat1*, Shazia Anjum3* and Muhammad Mukhtar4

Abstract

Background: The present study is intended to compare and document the therapeutic flora, their remedial use, and the traditional knowledge used frequently by the residents of the Cholistan desert and Pothwar (Potohar) Plateau of Punjab, Pakistan. The old endemic remedies of these areas are diminishing due to lack of qualitative and quantitative research.

Methods: The data was generated by unstructured-interviews, informal meetings, open-ended conversations and group discussions with local people and traditional health healers of the study area. Reported literature was also utilized.

Results: The study recorded a list of various medicinal plants used as traditional medicines by local people. Total 86 numbers of plant species belonging to 38 families and 67 plant species belonging to 29 families have been reported in the Pothwar and Cholistan respectively. Only 10.5% of similar plant species were present in the studied areas.

Conclusion: The investigation revealed that the local people of study areas inherit a rich traditional knowledge but there is great danger of losing this wealth of knowledge in the near future. Documentation of the knowledge exclusively from desert area of Cholistan, Pakistan is unique information in its nature. The study presents the undocumented knowledge worth recognition that will not only help in conservation of medicinal plant species but will highlight the pharmacological capacity for improved human healthcare regarding many common ailments.

Keywords: Medicinal plants, Traditional healthcare knowledge, Pothwar, Cholistan

Introduction

Pakistan features a diverse array of elevated peaks, snow mountains, irrigated immense plains, coasts, freezing and burning deserts. The country has been divided into four phyto-geographic regions namely the Irano-Turanian, Sino-Japanese, Saharo-Sindian and Indian element reflecting the unmatched wealth of its flora. A significant part of the country is of arid nature covering 40.9 million hectare (ha) of land together with 11 million ha of desert area. Medicinal plants play a significant role in lives of its inhabitants as they are considered as a primary source of treatment against many diseases. They also serve as a key income resource for poor field workers and people associated with herbal products manufacturers. Majority species of medicinal plants (about 70%) are uni-regional and rests of the species are bi-regional or pluri-regional [1]. The traditional healthcare knowledge has been passed on generally verbally over generations rather than as a written document due to which the knowledge is gradually diminishing. Additionally, increase in urbanization, growing population, habitat loss, improper documentation, over exploitation of some plant species, lack of implementation of laws and insufficient awareness are the factors contributing to the loss of this heritage [2].

Many workers have investigated the economic, ethno-botanic and medicinal importance of plants but ample research is still required [2-4]. However, during the past decade research work has been carried out in a range of...
institutions to establish the antimicrobial, anticancer, anti-
oxidant, anti-inflammatory effects of medicinal plants
[5-9]. The floristic and ethno-botanic inventories also have
been made [4,10,11]. The patients mostly use allopathic,
alternative and traditional medicines side by side without
prescription of registered practitioners. Progress in develop-
ment of an infrastructure and human resource to utilize
medicinal plant wealth in a proper way is limited [4]. The
ethno-botanic practices are common and have direct
socioeconomic impacts [12]. All these facets are en-
duced during this study. Study of the less explored
desert region of the province also seems vital. In current
study we have adopted partially the data from our previ-
ous studies [3,11].

Data regarding ethnobotanical or ethnopharmacologi-
cally characteristics of the plants of Cholistan desert and
Pothwar is almost non-existent except very few reports.
The main objective of present study is to explore the
relationship between local culture of folk people and
plants in the pursuit of drug development and medical
breakthroughs. The herbal treatments in respective re-
gions are favored over the allopathic ones for their low
cost and less side effects. The most important objective
of this study is the preservation of local plant knowledge.
Loss of the indigenous knowledge is a threat to the poor
rural economies based on traditional livestock farming
as that in the deserts like Cholistan or semi-arid area like
Pothwar. It was, therefore, deemed imperative to docu-
ment the ethnobotany knowledge possessed by the people
of respective areas. In addition to this, present study will
be a yardstick to probe standardization and systematic ex-
ploration of traditional herbs.

Study area
The total geographical area of Punjab, a province of
Pakistan is 20.63 million hectares with a composition of
13.37 and 7.26 million hectares as irrigated and rain fed
respectively. The two areas chosen for the present study
are the Pothwar (Potohar) Plateau (Semi-arid) and the
Cholistan desert (arid) (Figure 1).

The Cholistan is a desert covering an area of 26,000
Km² located between 27°42' and 29°45' N latitude and
69°52' and 75°24' E longitude (Figure 1) at a height of
112 m above sea level [13-16]. Its old civilization has van-
ished mainly due to a variety of hostile invading problems
caused by the Egyptian, Harappan and Mesopotamian
civilizations [17]. The prominent climatic features of the
Cholistan desert are sub-tropical, arid, burning hot, mon-
soon rainfall with intermittent long droughts and strong
summer winds having relatively low humidity and high
rate of evaporation [18]. The mean annual rainfall varies
between 100 mm in the West and 250 mm in the East,
with heavy showers during July to September in monsoon
and January to March during winter. The mean summer
temperature is 34-38°C, while that of winter is 15-20°C.
The June being the hottest experiences 45°C normally and
sometimes rises as high as 51°C [19].

The desert is separated into two eco-regions by old
Hakra River. The northern division covers about 7,770 km²
and is known as Lesser Cholistan. It is adjacent to canal ir-
rigated region and progresses with a series of saline alluvial
clayey flat land alternating with low sand dunes. The purely
aeolian sandy desert, called the Greater Cholistan covers
8,130 Km² in the southern region consisting of various
forms of sand ridges and inter-ridges valleys. It extends
about 480 km in length and 32 to 192 km in width.
Cholistan Desert presents a multifarious prototype of al-
luvial and aeolian depositions [20-22].

The desert of Cholistan is one of the key ecological
arid zones with extreme seasonal variation and consists of
a wide variety of edaphic conditions as described above.
Human population of this desert comprises of more than
110,000 pastoral nomads (originally Buddhist and Sikh,
but now comprising 95% Muslims and 5% Hindu com-
unities). The economy of the Cholistan desert is pre-
dominantly pastoral and people have been practicing a
nomadic lifestyle for centuries. Saraiki is the local lan-
guage of the area.

The second study area of semi-arid nature (Pothwar/
Potohar) stretches from latitude 32°10'-34°9' N and longi-
tude 71°10'-73°55 E comprising of Attock (Attock, Fateh
Jang, Hasan abdal, Jand, Pindi Gheb), Rawalpindi (Gujar
Khan, Kahuta, Kotli sattian, Murree, Rawalpindi, Taxila),
Islamabad, Jehlum (Jhelum, Pind Dadan Khan, Sohawa)
and Chakwal (Chakwal, Choa Saidan Shah, Talagang)
districts of the Punjab [23] and covers 23,160 sq. Km
area. This land tract is bordered on the north by the Kala
Chitta Range and the Margalla Hills, and on the south by
the Salt Range. On the eastern side lies the River Jhelum
and Indus on its west. This region varies in height from
305 to 610 meters above sea level and lies in the north of
Salt Range. Soanian Culture prevailed in this area evi-
denced by the data obtained from fossils, coins, tools, and
remnants of primeval archaeological sites. Historically,
notable areas of this region include two UNESCO World
Heritage sites, The Rohtas Fort and Taxila [24,25]. Others
include namely Rawat Fort, Pharwala Fort and Katasraj
temple. The typical weather of Pothwar ranges from
semi-arid to sub-humid subtropical continental [26].
The Plateau is drained by Hao and Swan rivers. Its top-
ography is tremendously varied, consisting of ridges,
troughs and basins. The large part of the Plateau has
been eroded and dissected by streams. The Salt Range
starts from nearby Jehlum district in the Jogi Tilla and
Bakrala Ridges. It crosses the Indus near Kalabagh and
extends southward into the districts of Bannu and Der-
Ismaeel Khan. The average height of the range is about
671 meters and the Skaser peak is 1,525 meters high.
Pothwar Plateau is actually an undulating, multi-colored, multi-cultural, pictorial and geologically poorly distinct area. In this densely populated land, agriculture is dependent primarily on annual rainfall (averages 380 to 510 mm). Precipitation is recorded maximum in the northwest and minimum in the southwest arid zones [27]. Various soils are found in the Pothwar Plateau typically, alluvial, loess, mixed material and colluvial types resulting from sandstone and shale [26]. Inceptisols, entisols and aridisols and with traces of alfisols soils are recorded [27]. According to 1998 district census report, 7,4,64,763 people were residing in the area and there is still tremendous increase in population. Majority of the people are Muslims while minorities include Christians, Hindus and Sikhs. The urbanity level was about 40%. However a great deal of inhabitants are still agrarian, many people are moving into industry and mining. Agricultural practices are dependent on rain fall [28]. Crop rotation and fallow are a common practice [29]. For instance wheat-ground nut cropping is a regular observation. Medicinal plants are mostly found as weeds which may compete with crops for natural resources [30] and at waste places.

The people in Punjab have their own distinct rural culture possessing their own principles, laws, traditions, ethnic groups Muslims (70%), Hindus (10%), Sikhs (15%), and Christians (5%), heritage, languages and much more. The rural to urban migration trend is also prevailing with many effects on traditions. The people in the rural areas...
are still highly dependent on natural products and natural remedies. They are closely related to plants and plant products play significant roles in their lives. Figure 1 shows the location map of Cholistan and Pothwar.

**Methods**

The study was undertaken during different seasons of the years (2010, 2011). Total of 136 local people including traditional healers were identified using the Participatory Rapid Appraisal Approach (PRA) [31]. PRA stipulated a valuable insight into the multiple dimensions and experiences of local people with traditional plant medicines. The informal meetings, open-ended conversations allowed us to develop problems that were important to the community but unknown to the investigators [32]. With the help of the local community the most renowned traditional healers in the study area were consulted. The traditional healers were expert practitioners who medicated the local population using ethno medicinal plants and their products. The informers were 20–80 years old including both men and women (Table 1). Informal and verbal consent was taken from each individual traditional healer who took part in the study. To confirm the use of each plant used for treating the same disease, at least three traditional healers were consulted.

The whole study area of Cholistan was divided into 11 transect lines covering almost all macro and micro habitats. The transect lines which were followed during this study were as follows: Fort Abbas to Dodhlan Plantation Border Line Area, Dak wala to Border Line Area, Fort Morot to Rana Bhana, Kalay Pahar to Border Line Area, Yazman to Wanjhara, Yazman to Bijnot, Fort Derawar to Bijnot, Fort Derawar to Garare Wala, Fort Khair Garh to Kakki Wala, Kot Murid to Ghunyan Wala and Rahim Yar Khan to Islam Garg while in Pothwar region, villages in Chakwal, Talagang, Jhelum, Rawalpindi, Gujar Khan, Murree, Kahuta, Pindi Gheb, Attock, Kala Chitta hills were randomly selected.

Visits were made to the places where traditional healers usually accumulate plants for their therapeutic purposes. The plants mentioned in this manuscript as traditional medicines were identified in the field by the traditional healers during the dialogues between them. Voucher specimens were assigned when plants encountered for the first time. They were also assigned during flowering or fruiting. The plant specimens were treated as per standard taxonomic procedures [33]. The collected specimens were dried in newspapers/blotting papers. The dried specimens were sprayed with a saturated solution of Mercuric Chloride in rectified spirit. The specimens were mounted very carefully on herbarium sheets of standard size (41.25 × 28.75 cm) by using German glue. All the specimens were fully labeled on the right lower corner. The field data was then given herbarium labels. The herbarium specimens of this work have been deposited in the herbarium of Cholistan Institute of Desert Studies, The Islamia University of Bahawalpur. For small herbaceous plants, the entire plants were collected. To get insight of folklore remedies and their uses and to get first hand knowledge, meetings were held with elderly inhabitants, local Hakeems (Herbal practitioners) and domestic women of Cholistan desert and Pothwar area. The interviews and deliberations were executed in Siraki, Pothwari and Punjabi, the local languages of Cholistan and Pothwar correspondingly since the authors are native speakers of the languages. Data on specific plant parts (leaves, twigs, fruits, pods stem bark, roots etc.), and the ethno-pharmacological values were collected. For the record of medicinal uses, information on the plant parts used, their collection, processing and preparation of drugs, properties, mode of administration dosage and the diseases cured were also recorded. Collected information was also verified in different localities from local inhabitants either by showing the plant specimen or telling local names to the respondents. The plants were scientifically identified and documented as well. Scientific literature already cited was also reviewed to cross check the collected information about medicinal and ethno-botanical uses.

The descriptive data gathered for this study was recorded and saved with respect to date. Contradictory and exclusive statements were noticed and were been given close attention. The repeated data was recorded in this report by data reduction technique, the systematic content analysis. In its broad sense, different reviews have highlighted a range of aspects of content analysis, from its capacity to generate quantitative descriptions by analyzing word counts [34] to its ability to help researchers infer conclusions from a text by breaking it into distinct entities of useful data that can then be implicitly rationalized that is compressing many words of text into fewer manageable groups [35].

**Table 1 Age and sex characteristics of traditional healers interviewed in the present study**

| Gender | Age (years) | Total |
|--------|-------------|-------|
|        | 20-40 | 40-60 | 60-80 |     |
| Male   | 53    | 38    | 17    | 108  |
| Female | 7     | 16    | 5     | 28   |

**Results and discussion**

**Medicinal plant diversity**

This study records 67 plant species as useful in traditionally curing 123 human diseases in Cholistan Desert (Table 2). These medicinal plants were distributed among 29 families and 55 genera. The largest proportion of medicinal plants collected belonged to the families Zygophyllaceae (5), Capparidaceae (5), Poaceae (6),
| Sr. No. | Plant Name [voucher specimen #] | Vernacular name | Family | Plant part used | Disease cured | References |
|---------|---------------------------------|----------------|--------|----------------|-------------|------------|
| 1.      | *Abutilon muticum* (Del.ex DC.) Sweet [2510/CIDS/IUB] | Kanghi-buti | Malvaceae | Leaves and roots | Renal stones and heartburn, Infectious diseases. | Traditional Health Healers [THH]; [60] |
| 2.      | *Acacia jacquemontii* Benth. [2512/CIDS/IUB] | Banwli | Mimosaceae | Bark and leaves | Chickenpox, pain, fever and small pox | [THH] |
| 3.      | *Acacia nilotica* (Linn.) Delile [2513/CIDS/IUB] | Babul or Kikar | Mimosaceae | Leaves, bark, flowers, fruit and gum | Men sex problems, diarrhea, sexual debility, hemorrhages and high blood sugar. | [THH]; [61] |
| 4.      | *Aerva javanica var. javanica* [2201/CIDS/IUB] | Bui | Amaranthaceae | Root, bark and leaves | Renal stones and upper-respiratory infection. | Constipation and remove gastrointestinal parasites. | [THH]; [62] |
| 5.      | *Alhagi maurorum* Medic [2529/CIDS/IUB] | Jawansa | Papilionaceae | Whole plant | Blood purifier, fever, Jaundice and respiratory diseases. | Increased perspiration, cough, and constipation. | [THH]; [63] |
| 6.      | *Blepharis scindica* T. Anders. [2001/CIDS/IUB] | Gandi-boti | Acanthaceae | Whole plant | General weakness and pain | | [THH] |
| 7.      | *Boerhavia procumbens* Banks ex Roxb [2518/CIDS/IUB] | Biskhipra | Nyctaginaceae | Whole plant | Chest infections, renal failure and painful periods in women. | Blood purifier. Liver diseases, sexually transmitted infections and sluggishness. | [THH]; [64]; [65]; [66] |
| 8.      | *Calligonum polygonoides* Linn [2663/CIDS/IUB] | Phog | Polygonaceae | Flowers and green twigs | Sore eyes, severe thirst. Indigestion, sore throat and pain. | | [THH] |
| 9.      | *Calotropis procera* subsp. hamiltonii (Wight) Ali [2005/CIDS/IUB] | Ak | Asclepiadaceae | Latex, leaves, flower buds and root bark | Painful menstruation, uterus problems, asthma, stomachache and muscular weakness. Snake bite, piles, leprosy, sexually transmitted diseases, asthma and joint pain. | Painful menstruation, uterus problems, asthma, stomachache and muscular weakness. Snake bite, piles, leprosy, sexually transmitted diseases, asthma and joint pain. | [THH]; [67]; [68] |
| 10.     | *Capparis decidua* (Forsskal) Edgew [2315/CIDS/IUB] | Karir | Capparidaceae | Leaves, fruit and stem | Piles, fevers, painful menstruation, high blood sugar, obesity, indigestion and bone fractures. Remove intestinal worms, used as sexual stimulant, relieves flatulence, increased perspiration and constipation. | | [THH]; [69] |
| 11.     | *Capparis spinosa* Linn. [2316/CIDS/IUB] | Kubber | Capparidaceae | Leaves flowers | Joint, muscle pain, asthma, indigestion and liver disorders | | [THH] |
| 12.     | *Cassia italica* subsp. *Italica* [2314/CIDS/IUB] | Ghoray-wall or Sana | Caesalpinaceae | Whole plant | Arthritis, pain, fevers and indigestion | | [THH] |
| 13.     | *Cenchrus biflorus* Roxb. [2533/CIDS/IUB] | Mohabat Boti | Poaceae | Whole plant | Kills intestinal worms | | [THH] |
| 14.     | *Cenchrus ciliaris* L. [2530/CIDS/IUB] | Daman | Poaceae | Whole plant | Intestinal worms, increase milk production in cattle and wound healing. Relieves pain and used as emollient. | | [THH]; [70] |
| No. | Species | Common Name | Family | Part Used | Medicinal Uses |
|-----|---------|-------------|--------|-----------|----------------|
| 15. | *Cenchrus setigerus* Vahl. | Chuti Daman | Poaceae | Whole plant | Allergies, fever, common cold and intestinal worms. [THH] |
| 16. | *Chrozophora sabulosa* Kar. & Kir. [2509/CIDS/IUB] | Nilakari | Euphorbiaceae | Whole plant | Leprosy, contagious infections with symptoms like cough, wheezing, cold, fever, chills, and a sore throat. [THH] |
| 17. | *Citrus colocynthis* (Linn.) Schrad [2350/CIDS/IUB] | Tummaor Korr-tumma | Cucurbitaceae | Roots, fruits and seeds | High blood sugar, painful menstruation, numbness or tingling in the legs and digestive disorders. [THH][67] |
| 18. | *Cleome brachycarpa* Vahl. ex. DC. [2317/CIDS/IUB] | Noli or Kastoori | Capparidaceae | Whole plant | Intestinal worms, pain, high blood sugar, and liver disorders. [THH] |
| 19. | *Cleome scaposa* DC [2318/CIDS/IUB] | Khastoori boti | Capparidaceae | Whole plant | Itchiness, high blood sugar, used as diuretic and in liver disorders. Reduces fever and pain. [THH][68]; [69]; [70] |
| 20. | *Convolvulus prostratus* Forssk [2348/CIDS/IUB] | Hiran-booti | Convolvulaceae | Leaves and soft twigs | Excessive thirst, heartburning, as diuretic, anti-high blood sugar and fever. Treats constipation. [THH][61] |
| 21. | *Corchorus depresus* (Linn.) Stocks [2672/CIDS/IUB] | Bhaon-phali | Tiliaceae | Whole plant | Male sexual disorders and as sexual stimulant. [THH] |
| 22. | *Cressa cretica* Linn. [2347/CIDS/IUB] | Ooini | Convolvulaceae | Whole plant | Chest tightness and coughing, skin diseases and fever. Loss of appetite, as tonic and sexual stimulant. [THH][71], [72] |
| 23. | *Crotalaria burhia* Buch.-Ham. ex Benth [2527/CIDS/IUB] | Chag | Papilionaceae | Whole plant | Reduces fever, joint pain, skin diseases, general weakness and stomachache. Relieves pain in the body. [THH][73] |
| 24. | *Cucumis melo var. agrestis* Naudin [2351/CIDS/IUB] | Chibbarr | Cucurbitaceae | Fruit | Inappropriate eating habits and constipation. [THH] |
| 25. | *Cuscuta reflexa* Roxb. [2352/CIDS/IUB] | Akashbail | Cuscutaceae | Whole plant | Lice and dandruff, unhealthy skin and itching. [THH] |
| 26. | *Cymbopogon jwarancusa* (Jones) Schult. [2533/CIDS/IUB] | Katrin or Khavi | Poaceae | Whole plant | Diarrhea and vomiting, thirst, fever, joint and muscle pain. As diuretic. [THH] |
| 27. | *Cyperus rotundus* Linn. [2359/CIDS/IUB] | Moothaor | Cyperaceae | Roots and Deela | Indigestion, burning, excessive urination, high blood sugar, jaundice and fever. Loss of appetite. [THH][74] |
| 28. | *Dipterygium glaucum* Decne. [2319/CIDS/IUB] | Phel | Capparidaceae | Whole plant | Skin redness and irritation, wounds, unhealthy patchy skin, chronic fever. [THH][75] |
| 29. | *Echinops echinatus* Roxb. [2402/CIDS/IUB] | Unt-katara | Asteraceae | Whole plant and roots | Jaundice, inappropriate eating habits, indigestion, Chronic liver diseases and sexual weakness. [THH] |
| 30. | *Euphorbia granulata* Forssk. [2506/CIDS/IUB] | Dudheli | Euphorbiaceae | Whole plant | Skin diseases, pain, and high blood sugar. Intestinal worms and constipation. [THH][76] |
| No. | Species | Scientific Name | Family | Part(s) Used | Medicinal Uses                                                                 | Reference(s) |
|-----|---------|-----------------|--------|-------------|---------------------------------------------------------------------------------|--------------|
| 31. | Euphorbia prostrata | Ait. [2503/CIDS/IUB] | Euphorbiaceae | Whole plant | Piles, sexual weakness, skin redness and irritation and pain.                    | [THH]; [76] |
| 32. | Fagonia cretica | Linn [2675/CIDS/IUB] | Zygophyllaceae | Whole plant | Liver diseases, lack of blood, fever, pain and as blood purifier and increase stamina. | [THH] |
| 33. | Farsetia hamiltonii | Royle [2313/CIDS/IUB] | Brassicaceae | Whole plant | As tonic and against stomach ache and joint, muscle pain and diabetes. | [THH]; [77] |
| 34. | Gisekia pharnaceoides | Linn. [2101/CIDS/IUB] | Aizoaceae | Whole plant | Jaundice, inappropriate eating habits, fever and pain. Constipation, remove intestinal worms and skin infections. | [THH]; [78] |
| 35. | Glinus lotoides | Linn [2514/CIDS/IUB] | Molluginaceae | Whole plant | Diarrhea, poor functioning of liver, externally to cure boils and wounds. | [THH] |
| 36. | Grewia villosa | Willd. [2673/CIDS/IUB] | Tiliaceae | Whole plant | Urinary tract infections, liver diseases, eye-ache, sexually transmitting diseases. | [THH] |
| 37. | Haloxylon recurvum | Bunge. ex. Boiss. [2335/CIDS/IUB] | Chenopodiaceae | Whole plant | Gastric problems and kidney Stones. | [THH] |

Looking at the table, it seems the entries are missing some of the expected columns. The titles of the columns are not explicitly stated, but we can infer them from the context. The table likely includes columns for the species name, scientific name, family, part(s) used, medicinal uses, and references. Each entry is a medicinal plant found in the Cholistan Desert, with specific uses and references cited.
| No. | Name of Plant | Family | Part Used | Uses |
|-----|---------------|--------|-----------|------|
| 48. | *Oligochaeta ramosa* (Roxb.) Magenitz | Asteraceae | Whole plant | Irritation, liver diseases, joint pain and as brain tonic |
| 49. | *Oxystelma esculentum* (Linn. f.) R. Brown | Asclepiadaceae | Whole plant | Painful urination, sexually transmitted diseases, acne and pain. |
| 50. | *Panicum antidoteale* Retz | Poaceae | Whole plant | Severe sore throat, small pox and respiratory tract infection |
| 51. | *Peganum harmala* Linn. | Zygophyllaceae | Leaves, roots and seeds | Emotional disturbances, painful menstruation, seizures, insanity and itchy skin. Abdominal pain and smoke has insecticidal properties. |
| 52. | *Pergularia daemia* (Jacq.) N. E. Brown | Asclepiadaceae | Whole plant | Intestinal worms, reduces fever, flatulence, chest tightness, stomachache and gynecological problems |
| 53. | *Polygonum plebejum* R. Br | Polygonaceae | Roots and whole plant | Respiratory tract infections, indigestion, vomiting and diarrhea |
| 54. | *Prosopis cineraria* (Linn.) Druce | Mimosaceae | Leaves, bark, flowers and pods | Heal wounds, for birth control, blood deficiency, protein deficiency, painful menstruation and joint, muscle pain. |
| 55. | *Pulicaria crispa* (Cass.) Benth. & Hook. f. | Compositae | Whole plant | Fever, headache, severe cold, cough and jaundice. |
| 56. | *Salvia baryosma* (Roem. ex. Scult.) Dany. | Chenopodiaceae | Whole plant | Remove intestinal worms, itching, indigestion, and sores. |
| 57. | *Salvia oleoides* Decne. | Solanaceae | Fruit, bark and leaves | Nutritive deficiency, inappropriate eating habits, skin boils, high blood sugar, gum bleeding and stomachache. |
| 58. | *Solanum surattense* Burm. F. | Solanaceae | Whole plant | Joint pain, Fever, used as blood purifier, in breathing problems, severe headache, leprosy, as diuretic, hair tonic and cure abdomen pain, gas trouble, chronic cough and pain. |
| 59. | *Sporobolus ioclados* (Nees ex Trin.) Nees | Poaceae | Whole plant | Severe fever, headache and vomiting. |
| 60. | *Swertia fruticosa* Forssk. ex J. F. Gmelin | Chenopodiaceae | Whole plant | Constipation, painful menstruation, red eyes, indigestion and wound healing. |
| 61. | *Tamarix aphylla* (Linn.) Karst | Tamaracaceae | Leaves, bark and nuts | Liver diseases, indigestion, stomachache, leucorrhoea, sexual weakness and skin problems. |
| 62. | *Tribulus longipetalus* subsp. *Longipetalus* | Zygophyllaceae | Fruits and seeds | Renal stones, male sexual problems, anemia and general weakness. |
Solanaceae (3), Asclepiadaceae (4), Cucurbitaceae (3), Chenopodiaceae (4), Papilionaceae (3), Molluginaceae (3), Euphorbiaceae (3), Asteraceae (3) and Mimosaceae (3). Poaceae, Zygophyllaceae and Capparidaceae constitute the maximum diversity of species used in herbal medication.

Cholistan Desert is uniquely located in wild land with dearth of endemic flora counting only 128 species belonging to 32 families. During the present study people including local elders (Siana), herbal and homeopathic practitioners and spiritual healers were interviewed. They play an imperative role in primary healthcare of the local inhabitants as the majority of their clients come from poor families who cannot meet the expense of the modern healthcare services. As said by traditional healers, the local people are still dependent on wild plants for prime healthcare owing to the widespread faith in its efficiency. According to the current survey, local people for curing various diseases, commonly use 67 plant species belonging to 29 families. The diseases cured vary from simple stom-achache to more complicated such as male and female urino-genital disorders. It is evident from Table 2 that 14 plant species are being used for the treatment of gastrointestinal tract disorders. Moreover, it is observed that 16 plant species are consumed as antibacterial and cure for skin diseases. 10 of the plant species are particularly utilized for respiratory tract problems, whereas, for musculo-skeletal and joint disorders 10 plant species are used. There are 5 species being consumed for the male sexual disorders, and 10 species for the female sexual disorders. For urinary tract infections 5 plant species have been exploited, and 10 plant species are being consumed as anti-diabetics. In addition to this, traditional healers are using 14 plant species to cure fever, 7 plant species to cure liver diseases, 9 plant species to treat jaundice and renal stones are being cured with 6 plant species. Five plants including Heliotropium strigosum, Withania somnifera, Mukia maderaspatana, Cymbopogon jwarancusa, and Peganum harmala are commonly used for the treatment of CNS disorders, like dementia.

Data acquired from Northern Punjab (Pothwar area) is assembled in Table 3 and the plants species are sorted alphabetically. A sum of 86 plant species belonging to 38 families have been reported, used for the cure of different diseases. The highest numbers (8) of medicinal plants are from Asteraceae. 22 are found to be used in treatment of jaundice and liver diseases. 22 plant species have been benefited as anti-diabetic. Solanum surattense has been used by local people for the cure of abdomen pain, gas trouble and chronic coughs and pain. It is also reported to possess antibacterial activity against drinking water bacteria [36,37]. Four plant species are used to cure sexually transmitted diseases, two plant species to treat sexual impotency in males, 3 being used for treatment of rheumatic/ joint pain, 7 for cough and asthma, 3 against piles, 2 species to cure urinary problems, 5 used in cure to skin problems and dandruff, 4 species for eye diseases, 4 for high blood pressure treatment, 20 for digestive system disorders, rest of the reported plants species are used against various other ailments like fever, ear pain, touch ache, few as antidote etc. In district Attock, 35 different types of human ailments that have been reported in previous studies to be used in conventional system [10].

Data acquired from Northern Punjab (Pothwar area) and Southern Punjab (Cholistan) bears only 10.5% similarity. The similar medicinal plants of both areas are comprised of 9 plant species such as Calotropis procera subsp. hamiltonii (Wight) Ali, Citrullus colocynthis (Linn.) Schrad, Cyperus rotundus Linn., Acacia nilotica (Linn.) Delile, Boerhavia procumbens Banks ex Roxb, Ziziphus nummularia (Burm. f.) Wight & Arn., Solanum surattense Burm. F., Withania somnifera (Linn.) Dunal and Peganum harmala Linn.

Table 2 Medicinal Flora of Cholistan Desert (Southern Punjab) (Continued)

| No. | Plant Name | Family | Part Used | Medicinal Use |
|-----|------------|--------|-----------|---------------|
| 63  | Tribulus longipetalus subsp. Macropterus [2677/ CIDS/IUB] | Zygophyllaceae | Whole plant | Male sexual problems, itchy skin, chest/heart pain, piles, bleeding from nose and pain. [THH] |
| 64  | Withania coagulens (Stocks) Dunal [2669/CIDS/IUB] | Zygophyllaceae | Whole plant and fruit | Jaundice, inappropriate eating habits and skin problems. [THH] |
| 65  | Withania somnifera (Linn.) Dunal [2670/CIDS/IUB] | Solanaceae | Leaves and root bark | Boils, nerve weakness, joint pain and as sexual stimulant. [THH]; [36]; [67] |
| 66  | Ziziphus nummularia (Burm. f) Wight & Arn [2664/CIDS/IUB] | Rhamnaceae | Fruit, bark, leaves and seeds | Skin diseases, cold, cough, stomachache, diarrhea, hair roughness, high blood sugar and help wound healing. [THH]; [36]; [67]; [82] |
| 67  | Zygophyllum simplex Linn [2674/CIDS/IUB] | Zygophyllaceae | Whole plant | Patchy skin, wounds, acne and Bleeding [THH] |
| Sr. No. | Plant Name [voucher specimen #] | Vernacular name | Family | Plant part used | Disease cure | References |
|--------|---------------------------------|----------------|--------|-----------------|--------------|------------|
| 1      | Abutilon indicum G. Don [0001/ASAB/NUST] | Kanghi | Malvaceae | Whole plant | Diarrhea, sexually transmitted diseases, burning with urination | Traditional Health Healers [THH]; [65] |
| 2      | Acacia modesta Wall. [0002/ASAB/NUST] | Phulahi | Mimosaceae | Bark of tree | gas trouble and abdominal diseases | [THH]; [67] |
| 3      | Acacia nilotica (L.) Delile. [0003/ASAB/NUST] | Kiker | Mimosaceae | Bark, leaves and branches | Mouth sores, gum pain and toothache, eye sores, sexual disability, diarrhea, asthma | [THH]; [67]; [68] |
| 4      | Achyranthus aspera L. [0004/ASAB/NUST] | Puth kanda | Amaranthaceae | Whole plant | Excessive menstruation, piles, abdominal pain, toothache, severe diarrhea. | [THH]; [65] |
| 5      | Adhatoda vasica Nees [0005/ASAB/NUST] | Bekkar | Acanthaceae | Leaves | High blood sugar | [THH]; [82] |
| 6      | Adiantum capillus veneris L. [0006/ASAB/NUST] | Sarhaj | Adiantaceae | Leaves | Jaundice and liver diseases | [THH]; [83] |
| 7      | Albizia lebbek (L.) Benth [0007/ASAB/NUST] | Shrin | Mimosaceae | Leaves | Eye problems | [THH]; [67] |
| 8      | Allium cepa L. [0008/ASAB/NUST] | Piaz | Liliaceae | bulb | High blood pressure, high blood sugar | [THH]; [82] |
| 9      | Allium sativum L. [0009/ASAB/NUST] | Thoom | Liliaceae | bulb | Ear pain, hypertension, high blood sugar | [THH]; [67]; [82] |
| 10     | Aloe vera L. [0010/ASAB/NUST] | Knwar gandal | Liliaceae | Leaf sap, stem | Abdominal pains, constipation, skin diseases, high blood sugar | [THH]; [67]; [82] |
| 11     | Amaranthus viridis L. [0011/ASAB/NUST] | Chaulai | Amaranthaceae | Leaves | Menstrual disturbance, constipation | [THH]; [36]; [65] |
| 12     | Anethum graveolense L. [0012/ASAB/NUST] | Soye | Apiaceae | seeds | Abdominal pain | [THH]; [67] |
| 13     | Argyrolabium roseum (Comb) Jaub & Spach. [0013/ASAB/NUST] | Makhni | Papilionaceae | Whole plant | Jaundice and liver diseases | [THH]; [83] |
| 14     | Artemisia scoparia Walds & Kit. [0014/ASAB/NUST] | Done Jhan, pinche | Asteraceae | Whole plant | Abdominal disorder, earache | [65] |
| 15     | Atriplex spp. [0015/ASAB/NUST] | Gerukh pari | Chenopodiaceae | Leaves, whole plant | Fever, jaundice, sluggishness, liver disease, joint pain | [36] |
| 16     | Berberis lycium Royle. [0016/ASAB/NUST] | Sumbul | Berberidaceae | Leaves | Jaundice and liver diseases | [THH]; [83] |
| 17     | Boerhaavia procumbens L. [0017/ASAB/NUST] | Itsit | Nyctaginaceae | Whole plant | Jaundice, liver diseases, sexually transmitted diseases, weakness | [THH]; [83]; [65] |
| 18     | Bryophyllum pinnatum Kurz. [0018/ASAB/NUST] | Zakhm-e-hayat | Crassulaceae | Leaves | Wounds healing | [THH]; [67] |
| 19     | Cajanus cajan (L.) Millsp. [0019/ASAB/NUST] | Arar ke dal | Papilionaceae | seeds | High blood sugar | [THH]; [82] |
| 20     | Calotropis procera Alton. F. [0020/ASAB/NUST] | Ak | Asclepiadaceae | Leaves, latex and flowers | Snake bite, piles, leprosy, sexually transmitted diseases, asthma, joint pain | [THH]; [67]; [68] |
| 21     | Cannabis sativa L. [0021/ASAB/NUST] | Bhang | Cannabinaceae | Leaves, flowers | Indigestion, sexually transmitted diseases, also used as sedative, narcotic and antidote against poison | [THH]; [36]; [65] |
| 22     | Caralluma edulis (L.) Benth ex Hook. f. [0022/ASAB/NUST] | Choung | Asclepiadaceae | aerial parts | High blood sugar | [82] |
| No. | Scientific Name                        | Common Name | Family       | Part Used | Uses                                                                 | References |
|-----|---------------------------------------|-------------|--------------|-----------|----------------------------------------------------------------------|------------|
| 23  | Carissa opaca Stapf. ex. Haines       | Garanda     | Apocynaceae  | Leaves    | Jaundice and liver diseases                                          | [THH]; [83]|
| 24  | Carthamus oxyantha Bieb              | Pohli       | Asteraceae   | seeds     | Oil is used against itching                                          | [THH]; [65]|
| 25  | Chenopodium album L.                  | Bathu       | Chenopodiaceae| Whole plant| Jaundice, urinary problems, antidote against snake bite             | [THH]; [36]; [65]|
| 26  | Cicer arietinum L.                    | Chinnay     | Papilionaceae| seeds     | High blood sugar                                                     | [82]       |
| 27  | Cichorium intybus L.                  | Kasni       | Asteraceae   | Roots, whole plant | High blood sugar, jaundice and liver diseases | [THH]; [66]; [82]; [83] |
| 28  | Citrullus colocynthus (L.) Schrad    | Tumma       | Cucurbitaceae| Fruit     | Abdominal diseases, constipation                                     | [THH]; [67]|
| 29  | Convolvulus arvensis L.               | Laili, erlai| Convolvulaceae| Aerial parts| Abdominal worms, used as deodorant, skin disorders                  | [THH]; [36]; [65]; [67] |
| 30  | Cynodon dactylon L.                   | Khabal ghas | Poaceae      | Stem, leaves| Dysentery with fever                                                 | [65]       |
| 31  | Cyperus rotundas L.                   | Deela       | Cyperaceae   | Whole plant| Indigestion, vomiting, diarrhea and vomiting, fever                 | [65]       |
| 32  | Dalbergia sissoo Roxb.                | Tali        | Papilionaceae| Leaves    | Dandruff                                                             | [67]       |
| 33  | Dodonaea viscosa (L.) Jacq.           | Sanatha     | Sapindaceae  | Leaves    | High blood sugar                                                     | [82]       |
| 34  | Eucalyptus camaldulensis Dehnh.       | Sufaida, Lachi| Myrtaceae   | Leaves    | Flu                                                                  | [THH]; [67]|
| 35  | Euphorbia helioscopia L.              | Chatri dodak| Euphorbiaceae| Leaves, root, latex | Constipation, increases milk supply                                | [THH]; [65]|
| 36  | Euphorbia raylana Boiss.             | Danda thor  | Euphorbiaceae| branch    | Ear pain                                                             | [67]       |
| 37  | Fagonia indica Burm. F. [0038/ASAB/NUST] | Dhamian      | Zygophyllaceae| Leaves and branches | Gas trouble, skin problems, high blood sugar                 | [THH]; [67]; [82]|
| 38  | Ficus bengalensis L.                  | Bohr        | Moraceae     | Leaves and branches latex | High blood sugar                                                   | [THH]; [67]; [82]|
| 39  | Foeniculum vulgare Mill.             | Soonf       | Apiaceae     | inflorescence | Eye-cataract, stomach disorders, indigestion                      | [THH]; [67]|
| 40  | Fumaria indica (Husskn.) H.N. Pugsley [0041/ASAB/NUST] | Shahtra papra | Fumariaceae | Whole plant | Diarrhea, also used as blood purifier                              | [THH]; [36]|
| 41  | Hordeum vulgare L. [0042/ASAB/NUST]   | Jo          | Poaceae      | seeds     | Kidney pain, high blood sugar, jaundice                              | [66]; [67]; [82]; [83]|
| 42  | Ipomoea pentaphylla (L.) Jacq.        | Kaan Kati   | Convolvulaceae| Seeds     | Jaundice, intestinal pain and worms                                  | [THH]; [36]|
| 43  | Justicia adhatoda L. [0044/ASAB/NUST] | Bahker      | Acanthaceae  | roots     | Jaundice and liver diseases                                          | [THH]; [83]|
| 44  | Kickxia ramosissima (Wall) Janchen    | Khunger booti| Scrophulariaceae| Whole plant| High blood sugar                                                     | [82]       |
| 45  | Lactuca serriola L. [0046/ASAB/NUST] | Kahu        | Asteraceae   | Whole plant| Stomach ache, cough, and asthma                                     | [THH]; [65]|
| 46  | Malva parviflora Wall. [0047/ASAB/NUST] | Sonchal    | Malvaceae    | Whole plant| Cough, flue and fever                                                | [THH]; [36]|
| 47  | Melia azedarach L. [0048/ASAB/NUST]   | Dharek, bakain, Herak | Meliaceae | Leaves, fruits | Piles, foot itching, high blood sugar, emotional disturbance, blood pressure | [THH]; [67]; [68]; [82]|

**Table 3 Medicinal Flora of Pothwar Plateau (Northern Punjab)** (Continued)
Table 3 Medicinal Flora of Pothwar Plateau (Northern Punjab)  (Continued)

| No. | Common Name | Scientific Name | Family | Part Used | Medical Use | Additional Information |
|-----|-------------|-----------------|--------|-----------|-------------|------------------------|
| 49  | Momordica charantia L. | [0049/ASAB/NUST] | Cucurbitaceae | fruits | High blood sugar | [THH]; [82] |
| 50  | Morus alba L. | [0050/ASAB/NUST] | Moraceae | leaves, fruits | Cough, sore throat, jaundice and liver diseases | [THH]; [36]; [67]; [83] |
| 51  | Morus nigra L. | [0051/ASAB/NUST] | Moraceae | fruit | Cough, sore throat, jaundice and liver diseases | [THH]; [66]; [83] |
| 52  | Myrsine africana L. | [0052/ASAB/NUST] | Myrsinaceae | leaves | Jaundice and liver diseases | [THH]; [83] |
| 53  | Ocimum album L. | [0053/ASAB/NUST] | Lamiaceae | leaves | Mouth sores | [THH]; [67] |
| 54  | Ocimum basilicum L. | [0054/ASAB/NUST] | Lamiaceae | leaves | Mouth sores | [THH]; [67] |
| 55  | Ocimum sanctum L. | [0055/ASAB/NUST] | Lamiaceae | leaves | High blood sugar | [THH]; [82] |
| 56  | Oxalis corniculata L. | [0056/ASAB/NUST] | Oxalidaceae | leaves, seeds | Jaundice, liver diseases, stomach disorder | [THH]; [36]; [67]; [83] |
| 57  | Parthenium hysterophorus L. | [0057/ASAB/NUST] | Asteraceae | whole plant | Severe diarrhea. | [36] |
| 58  | Peganum heramala L. | [0058/ASAB/NUST] | Zygophyllaceae | seeds and whole plant | Abdominal pain, also has insecticidal properties | [THH]; [67] |
| 59  | Phyllanthus emblica L. | [0059/ASAB/NUST] | Euphorbiaceae | fruits | Jaundice and liver diseases | [THH]; [83] |
| 60  | Plantago lanceolatum L. | [0060/ASAB/NUST] | Plantaginaceae | seed husk | Gas trouble, indigestion, stomach problems | [THH]; [67] |
| 61  | Plantago ovata Forssk. | [0061/ASAB/NUST] | Plantaginaceae | fruit, seed husk | Jaundice and liver diseases | [THH]; [66]; [83] |
| 62  | Pongamia pinnata | [0062/ASAB/NUST] | Papilionaceae | leaves, seeds, root | Skin problems and stomachache | [65] |
| 63  | Praecitrullus fistulosus (Stocks.) Pangalo. | [0063/ASAB/NUST] | Cucurbitaceae | leaves | Blood pressure | [67] |
| 64  | Psidium guajava L. | [0064/ASAB/NUST] | Myrtaceae | leaves | High blood pressure, high blood sugar, constipation | [THH]; [67]; [82] |
| 65  | Punica granatum L. | [0065/ASAB/NUST] | Punicaceae | fruit | Diarrhea, anemia | [THH]; [67] |
| 66  | Raphanus sativus L. | [0066/ASAB/NUST] | Brassicaceae | root | Jaundice and liver diseases | [THH]; [83] |
| 67  | Rhazya stricta Decne. | [0067/ASAB/NUST] | Apocynaceae | leaves and branches | Tooth ache, acne | [67] |
| 68  | Ricinus communis L. | [0068/ASAB/NUST] | Euphorbiaceae | leaves, oil | Wound healing, constipation, joints swelling and pain. | [THH]; [36]; [67] |
| 69  | Rosa indica L. | [0069/ASAB/NUST] | Rosaceae | petals | Eye burning, constipation, abdominal pain. | [THH] |
| 70  | Rumex hastatus D. Don, Prodr. | [0070/ASAB/NUST] | Polygonaceae | leaves | Jaundice and liver diseases | [THH]; [83] |
| 71  | Silybum manianum L. Gaertn | [0071/ASAB/NUST] | Asteraceae | leaves, seeds | Liver diseases, horse bite | [83]; [84] |
| 72  | Sisymbrium irio L. | [0072/ASAB/NUST] | Brassicaceae | leaves, seeds | Throat, chest infection and swelling | [THH]; [36]; [65] |
| 73  | Solanum nigrum L. | [0073/ASAB/NUST] | Solanaceae | leaves and branches | Abdominal pain, stomachache, high blood sugar, burnt skin and wounds | [THH]; [37]; [67]; [82] |
| 74  | Solanum surratense Burm. F. | [0074/ASAB/NUST] | Solanaceae | fruits, flowers | Abdomen pain, gas trouble, chronic coughs and pain | [THH]; [36]; [67] |
Table 3 Medicinal Flora of Pothwar Plateau (Northern Punjab) (Continued)

| Sr. No. | Plant Name [voucher specimen #] | Vernacular name | Family | Plant part used | Disease | Cure | References |
|---------|--------------------------------|----------------|--------|----------------|---------|------|------------|
| 75      | Sonchus arvensis L. [0075/ ASAB/NUST] | Dodak | Asteraceae | Whole plant | Jaundice, cough, chest stiffness, asthma |       |  [65] |
| 76      | Syzygium cumini (L.) Skeets. [0076/ASAB/NUST] | Jaman | Myrtaceae | Seeds | High blood sugar | THH; [67] |
| 77      | Tagetes petala L. [0077/ ASAB/NUST] | Sabarga | Asteraceae | Leaves | Ear pain | [67] |
| 78      | Tamarindus indica L. [0078/ ASAB/NUST] | Imli | Caesalpinaceae | Fruit, Roots | Jaundice and liver diseases | THH; [83] |
| 79      | Taraxacum officinale Weber | Doddak, Hand | Asteraceae | Leaves, Rhizome | High blood sugar, jaundice | THH; [82]; [83] |
| 80      | Trachyspermum copticum L. | Ajwain | Apiaceae | Seeds | Gas trouble, stomach upset | THH; [67] |
| 81      | Tribulus terrestris L. [0081/ ASAB/NUST] | Bhakra | Zygophyllaceae | Whole plant, leaves | Joint, muscle pain, urinary disorders, impotency | THH; [36]; [83] |
| 82      | Trigonella foenum-graecum L. | Methri | Papilionaceae | Seeds | High blood sugar | THH; [82] |
| 83      | Tylophora hirsuta L. [0083/ ASAB/NUST] | Glow | Asclepiadaceae | branches | High blood sugar | [82] |
| 84      | Vigna mungo (Burm. f.) Walp. [0084/ASAB/NUST] | Mung | Papilionaceae | seeds | High blood sugar | [82] |
| 85      | Withania somnifera (L.) Dunal | Aksun, asgard | Solanaceae | leaves | Cure joint, muscle pain, uterine diseases, used as sexual stimulant. | THH; [36]; [67]; [82] |
| 86      | Zizyphus nummularia (Burm. f.) Wight and Arn. [0086/ASAB/NUST] | Beri | Rhamnaceae | Leaves, fruits | Hair roughness, high blood sugar, wound healing | THH; [36]; [67]; [82] |

Sr. No. | Plant Name [voucher specimen #] | Vernacular name | Family | Plant part used | Disease | Cure | References |
|---------|--------------------------------|----------------|--------|----------------|---------|------|------------|
| 1       | Abutilon indicum G. Don [0001/ASAB/NUST] | Kanghi | Malvaceae | Whole plant | Diarrhea, sexually transmitted diseases, burning with urination | Traditional Health Healers THH; [41] |
| 2       | Acacia modesta Wall. [0002/ASAB/NUST] | Phulahi | Mimosaceae | Bark of tree | gas trouble and abdominal diseases | THH; [43] |
| 3       | Acacia nilotica (L.) Delile. [0003/ASAB/NUST] | Kiker | Mimosaceae | Bark, leaves and branches | Mouth sores, gum pain and toothache, eye sores, sexual disability, diarrhea, asthma | THH; [43]; [44] |
| 4       | Achyranthus aspera L. [0004/ASAB/NUST] | Puth kanda | Amaranthaceae | Whole plant | Excessive menstruation, piles, abdominal pain, toothache, severe diarrhea. | THH; [41] |
| 5       | Adhatoda vasica Nees [0005/ASAB/NUST] | Bekkar | Acanthaceae | Leaves | High blood sugar | THH; [59] |
| 6       | Adiantum capillus veneris L. [0006/ASAB/NUST] | Sarhaj | Adiantaceae | Leaves | Jaundice and liver diseases | THH; [61] |
| 7       | Albizia lebbeck (L.) Benth [0007/ASAB/NUST] | Shrin | Mimosaceae | Leaves | Eye problems | THH; [43] |
| 8       | Allium cepa L. [0008/ASAB/NUST] | Piaz | Liliaceae | bulb | High blood pressure, high blood sugar | THH; [59] |
| 9       | Allium sativum L. [0009/ASAB/NUST] | Thoom | Liliaceae | bulb | Ear pain, hypertension, high blood sugar | THH; [43]; [59] |
| 10      | Aloe vera L. [0010/ASAB/NUST] | Knwar gandal | Liliaceae | Leaf sap, stern | Abdominal pains, constipation, skin diseases, high blood sugar | THH; [43]; [59] |
| 11      | Amaranthus viridis L. [0011/ASAB/NUST] | Chaulai | Amaranthaceae | Leaves | Menstrual disturbance, constipation | THH; [41]; [57] |
| 12      | Anethum graveolense L. [0012/ASAB/NUST] | Soye | Apiaceae | seeds | Abdominal pain | THH; [43] |
| No. | Species                        | Family          | Part Used          | Medicinal Uses                                                                                     | Refs |
|-----|-------------------------------|-----------------|--------------------|---------------------------------------------------------------------------------------------------|------|
| 13  | *Argyrolobium roseum* (Comb)  | Papilionaceae    | Whole plant        | Jaundice and liver diseases                                                                        | [THH]; [61] |
|     | *Artemisia scoparia* Walds & K. | Asteraceae       | Whole plant        | Abdominal disorder, earache, fever, jaundice, sluggishness, liver disease, joint pain             | [41] |
| 15  | *Atriplex spp.*               | Chenopodiaceae   | Leaves, whole plant| Jaundice and liver diseases                                                                        | [THH]; [61] |
| 16  | *Berberis lycium* Royle.      | Berberidaceae    | Leaves             | Jaundice, liver diseases, sexually transmitted diseases, weakness                                 | [THH]; [41]; [61] |
| 17  | *Boerhaavia procumbens* L.   | Nyctaginaceae    | Whole plant        | Jaundice, liver diseases, sexually transmitted diseases, weakness                                 | [THH]; [41]; [61] |
| 18  | *Bryophyllum pinnatum* Kurz.  | Crassulaceae     | Leaves             | Wounds healing                                                                                   | [THH]; [43] |
| 19  | *Cajanus cajan* (L.) Millsp.  | Papilionaceae    | seeds              | High blood sugar                                                                                  | [THH]; [59] |
| 20  | *Calotropis procera* Alton. F. | Asclepiadaceae   | Leaves, latex and flowers | Snake bite, piles, leprosy, sexually transmitted diseases, asthma, joint pain                           | [THH]; [43]; [44] |
| 21  | *Cannabis sativa* L.          | Cannabinaceae    | Leaves, flowers    | Indigestion, sexually transmitted diseases, also used as sedative, narcotic and antidote against poison | [THH]; [41]; [57] |
| 22  | *Caralluma edulis* (L.) Benth ex Hook. f. | Asclepiadaceae | aerial parts        | High blood sugar                                                                                  | [59] |
| 23  | *Carissa opaca* Stapf. ex. Haines | Apocynaceae     | Leaves             | Jaundice and liver diseases                                                                        | [THH]; [61] |
| 24  | *Carthamus oxycantha* Bieb.   | Asteraceae       | seeds              | Oil is used against itching                                                                         | [THH]; [41] |
| 25  | *Chenopodium album* L.        | Chenopodiaceae   | Whole plant        | Jaundice, urinary problems, antidote against snake bite                                            | [THH]; [41]; [57] |
| 26  | *Cicer arietinum* L.          | Papilionaceae    | seeds              | High blood sugar                                                                                  | [59] |
| 27  | *Cichorium intybus* L.        | Asteraceae       | Roots, whole plant | High blood sugar, jaundice and liver diseases                                                       | [THH]; [42]; [59]; [61] |
| 28  | *Citrus colocynthis* (L.) Schrad | Cucurbitaceae    | Fruit              | Abdominal diseases, constipation                                                                    | [THH]; [43] |
| 29  | *Convolvulus arvensis* L.     | Convolvulaceae   | Aerial parts       | Abdominal worms, used as deodorant, skin disorders                                                 | [THH]; [41]; [43]; [57] |
| 30  | *Cucumis sativus* L.          | Cucurbitaceae    | Fruit              | Jaundice and liver diseases                                                                        | [THH]; [61] |
| 31  | *Cynodon dactylon* L.         | Poaceae          | Stem, leaves       | Dysentery with fever                                                                               | [41] |
| 32  | *Cyperus rotundus* L.         | Cyperaceae       | Whole plant        | Indigestion, vomiting, diarrhea and vomiting, fever                                               | [41] |
| 33  | *Dalbergia sissoo* Roxb.      | Papilionaceae    | Leaves             | Dandruff                                                                                            | [43] |
| 34  | *Dodonaea viscosa* (L.) Jacq. | Sapindaceae      | Leaves             | High blood sugar                                                                                  | [59] |
| 35  | *Eucalyptus camaldulensis* Dehn | Myrtaceae        | Leaves             | Flu                                                                                               | [THH]; [43] |
| 36  | *Euphorbia helioscopia* L.    | Euphorbiaceae    | Leaves, root, latex| Constipation, increases milk supply                                                                 | [THH]; [41] |
| 37  | *Euphorbia royleana* Boiss.   | Euphorbiaceae    | branch             | Ear pain                                                                                            | [43] |
| No. | Scientific Name                      | Common Name                  | Family            | Part Used              | Uses                                                                 | References |
|-----|-------------------------------------|------------------------------|-------------------|------------------------|----------------------------------------------------------------------|------------|
| 38  | Fagonia indica Burm. F.             | Dhamian                      | Zygophyllaceae    | Leaves and branches    | Gas trouble, skin problems, high blood sugar                          | [THH]; [43]; [59] |
| 39  | Ficus bengalensis L.               | Bohr                         | Moraceae          | Leaves and branches latex | High blood sugar                                                      | [THH]; [59] |
| 40  | Foeniculum vulgare Mill.           | Soonf                        | Apiaceae          | Inflorescence          | Eye-cataract, stomach disorders, indigestion                          | [THH]; [43] |
| 41  | Fumaria indica (Husskn.)           | Shahtra papra                | Fumariaceae       | Whole plant            | Diarrhea, also used as blood purifier                                 | [THH]; [57] |
| 42  | Hordeum vulgare L.                 | Jo                            | Poaceae           | Seeds                  | Kidney pain, high blood sugar, jaundice                               | [42]; [43]; [59]; [61] |
| 43  | Ipomoea pentaphylla (L.) Jacq.     | Kaan Kati                     | Convolvulaceae    | Seeds                  | Jaundice, intestinal pain and worms                                    | [THH]; [57] |
| 44  | Justicia adhatoda L.               | Bahker                        | Acanthaceae       | Roots                  | Jaundice and liver diseases                                           | [THH]; [61] |
| 45  | Kickxia ramosissima (Wall) Janchen | Khunger booti                 | Scrophulariaceae  | Whole plant            | High blood sugar                                                      | [59] |
| 46  | Lactuca serriola L.                | Kahu                         | Asteraceae        | Whole plant            | Stomach ache, cough, and asthma                                      | [THH]; [41] |
| 47  | Malva parviflora Wall.             | Sonchal                       | Malvaceae         | Whole plant            | Cough, flue and fever                                                 | [THH]; [57] |
| 48  | Melo azedarach L.                  | Dharek, bakain, Herak         | Meliaceae         | Leaves, fruits          | Piles, foot itching, high blood sugar, emotional disturbance, blood pressure | [THH]; [43]; [44]; [59] |
| 49  | Momordica charantia L.             | Karella                       | Cucurbitaceae     | Fruits                 | High blood sugar                                                      | [THH]; [59] |
| 50  | Morus alba L.                      | Shehtoot, Chitta toot         | Moraceae          | Leaves, fruits          | Cough, sore throat, jaundice and liver diseases                        | [THH]; [43]; [57]; [61] |
| 51  | Morus nigra L.                     | Kalla toot                    | Moraceae          | Fruit                  | Cough, sore throat, jaundice and liver diseases                        | [THH]; [42]; [61] |
| 52  | Myrsine africana L.                | Khukan                        | Myrsinaceae       | Leaves                 | Jaundice and liver diseases                                           | [THH]; [61] |
| 53  | Ocimum album L.                    | Chitti Tulsi                  | Lamiaceae         | Leaves                 | High blood sugar                                                      | [57] |
| 54  | Ocimum basilicum L.                | Niazbo                        | Lamiaceae         | Leaves                 | Mouth sores                                                           | [THH]; [43] |
| 55  | Ocimum sanctum L.                  | Tulsi                         | Lamiaceae         | Leaves                 | High blood sugar                                                      | [59] |
| 56  | Oxalis corniculata L.              | Gandora, khati booti          | Oxalidaceae       | Leaves, seeds           | Jaundice, liver diseases, stomach disorder                            | [43]; [57]; [61] |
| 57  | Parthenium hysterophorus L.        | Chatak chandni                | Asteraceae        | Whole plant            | Severe diarrhea                                                       | [57] |
| 58  | Peganum heralma L.                 | Hermal                        | Zygophyllaceae    | Seeds and whole plant   | Abdominal pain, also Smoke has insecticidal properties                 | [THH]; [43] |
| 59  | Phyllanthus emblica L.             | Aamla                         | Euphorbiaceae     | Fruits                 | Jaundice and liver diseases                                           | [THH]; [61] |
| 60  | Plantago lanceolatum L.            | Ispaghol                      | Plantaginaceae    | Seed husk              | Gas trouble, indigestion, stomach problems                            | [THH]; [43] |
| 61  | Plantago ovata Forssk.             | Bhatti                        | Plantaginaceae    | Fruit, Seed husk       | Jaundice and liver diseases                                           | [THH]; [42]; [61] |
| 62  | Pongamia pinnata (L.) Merril        | Sukh chain                    | Papilionaceae     | Leaves, seeds, root    | Skin problems and stomach ache                                       | [41] |
| 63  | Praecitrullus fistulosus (Stocks) Pangalo. | Teenda                      | Cucurbitaceae     | Leaves                 | Blood pressure                                                        | [43] |
Plant parts used

Plants as whole and different parts are commonly used to cure different diseases in the study area. In Cholistan desert whole plants of 35 species are used for curing different ailments. Leaves of 17 plants are used to prepare different medicines. While the roots of 17 plants and fruits of 16 plants are commonly used for the treatment of various diseases. Seeds/nuts of 15 plants bark 14 and are being used to treat several ailments. Stems/twigs of 13 plants are commonly used, whereas gum/resin 13,
latex 12, floral buds of 6 plants and thorns of 2 plants are used as medicine. Among all the plants studied in Pothwar Plateau leaves of most plants (39) are used in herbal remedies to cure different ailments while whole plants and seeds of 17 of these are mostly used medicinally by local inhabitants. Percentage of all plants parts used is depicted in Figure 2.

Twenty eight therapeutic plants are used in the form of decoction and paste (used externally). 25 plant species are used in the form powder and syrup of 12 plant species are prepared before their use as medicine. Infusion of 11 plant species, fresh juice of 8 plant species and tablets of 7 plant species are prepared and used as medicine. “Majoon”/electuary of 7 plant species, ash or salt of 5 plant species and mother tincture of 4 plants are used to cure different diseases in Cholistan Desert areas.

**Diagnosis and treatment of diseases**

Traditional healers commonly diagnose illness by visual inspection, interviewing patients for symptoms and the duration of the health problem. Symptoms related to variation in pulse rate, eye color, skin color, mouth infections, body temperature and condition of sores, are the basis for prescription of remedy. Internal disorders are usually cured by recommending the herbal preparations in the form of syrup, while external wounds and dermal infections are treated by applying and rubbing herbal preparations on the affected parts.

Ethno-pharmacologically prepared drugs are traditionally administered with either medium like water, cow/buffalo milk, goat milk, sheep milk, “lassi” and “arq” (distillate). These media are commonly advised according to the condition of the patient, age and nature of the disease. The main purpose of these liquids is for good absorption of medicine, to minimize the side effects (if any) of given remedy, and sometimes these are recommended to provide the nutritional support to the patient along with medicines.

During present study it has been observed that water is recommended for medicine preferably than followed by cow/buffalo milk, goat milk, sheep milk, “lassi” and “arq”.

The comprehensive information on ethno-medicinal flora of Cholistan desert and Pothwar with regard to scientific names, local names, family, part used and diseases cure have been provided in Tables 2 and 3 respectively.

The survey of both areas revealed the variation in recommended dosages of medicinal plants among the traditional healers for treating the same disease. The traditional healers believed that the doses for liquid preparations are prescribed in terms of a full, half or one fourth of a cup, depending on the age, physical condition of the patient being treated, type of illness, diagnosis and severity of the disease. There is no standardized criterion for the dosage of herbal remedies. The quantities of preparation and prescription rates generally vary with the degree and duration of the ailment. The age group of the patient, type and level of disease further decide the rate of treatment. Lack of standard procedures and quality control is seen as a common problem of conventional medicines in the developing world [38].

During the recent past ethnobotanic research has been done tremendously to explore, use and conserve natural resources especially in search of novel crude drugs. Medicinal plants are a significant source of phytochemicals that are of great importance for the health of individuals and communities [38]. Geographically quite many ethnobotanic studies have been published in recent years in Pakistan [2]. Nevertheless some of them are mentioned here. During past 5 years most of the studies are done in mountain regions [39-43]. The studies are mainly focused on listing of ethnobotanic uses of plants. Some of the plants reported have also been proven scientifically to contain valuable medicinal properties [44-48]. Several ethnobotanic surveys done from Punjab province include Soan Valley [49], Thal desert [50], Khusab [51] and

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**Figure 2** Plant parts (%) used as medicine against different diseases in a. Cholistan Desert and b. Pothwar Plateau.
Sialkot [52]. Specific studies done on Cholistan area include [53-59]. The present study also supports the usages reported by earlier studies cited in Tables 2 and 3.

Conclusions and recommendations
The reported number of medicinal plants (67 species) in the native folklore remedies seems very significant considering the vegetation cover of Cholistan as the area has very sparse vegetation. The prolonged and reoccurring drought phenomenon, environmental degradation, grazing pressure and wood cutting for fuel purpose are the notable factors worth consideration to assess the significance of medicinal plants of Cholistan.

It can be concluded from the present study that Cholistan desert and arid areas of Pothwar (86 Species) are rich in indigenous medicinal plant wealth. Data acquired on medicinal plants of Northern Punjab (Pothwar area) and Southern Punjab (Cholistan) bears only 10.5% similarity. The total number of population in the area also justifies the high number of plants species under medicinal use. The local people of both areas possess a wealth of traditional knowledge. Plants of semiarid area of Pothwar have comparatively been explored more scientifically. The present information provides basis for the recognition of this undocumented knowledge but will also help in conservation of such an important desert species of Cholistan. It also opens the way for further investigation in new dimensions for better healthcare of human beings regarding various diseases. This study has highlighted that old indigenous knowledge of traditional medicine is still in use predominantly in Cholistan desert. Many folk remedies used in traditional medicine are used as a first line of health care. The trust of the respondents on traditional medicine regarding its efficacy and cost effectiveness establishes its preference over the modern allopathic drugs. But there is variation in use of these folk remedies in both areas. The faith of the Cholistani pastoralists is more in the traditional medicines. As the folklore knowledge has been passed on generally verbally from generation to generation and not documented, it is gradually fading. So it is recommended that research and developmental efforts should be focused on these plants species to scientifically identify the plant potential and substantially improve the traditional herbal therapies of the rural people.

The observations emerged from the present study should be substantiated with pharaco-chemical studies in order to evaluate their effectiveness. The study indicated that the area of study have plenty of medicinal plants to treat a wide range of human ailments. Present study revealed that the local people prefer folk medicine due to low cost and sometimes it is a part of their social life and culture. It develops proactive link between short-term actions to long-term goals and offers analytical tools to the survival of human communities. Therefore, it is imperative to acquire and preserve this traditional system of plant utilization by proper documentation and identification of specimen. This work presents a review focusing on the main historical and current interactions between humans and the flora, the ecological implications and the role of the ethnobotany in plants conservation. The importance of ethnobiological studies for biodiversity conservation has increasingly been recognized. Sustainable harvesting of these plants is an essential component of this study to conserve natural sources. Thus there is a need to create awareness about the importance of these plants among local people and to provide them guidance and training in collection and processing to enhance the economic benefits from their indigenous flora.

Competing interests
The authors declare that they have no competing interests.

Authors’ contributions
All authors contributed equally and approved the final version of the manuscript. MQH and SA supervised the whole work.

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Author details
1 Medicinal Plant Research Laboratory, Department of Plant Biotechnology, Atta-ur-Rahman School of Applied Biosciences (ASAB), National University of Sciences and Technology (NUST), Islamabad, Pakistan. 2 University of Agriculture, University of Sargodha, Sargodha, Pakistan. 3 Cholistan Institute of Desert Studies (CIDS), The Islamia University of Bahawalpur, Bahawalpur, Pakistan. 4 Department of Biotechnology, American University of Ras Al Khaimah, PO Box 10021, Ras Al Khaimah, United Arab Emirates.

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