



Some Important Species of the Genus *Artemisia* L. (Asteraceae) From Northeastern (Gilgit-Baltistan) Pakistan and Their Folk Medicinal Uses

Adil Hussain^{1,2*}, Muhammad Qasim Hayat³, and Syed Ali Imran Bokhari²

¹Department of Biotechnology, Faculty of Life Sciences, University of Okara, Okara 56130 Pakistan

²Department of Biological Sciences, International Islamic University Islamabad 44000, Pakistan

³Department of Plant Biotechnology, Atta-ur-Rahman School of Applied Biosciences, National University of Sciences and Technology Islamabad, 44000 Pakistan

Abstract: The present study reports some important species of the genus *Artemisia* with their folk medicinal uses from the Northeastern (Gilgit-Baltistan) region of Pakistan. The localities where the awareness of traditional information was not reported previously were surveyed and the local traditional knowledge about novel species of *Artemisia* was reported. For ethnobotanical data collection, questionnaire-based interviews were conducted from the local inhabitants where a total of 195 key respondents including 72.50% men and 27.50% women with 35 to 60 years of age were included. Interviews were performed in working days of some communal areas like farms, gardens, bazaars, nurseries, colleges, homes, and schools. The majority of the male informers were farmers, herbalists, Hakeem's, laborers, government workers, and shopkeepers while the majority of the female informers were housewives, teachers, and field workers. Here for the first time, we report fifteen *Artemisia* species, which were popularly used among residents of Gilgit-Baltistan as ornamentals, food, fuel, and these were employed medicinally in the treatment of more than thirty different types of diseases. It is desirable to conclude that the species of *Artemisia* from this remote region have great significance from the medicinal point of view and characterize a valuable natural asset.

Keywords: Genus *Artemisia*, Rare species, Ethnobotany, Gilgit-Baltistan, Pakistan

1. INTRODUCTION

Ethnobotanical practices of many communities worldwide are employed to treat certain types of diseases. Various societies have their traditional knowledge of the folk medicinal uses of significant herbs [1]. Primarily, ethnobotanical studies provide information on classical uses of plants and associated knowledge that can be further expanded for supplementary scientific discoveries [2].

Ethnobotanical studies validate local knowledge for the protection and management of biological diversity and also support the transmission of traditional information appropriately [3]. According to the Royal Botanical Garden Kew's State of the World's Plants 2017, at least 28, 187 plant species

are recorded as having a medicinal use worldwide and are utilized effectively against many health-related problems by direct or indirect means [4]. *Artemisia* L. is a polymorphic genus from the *Asteraceae* family. Species of *Artemisia* are generally found in the northern hemisphere, primarily in those sectors which are temperate, and a limited number of species are found in the southern hemisphere of the world [5]. *Artemisia* is a diverse genus, encompassing 500 species in the form of both herbs and shrubs [6]. Species of this genus contain a huge variety of chemical compounds, which are employed to treat numerous health problems like depression, insomnia, epilepsy, psychoneurosis, irritability, and anxiety [7]. Different extracts of *Artemisia* species are reported with antibacterial, antimalarial, antitumor, hepato-protective [8]

anticancerous, antioxidant, and anthelmintic activities [9].

Research has shown that nearly 60 species of *Artemisia* from diverse regions in Pakistan have been reported so far. These include areas of Baluchistan, Northern Punjab, Khyber Pakhtunkhwa, Kashmir, and Gilgit-Baltistan [12]. In northern Pakistan, one study [13] reported 12 species of *Artemisia* which were employed with great prevalence among native people. These species were *Artemisia annua*, *Artemisia absinthium*, *Artemisia brevifolia*, *Artemisia dracunculoides*, *Artemisia roxburghiana*, *Artemisia dubia*, *Artemisia herba-alba*, *Artemisia japonica*, *Artemisia santolinifolia*, *Artemisia maritima*, *Artemisia scoparia*, and *Artemisia vulgaris*. People use *Artemisia* plants as their source of food, fuel, medicines, and ornaments. Another study [14] from north Pakistan also documented eight species of the genus *Artemisia* which were generally employed by the indigenous occupants as folk traditional medicine. The reported eight species were, *A. absinthium*, *A. dubia*, *A. brevifolia*, *A. japonica*, *A. maritima*, *A. roxburghiana*, *A. moorcroftiana*, and

One ethno-veterinary medicinal plant, *Artemisia brevifolia* has been commonly employed as an anthelmintic source in Pakistan [15]. Some species of *Artemisia* like *A. annua*, *A. absinthium*, and *A. vulgaris* have been reported for their traditional uses in some Asian and European countries [16]. Moreover, one investigation documented that the performance of sheep digestibility can be improved when different *Artemisia* species were consumed by the sheep in place of rice straw in the diet [17]. One important species of *Artemisia*, *A. dubia* has been used to treat ulcers, asthma, and skin diseases. This plant has also been used as a stomachic in regions of Nepal [18]. Many other *Artemisia* species have been explored and reported with their potential anti-diabetic properties and the *Artemisia* species have been employed in a lot of countries for the treatment of high blood pressure, diabetes, and stomach related problems [19]. Another significant *Artemisia* species is *A. aucheri*, a local Iranian plant employed against leishmaniasis as a traditional medicine [20].

Moreover in China, the folk utilization of *A. annua* for malaria and fever was discussed by Wright [21]. In Pakistan, some important species of

Artemisia are mostly found in the northern Gilgit-Baltistan region. This region bears a diverse climate and is well known for holding immense biodiversity of plants [10] and trades medicinal herbs internationally because this region is considered to be the hub of medicinal plants [11]. The medicinal values of some common *Artemisia* species have been reported by Hayat et al. [13], Ashraf et al. [14], and Ghafoor [12] from the northern region of the country but, some rare *Artemisia* species and their traditional uses were not well documented from this distant region, where people are still dependent on these rare medicinal plants to cope with different health-related problems. In view of this, the present study was undertaken to report some *Artemisia* species from the Gilgit-Baltistan region and their utilization for primary health care treatments of health-related problems.

2. MATERIALS AND METHODS

2.1 Sampling

Broad field surveys were conducted with the native people over two years (2016-2017) in different localities of Gilgit-Baltistan, where species of *Artemisia* were formerly reported [12, 14]. Gilgit-Baltistan in the North-eastern region of Pakistan that bears a diverse climate and is well known for having immense biodiversity of plants. This region is located between the latitude 35° to 37° East and longitude 72° to 75° North and has 7 districts namely, Gilgit, Baltistan, Ghizer, Ghanche, Hunza Nagar, Astore, and Diamer (Fig. 1). Field studies were performed as described in the literature [6, 22]. *Artemisia* species were collected from different localities of 5 major districts of the Gilgit-Baltistan region viz; Gilgit, Ghizer, Hunza-Nagar, Skardu, and Astore (Fig. 1).

2.2 *Artemisia* Species and Iconography

During the field visits, preliminary data were collected *in situ* during meetings with the native inhabitants of 5 districts of the Gilgit-Baltistan region. To make it easy for the respondent, a checklist of collected *Artemisia* species was produced along with their photographs to have detailed meetings and conversations to obtain ethnobotanical information about *Artemisia* species [23].

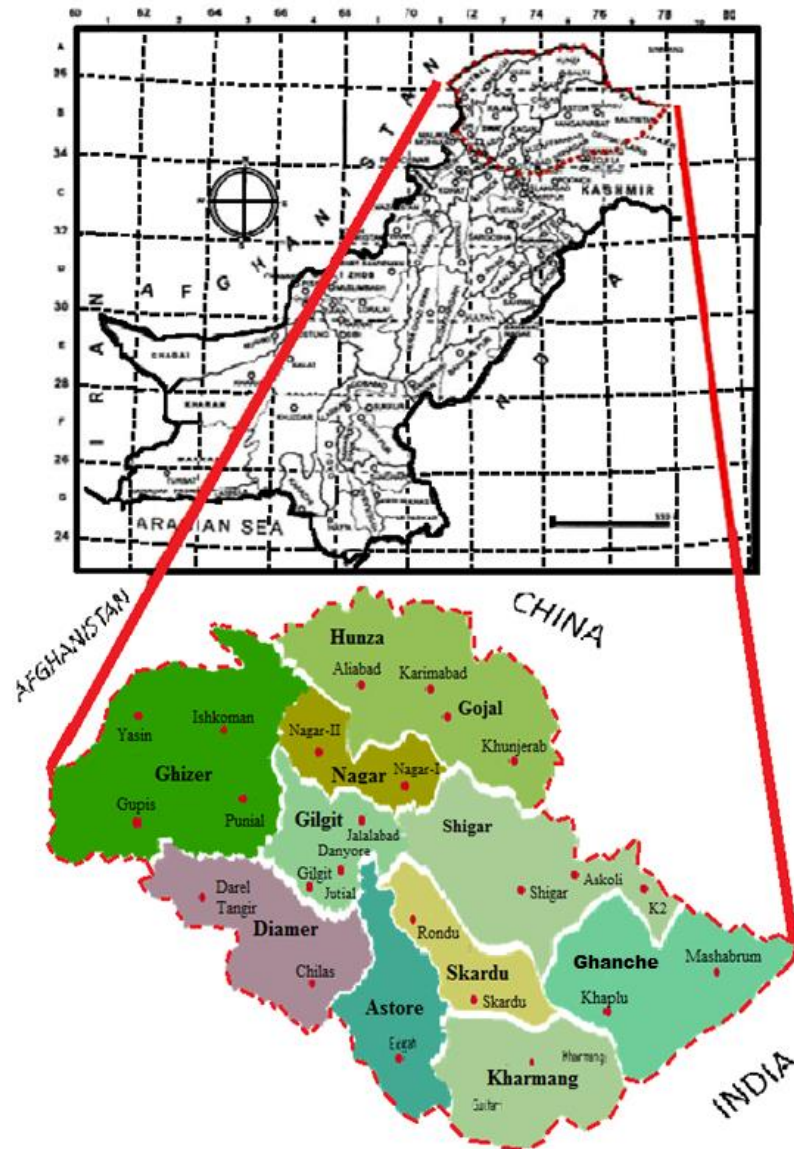


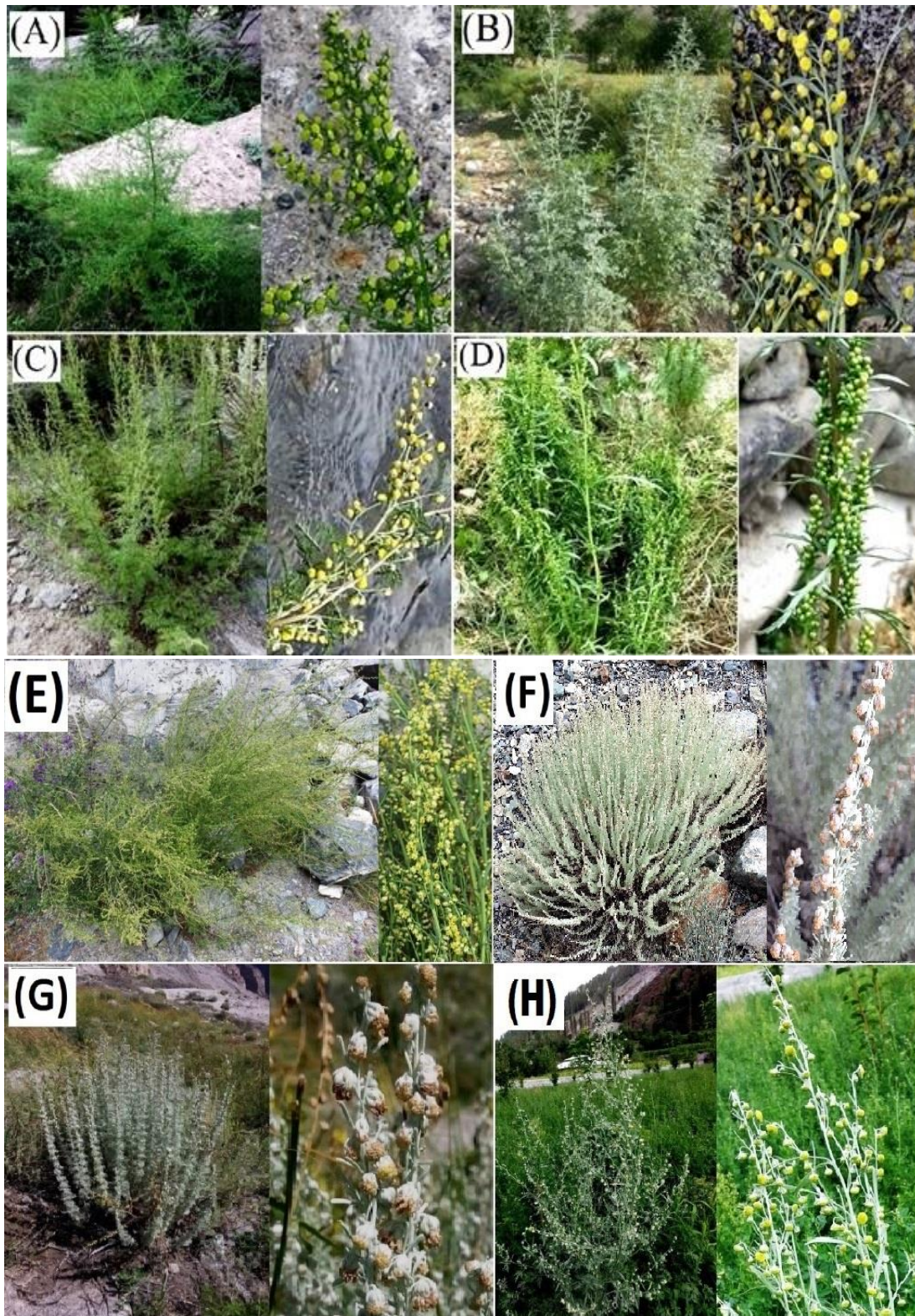
Fig 1. Map indicating different districts of the Northeast (Gilgit-Baltistan) Pakistan for the collection of *Artemisia* species.

2.3 Interviews and Conversations

During the field surveys, questionnaire-based interviews and discussions were conducted with the local inhabitants. The ethnobotanical data on *Artemisia* species which have been typically utilized for medicinal purposes in the surveyed regions were recorded. Before performing the interviews, the native people were notified and authorizations were obtained in prior informed consent (PIC) form.

The collection and management methods of plants used against different health-related problems, along with their local names and mode

of administration were documented with the help of a detailed questionnaire [13]. The conversations were performed in different native languages of the studied areas including Shina, Urdu, Astori, Brushuski, Balti, and Khovar. A total of 195 key respondents including 72.50% men and 27.50% women from 35 to 60 years of age were questioned. Interviews were conducted specifically with those people having superior acquaintance of folk medicinal utilization of the plant. Interviews were also performed on working days in some communal areas like farms, gardens, bazaars, nurseries, colleges, homes, and schools. The majority of the male study participants were farmers, herbalists,



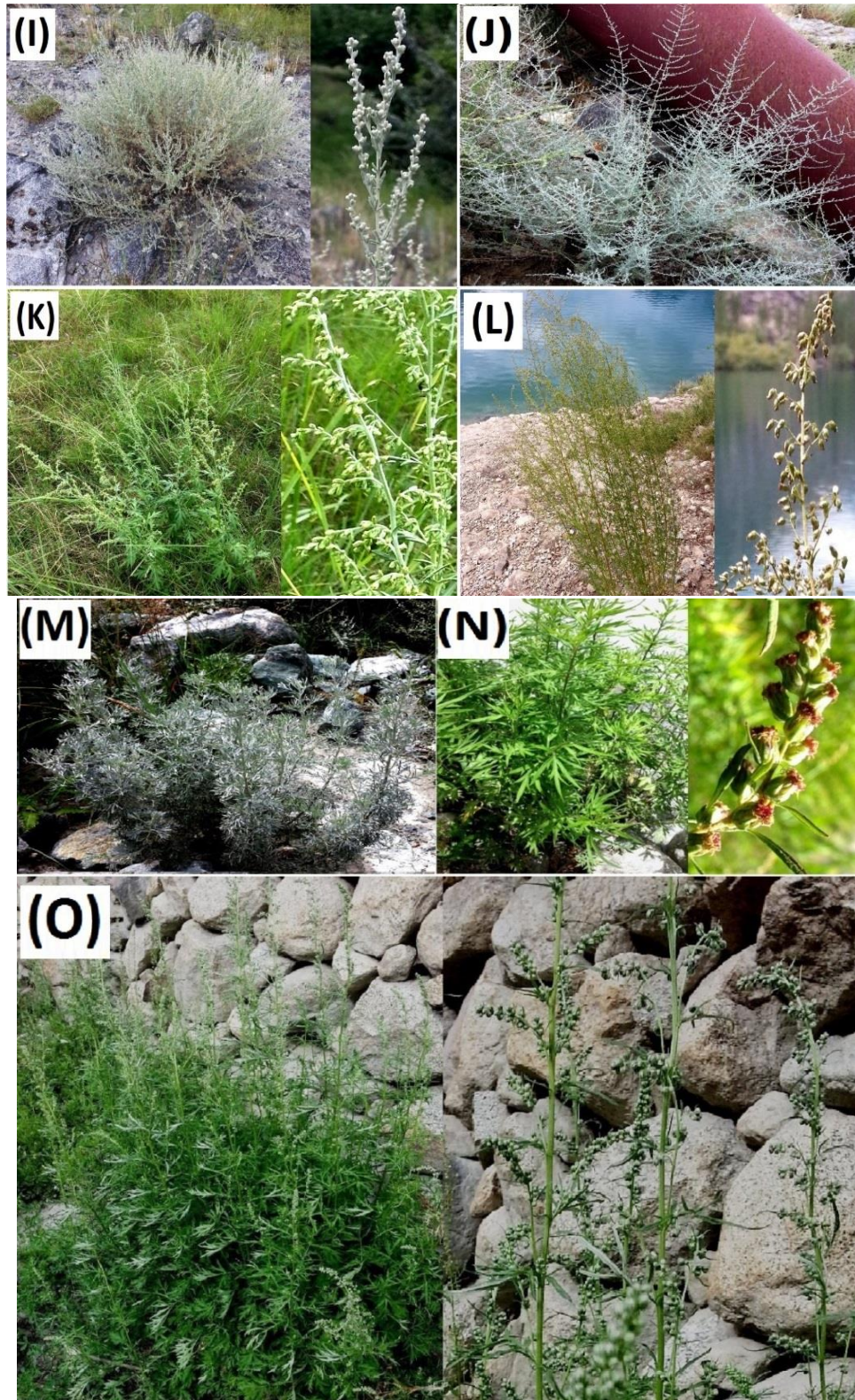


Fig 2. Plant and fluorescence of *Artemisia* species from different regions of Gilgit-Baltistan Pakistan: Photographs by Adil Hussain & Tanseer Hussain. (A)= *A. annua* (B)= *A. absinthium* (C)= *A. chamaemilifolia* (D)= *A. biennis* (E)= *A. campestris* (F)= *A. rutifolia* var. *altaica*. (G)= *A. rutifolia* var. *ruoqiangensis* (H)= *A. sieversiana* (I)= *A. maritima* (J)= *A. herba-alba* (K)= *A. indica* (L)= *A. scoparia* (M)= *A. austriaca* (N)= *A. verlotioram* (O)= *A. vulgaris*

Hakeem's, laborer's government workers, and shopkeepers while the majority of the female informers were housewives, teachers, and field workers.

2.4 Preparation of Herbarium and Plant Identification

The collected plants were pressed, dried up, labeled, and mounted on the herbarium sheets for submission in the Herbarium of Pakistan Museum of Natural History (PMNH) Islamabad, Pakistan to acquire a voucher specimen number for future reference (Table 1). The collected plants were identified by evaluating their morphological characteristics and also by relating them with existing samples in the herbarium of PMNH. The Flora of Pakistan was also consulted to confirm the identification of collected plants as described in studies [24].

3. RESULTS AND DISCUSSIONS

The list of studied *Artemisia* species in alphabetical order with their botanical names, local names, distribution, parts used, and life form is provided in Table 2. Here, we report 15 species of *Artemisia* with their folk medicinal and common uses from the Gilgit-Baltistan region of Pakistan. The *Artemisia* species reported include *A. annua* (Fig. 2A), *A. absinthium* (Fig. 2B), *A. sieversiana* (Fig. 2H), *A. maritima*, (Fig. 2I), *A. campestris* (Fig. 2E), *A. biennis* (Fig. 2D), *A. herba-alba* (Fig. 2J), *A. indica* (Fig. 2K), *A. scoparia* (Fig. 2L), *A. vulgaris* (Fig. 2O). To the best of our knowledge, this study preliminary reports the ethnobotanical data of some rare species of *Artemisia* including *A. chamemelifolia* (Fig. 2C), *A. rutifolia* var. *altaica* (Fig. 2F), *A. rutifolia* var. *ruoqiagensis* (Fig. 2G), *A. austriaca* (Fig. 2M) and *A. verlotiorum* (Fig. 2N) from the Gilgit-Baltistan region of Pakistan. The details of the studied *Artemisia* species along with their folk traditional and common uses are given in Table 2. Among the fifteen *Artemisia* species, 5 were shrubs and 10 species were herbs (Fig. 3). On a life cycle basis, 12 *Artemisia* species were found to be perennial, 1 species annual, and 2 species were biannual (Fig. 4). Concerning the utilization of different parts of *Artemisia* plants, the ethnobotanical data showed that 8 *Artemisia* species were used whole. On the other hand, only a single part or in combination (Seed, flower, leaves, stem,

and roots) of the remaining 7 plants were used for medicinal purposes (Fig. 5).

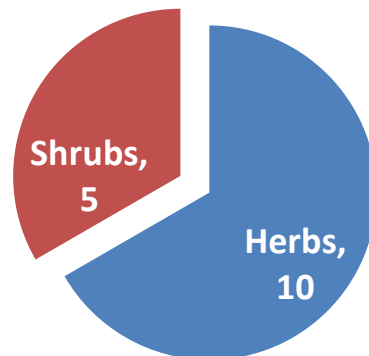


Fig. 3. Habit distribution of *Artemisia* species collected from different regions of Gilgit-Baltistan Pakistan.

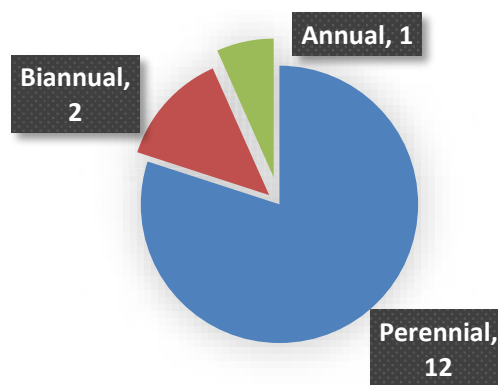


Fig. 4. Life cycle distribution of *Artemisia* species collected from different regions of Gilgit-Baltistan Pakistan

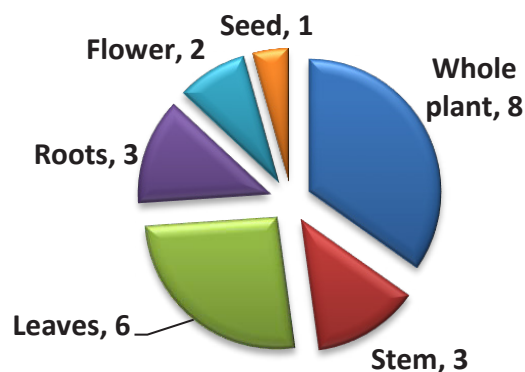


Fig. 5. Distribution of parts utilization of *Artemisia* plants collected from different regions of Gilgit-Baltistan Pakistan

Table 1. List of *Artemisia* species with GPS data, locality, and voucher specimen number collected from different location of Gilgit-Baltistan, Pakistan

Taxon	Latitude	Longitude	Location	Voucher specimen no
<i>Artemisia Absinthium</i> L.	N-36'19.756	E-74'52.520	Ataabad Hunza-Nagar	PMNH-41647
<i>Artemisia annua</i> L.	N-35'54.949	E-74'18.508	Barmas paen Gilgit	PMNH-41582
<i>Artemisia biennis</i> Willd	N-36'09.387	E-74'11.941	Naltar valley Gilgit	PMNH-41622
<i>Artemisia campestris</i> L.	N-36'08.708	E-74'12.397	Naltar valley Gilgit	PMNH-41619
<i>Artemisia chamaemelifolia</i> Vill.*	N-36'09.622	E-74'11.622	Naltar valley Gilgit	PMNH-41630
<i>Artemisia herba-alba</i> Asso.*	N-35'54.061	E-74'12.762	Kargah nala Gilgit	PMNH-41599
<i>Artemisia indica</i> Willd.	N-36'15.250	E-73'24.240	Yasin Ghizer	PMNH-41694
<i>Artemisia maritima</i> L. Ex Hook f	N-35'52.660	E-74'25.594	Minawar Gilgit	PMNH-41616
<i>Artemisia rutifolia</i> var. <i>altaica</i> (Krylov) Krasch *	N-35'11.963	E-75'37.387	Sadpara lake Skardu	PMNH-41712
<i>Artemisia rutifolia</i> var. <i>ruoqiagensis</i> Y.R.Ling	N-36'08.708	E-74'12.397	Naltar valley Gilgit	PMNH-41618
<i>Artemisia austriaca</i> Jacq.*	N-36'01.609	E-74'33.255	Bagrote valley Gilgit	PMNH-41643
<i>Artemisia scoparia</i> Waldst. & Kit.	N-35'26.665	E-75'26.960	Kachura lake Skardu	PMNH-41714
<i>Artemisia sieversiana</i> Ehrhl. Ex Willd.	N-36'14.875	E-73'21.810	Khalti lake Ghizer	PMNH-41691
<i>Artemisia verlotiorum</i> Lamotte.*	N-36'08.543	E-73'51.721	Bubar Ghizer	PMNH-41684
<i>Artemisia vulgaris</i> L.	N-36'20.508	E-74'52.277	Shishkat Hunza-Nagar	PMNH-41646

The voucher numbers were obtained from the Pakistan Museum of Natural History (PMNH) Islamabad Pakistan.

Collectors: Adil Hussain and Tanseer Hussain. “*” Represents rare *Artemisia* species whose folk medicinal uses are reported first time here from the Northeast (Gilgit-Baltistan) region of Pakistan

This ethnobotanical data has confirmed that the majority of the *Artemisia* species were employed for more than thirty different diseases in the study area. Five *Artemisia* species were utilized against diarrhea and three species against vomiting. Six *Artemisia* species were used to cure fever and four species are used to treat colds, cough, flu, pneumonia, and chest pain. Eight species were used against stomach worms and abdominal cramps. Eight species were used as pain killers, wound healers, and anti swellings. Four *Artemisia* species were used to treat diabetes and to maintain blood pressure. Two species were reported with their traditional uses against piles and one species was used against urinary problems. Two *Artemisia* species reported in this study were utilized to treat gastric and acidity problems. Four species were employed

against cholera and jaundice. One *Artemisia* species was used as a remedy against dental problems. Two *Artemisia* species were used against malarial parasites and a mosquito bite. One species was used against dizziness and insomnia. Three *Artemisia* species were reported as anti-inflammatory agents. One species was used against dermal contagions. Six species of *Artemisia* were used as an insect repellent. Three species were taken as anti-aging remedies and flavoring agents in traditional foods like “Dawdoo” and “soup”. Characteristically, numerous parts of *Artemisia* plants were prepared and taken with water, sugar, tea, and milk, etc. The frequent preparations comprise decoction and powder form etc. Many researchers have reported the ethnobotanical importance of *Artemisia* species from different localities of Pakistan [13, 14, 25, 26].

Table 2. Folk medicinal uses of *Artemisia* species from Gilgit-Baltistan region of Pakistan

S. No.	<i>Artemisia</i> spp.	Local Name	Life form	Local Distribution	Part used	Folk medicinal uses	Common uses
1	<i>A. annua</i>	Kashuphaphring, Kakayomon, Khakas	Herb	Gilgit, Astore and Ghizer	Whole plant	Leaves are used for the treatment of fever, cough, vomiting, diarrhea, stomach worm, and chest related ailments. Diabetic patients use dried leaves for making green tea. Leaf paste is used to heal wounds. Decoction of the whole plant is used to treat piles. People in Gilgit-Baltistan utilize it as an anti-aging remedy.	Live plant is used for ornamental purposes in Gilgit-Baltistan. Whole plant is used as an insect repellent. It is also utilized as fodder for goats and sheep.
2	<i>A. absinthium</i>	Khakamus, Khakas, Kkayomon, Khalkhalush	Herb	Gilgit, Ghizer, Astore, Hunza Nagar, Skardu, and Chilaas	Whole plant	Leaves are used to treat diabetes, vomiting, diarrhea, and stomach worm. Decoction of roots is also used against piles. Leaf paste is used for joint pain. Leaf juice in a small amount is given to pregnant women to ease labor pain. Leaves paste is used as a flavor enhancer in local foods (Daodo, Soup) and taken as an anti-aging remedy. Also used against fever, headache, back pain, dizziness and to treat insomnia	Used as an insecticide and also used as a flavoring agent in foods. Used as fodder for the cow
3	<i>A. chamemelifolia</i>	Jhao, Kakayomon	Herb	Naltar Gilgit, Ghizer, Hunza Nagar and Skardu	Whole plant	Leaves decoction is given to children as an anthelmintic. Also used to stop loose motions	Fodder for goat and sheep's
4	<i>A. biennis</i>	Bebari, Askor	Herb	Gilgit, Skardu, Astore, Hunza Nagar, Ghizer and Chilaas	Leaves Flower and seeds	Leaves are used against stomach pain and stomach worm. Leaves paste is used to heal wounds.	Seed powder is used as an insect repellent

5	<i>A. campestris</i>	Jaam, Jawan, Laheshi	Herb	Gilgit and Skardu	Whole plant	Leaves and flowers are used to treat cholera, fever, cough, and pneumonia. Roots decoction is used to treat jaundice.	Fodder for cow and donkey
6	<i>A. rutifolia</i> var. <i>ruoqiagensis</i>	Shao Zoon, Karbhursay, Karphobursay	Shrub	Naltar, Gilgit, Hunza Nagar	Whole Plant	Decoction of leaves is used for coughs, and fever. The tea prepared from dried leaves is given to women during childbirth to relieve pain	Used for ornamental purposes and to make roofs in villages of Gilgit-Baltistan. Also used for fuel purposes
7	<i>A. rutifolia</i> var. <i>altaica</i> .	Brom-mon, Zoon, Karbhursay	Shrub	Sadpara Skardu Naltar Valley Gilgit	Flower	Dried flowers are ground and powdered and used as anthelmintic for children	Used as a source of fuel for villagers
8	<i>A. herba-alba</i>	Charah, Sharajay, Jhawo	Shrub	Gilgit, Ghizer, Hunza Nagar, Astore, Skardu and Chilas	Whole plant	Leaves are used to control high blood pressure, to treat gastric problems, diarrhea, and abdominal cramping. Leaf juice is also ingested to treat diabetes. Also used for urinary problems. Roots are used to treat jaundice	Used as a source of fuel and employed for shelter purpose
9	<i>A. indica</i>	Khakas	Herb	Astore, Ghizer, and Skardu	Leaves and roots	Leaf decoction is used for diarrhea and abdominal cramping and stomach worm. Leaf paste is used for skin diseases. Root extract is used to relieve pain, especially kidney pain	Whole plant is used as insecticidal and mosquito repellent
10	<i>A. maritima</i>	Zoon, Kino Zoon, Biralis, Bhursay	Shrub	Gilgit, Skardu, Ghizer, Hunza Nagar and Astore	Whole plant	The leaves are used for stomach, fever, diarrhea and to normalize high blood pressure. Leaf decoction is used against malaria and mosquito bite. The plant is given to children for stomach-ache and to kill the stomach worm. Its roots are used as a cure for jaundice. Diabetic people use dried leaves to make tea as a cure for diabetes	Used as insect repellent and fodder for goats and sheep. Used for fuel and shelter purpose

S. No.	<i>Artemisia</i> spp.	Local Name	Life form	Local Distribution	Part used	Folk medicinal uses	Common uses
11	<i>A. austriaca</i>	Nilo Zoon	Shrub	Naltar, Bagrote Gilgit	Leaves and roots	Leaves are used to treat fever, pneumonia, and chest related ailments. Roots are dipped in hair oil and used as antidandruff	Used for ornamental purposes and fodder for goat
12	<i>A. scoparia</i>	Khasmer phyahma, Jhao	Herb	Gilgit, Skardu and Astore	Whole plant	Whole plant is used as diuretic, purgative, anti-inflammatory, and for the treatment of jaundice. Leaves are employed as an insecticidal	Used for fuel purpose and given as fodder to animals
13	<i>A. sieversiana</i>	khakhamus, Khakas	Herb	Skardu Baltistan	Leave, stem and roots	Leaves and stem are used against stomach worm and vomiting. Decoction of the plant is used to relieve joints pain. Root extract is applied to reduce swellings. Used with local foods as a flavor enhancer and considered as an anti-aging remedy	Fodder for cow and goat
14	<i>A. verlotiorum</i>	Khakhalus	Herb	Gahkuch, Sherqila, Bubar Ghizer	Leaves and stem	Leaves are used against stomach related problem. Stem is used as miswak to brush teeth.	Fodder for goat
15	<i>A. vulgaris</i>	Phamering	Herb	Khunjerab, Gojal Hunza Nagar, Gilgit and Skardu	Leaves and stem	Decoction of leaves is used to treat fever and cough. Also used as an anti-inflammatory and wound healer	Fodder for goat and sheep

Species of this genus are also used in traditional medicine in many communities of the world due to the presence of important phytochemicals. The crude extracts of *Artemisia* have proven potential antimicrobial and antioxidant activities, and these were very effective in the treatment of health-related problems [9]. In northern Pakistan, previous researchers, working in different areas of Pakistan have also reported traditional uses of *Artemisia* species [13, 14, 27]. Meetings and interviews conducted with local communities confirmed that the use of *Artemisia* species as traditional medicine is a common practice in those areas [13]. The data on folk medicinal uses of *Artemisia* species reported here are following other studies reported from other localities of Pakistan [13, 14, 27, 30]. Results of this study showed *A. scoparia* as an anti-inflammatory and purgative agent. A previous study of Hayat et al. [13] also reported *A. scoparia* as purgative and a remedy against burns in the Attock city of Pakistan. The majority of the species of *Artemisia* reported here are used against stomach-related problems like diarrhea, abdominal cramp, and intestinal worm.

A study by Hayat et al. [13] also displayed that *A. absinthium* is also employed against stomach-related problems predominantly against the intestinal worm. In the Kurram agency of Pakistan, *A. brevifolia* has been taken as an anthelmintic and also used against stomach related complications [29].

In one study, Qurashi et al. [27] reported the potential folk medicinal uses of *A. maritima* and *A. absinthium* from the Gilgit region of Pakistan. They suggested that the expansion and implementation of conservation methodologies are direly needed in the studied region that meets basic requirements and fulfills the economic development options. Moreover, the frequent plant utilization for medicinal purposes executes some alarming intimidations on plant population and their growth in nature [28].

In the Chitral valley of Pakistan, one study confirmed that *A. maritima* can be utilized as a cure against fever, intestinal worm, and stomach ache [30]. Another study from the Chitral region [31]. confirmed the folk medicinal utilization of *A. rutifolia* against certain gastrointestinal problems. Fever and stomach worms have also been treated

with this significant plant. Ahmed et al. [32] indicated the utilization of *A. santolinifolia* and *A. japonica* as folk medicines in the Chitral valley of Pakistan.

Folk traditional uses of two *Artemisia* species like *A. scoparia* and *A. vulgaris* were conferred by Khan et al. [33] and Hussain et al. [34] and their outcomes correspond with the results of this study. Many *Artemisia* species from the Gilgit-Baltistan region of Pakistan were studied for the antimalarial compound artemisinin by Mannan et al. [35].

They investigated *A. annua* and recommended this plant as a better source of artemisinin with potential antimalarial activity. This plant is also effective against fever, jaundice and it is taken as a blood purifier [36]. One more study from Pakistan reported the folk traditional utilization of *A. absinthium*, *A. brevifolia*, and *A. scoparia* with greater ethnopharmacological prominence [37].

Ashraf et al. [14] also reported an ethnobotany of *Artemisia* species from Pakistan. They substantiated that in addition to Pakistani regions, the majority of the *Artemisia* species are also used as folk medicine in other parts of the world. Eight *Artemisia* species were explored in their study, which was traditionally used by the native people as folk medicine. The reported species were *A. dubia*, *A. absinthium*, *A. moorcroftiana*, *A. brevifolia*, *A. japonica*, *A. vulgaris*, *A. maritima*, and *A. roxburghiana*. Their results about the ethnobotanical study of some *Artemisia* species are following the findings of this study, for example, Ashraf et al. [14] reported *A. absinthium* utilization against gastric problems and intestinal worms. We also found that this plant is used against stomach worms.

Fahad and Bano [25] investigated some threatened plants collected from two diverse altitudes from the Gilgit-Baltistan region of Pakistan. They acknowledged that *A. laciniata* is used against gall bladder infections, high fever, and jaundice. Their study further confirmed that the leaf paste of *A. maritima* is effective against skin infections. Here we found that *A. maritima* is used against stomach problems, diabetes, and malaria.

One study reported the folk medicinal significance of *Artemisia* from Astore valley of Gilgit-Baltistan region of Pakistan [38].

Recently, studies on *Artemisia* for their anatomical, morphological and molecular studies from the Gilgit-Baltistan region of Pakistan has added more important species from the region [39, 40-44] and the folk traditional uses of the species should also be reported.

Nevertheless, this investigation reports some significant *Artemisia* based therapies. For-example two species, *A. campestris* and *A. scoparia* were both been used as a cure for jaundice in the Gilgit-Baltistan region of Pakistan. Two species, *A. annua* and *A. absinthium* were employed in the treatment of piles. These two plants were also used as flavor enhancers in the local foods stuff and also taken as anti-aging medicine. Another important species, *A. chamaemelifolia* was taken as an anthelmintic specifically in children. One taxon, *A. rutifolia* var. *ruoqiagensis* was given to pregnant women to get relief from labor pain during pregnancy. *A. indica* was used against kidney pain and taken as a cure against skin related problems. One rare species *A. austriaca* was used against pneumonia and problems associated with the chest. *A. verlotiorum* was popularly used to treat stomach problems and used for dental concerns.

4. CONCLUSION

The results of this study substantiated a great diversity of *Artemisia* species and insights into their traditional utilization, along with their preparation and applications. Since the distant past, traditional utilization of medicinal herbs is still maintained and prominent within the indigenous communities of the Gilgit-Baltistan region. This continued perception very manifestly supports the persistent reliance of the local people on medicinal plants of the area. Ethnobotanical data from this study confirm that species of the genus *Artemisia* from Gilgit-Baltistan are very significant from a medicinal point of view and embodying a valuable natural asset. Consequently, this fundamental awareness gives necessary pointers for researchers to examine their chemical composition and significant biological activities to deal with different health-related complications predominantly in the fields of dermatology, hepatology, neurology, oncology, and parasitology.

6. REFERENCES

1. M.E. Osawaru, and F.M. Dania-Ogbe. Ethnobotanical studies of West African okra [*abelmoschuscaillei* (A. chev) stevels] from some tribes of south western Nigeria. *The Scientific World Journal* 5: 1 (2010).
2. M. Parada., E. Carrio, M.A. Bonet, and J. Valles. Ethnobotany of the Alt Empord' a region (Catalonia, Iberian Peninsula): plants used in human traditional medicine. *Journal of Ethnopharmacology* 124: 609–618 (2009).
3. M. Ibrar., F. Hussain, and A. Sultan. Ethnobotanical studies on plant resources of Ranyal Hills, District Shangla, Pakistan. *Pakistan Journal of Botany* 39: 329–337 (2007).
4. Royal Botanic Gardens Kew's State of the World's Plants 2017: https://stateoftheworldsplants.org/2017/report/SOTWP_2017.pdf
5. C. Oberprieler., S. Himmelreich, M. Kaallersjo, J. Valle`s, and R. Vogt. *Anthemideae*. In: *Systematics, evolution, and biogeography of the Compositae*, Funk V, Susanna A, Stuessy TF. Bayer R (Ed.). IAPT, Vienna, p. 631–666 (2009).
6. J. Martin., M. Torrel, A.A. Korobkov, and J. Valles. Palynological features as systematic marker in *Artemisia* L. and related genera (*Asteraceae*, *Anthemideae*)–II: implications for subtribe Artemisiinae delimitation. *Plant Biology* 5(1): 85-93 (2003).
7. H.L. Walter, P.F. Memory, and L. Elvin. Ed. *Medicinal Botany*, 2nd Ed, John Wiley and Sons, New Hersey: 345 (2003).
8. D.A. Terra., L. de Fátima Amorim, M.T.J. de Almeida Catanho, A. de Souza da Fonseca, S.D. Santos-Filho, J. Brandão-Neto, A. da Cunha Medeiros, and M. Bernardo-Filho. Effect of an extract of *Artemisia vulgaris* L. (Mugwort) on the in vitro labelling of red blood cells and plasma proteins with technetium-99m. *Brazilian Archives of Biology and Technology* 50: 123-128 (2007).
9. A. Hussain., M.Q. Hayat, S. Sahreen, Q.U. Ain, and S.A.I. Bokhari. Pharmacological Promises of Genus *Artemisia* (*Asteraceae*): a Review. *Proceedings of the Pakistan Academy of Sciences: B. Life and Environmental Sciences*. 54 (4): 265–287 2017.
10. Z.K. Shinwari. Medicinal plants research in Pakistan. *Journal of Medicinal Plant Research*. 4(3): 161-176 (2010).

11. Z.K. Shinwari, and S.S. Gilani. Sustainable harvest of medicinal plants at Bulashbar Nullah, Astore (Northern Pakistan). *Journal of Ethnopharmacology* 840: 289-298 (2003).
12. A. Ghafoor. *Asteraceae* (I)-*Anthemideae* In: Ali SI, & Qaiser M (eds.), *Flora of Pakistan, Missouri Botanical Garden, St. Louis, Missouri, U.S.A.*, 207: 93-161 (2002).
13. M.Q. Hayat., M.A. Khan, M. Ashraf, and S. Jabeen. Ethnobotany of the Genus *Artemisia* L. (*Asteraceae*) in Pakistan. *Ethnobotany Research and Applications* 7: 147-162 (2009).
14. M. Ashraf., M.Q. Hayat, S. Jabeen, N. Shaheen, M.A. Khan, and J. Yasmin. *Artemisia* L. species recognized by the local community of northern areas of Pakistan as folk therapeutic plants. *Journal of Medicinal Plants Research* 4: 112-119 (2010).
15. Z. Iqbal., M. Lateef, M. Ashraf, and A. Jabbar. Anthelmintic activity of *Artemisia brevifolia* in sheep. *Journal of Ethnopharmacology* 93(2-3): 265–268 (2004).
16. P. Proksch. *Artemisia*. In: Hansel, R. Keller, K. Rimpler, H. Schneider, G. and Hrsg (Eds.), *Hagers Handbuch der Pharmazeutischen Praxis*. Springer-Verlag, Berlin. 357-377 (1992).
17. Y.D. Ko., J.H. Kim, A.T. Adesogan, H.M. Ha and Kim. The effect of replacing rice straw with dry wormwood (*Artemisia* sp.) on intake, digestibility, nitrogen balance and ruminal fermentation characteristics in sheep. *Animal Feed Science and Technology* 125: 99-110 (2006).
18. P.P. Sapkota. Ethno-ecological observation of Magar of Bukini, Baglung, Western, Nepal. Dhulagiri. *Journal of Sociology and Anthropology* 2: 227-252 (2008).
19. A. Subramoniam., R.S. Pushpangadan, S. Rajasekharan, D.A. Evans, P.G. Latha, and R. Valsaraj. The effects of *Artemisia pallen* Wall. on blood glucose level in normal and alloxan-induced diabetic rats. *Journal of Ethnopharmacology* 1: 13-17 (1996).
20. M. Azadbakht., H. Ziaei, F. Abdollahi, and B. Shabankhani. Effect of essential oils of *Artemisia*, *Zataria* and *Myrtus* on *Trichomonas vaginalis*. *Journal of Medicinal Plants* 8: 35-40 (2003).
21. W.C. Wright. *Artemisia*. Taylor and Francis, London pp, 1-344 (2002).
22. K.W. Bridges, and Y.H. Lau. The skill acquisition process relative to ethnobotanical methods, *Ethnobotany Research and Applications* 4: 115-118 (2006).
23. K. Rehman., Z.R. Mashwani, M.A. Khan, Z. Ullah, and H.J. Chaudhary. An ethnobotanical perspective of traditional medicinal plants from the Khattak tribe of Chonthra Kara. *Journal of Ethnopharmacology* 165: 251–259 (2015).
24. S.I. Ali, and M. Qaiser. (Eds.). *Flora of West Pakistan. Nos 194-217* Karachi (1993-2010).
25. S. Fahad, and A. Bano. Ethnobotanical and physiological studies of some endangered plant species collected from two different altitudes in Gilgit Baltistan. *Pakistan Journal of Botany* 44: 165-170 (2010).
26. M. Nadeem., Z.K. Shinwari, & M. Qaiser. Screening of folk remedies by genus *Artemisia* based on ethnomedicinal surveys and traditional knowledge of native communities of Pakistan. *Pakistan Journal of Botany* 4: 111-117 (2013).
27. R.A. Qureshi., M.A. Ghufuran, K.N. Sultana, M. Ashruf, and A.G. Khan. Ethnobotanical studies of medicinal plants of Gilgit District and surrounding areas. *Ethnobotany Research and Applications* 5: 115-122 (2006).
28. S.K. Ghimire., O. Gimenez, R. Pradel, D. McKey, and Y. Aumeeruddy-Thomas. Demographic variation and population viability in a threatened Himalayan medicinal and aromatic herb *Nardostachys grandiflora*: matrix modelling of harvesting effects in two contrasting habitats. *Journal of Applied Ecology* 45: 41–51 (2008).
29. S.S. Gilani., S.Q. Abbas, Z.K. Shinwari, F. Hussain, and K. Nargis. Ethnobotanical studies of Kurram Agency, Pakistan through rural community participation. *Pakistan Journal of Biogeographical Sciences* 6: 1368-1375 (2003).
30. A. Aziz. Indigenous knowledge of plant uses and ethnobotany of Chitral with particular reference to medicinal plants. Proceedings of the Ethnobotany Workshop. *National Agriculture Research Center, Islamabad* (1996).
31. H. Ali., and M. Qaiser. The ethnobotany of Chitral valley, Pakistan with particular reference to medicinal plants. *Pakistan Journal of Botany* 41(4): 2009-2041 (2009).
32. S. Ahmad., A. Ali, H. Beg, A.A. Dasti, and Z.K. Shinwari. Ethnobotanical studies on some medicinal plants of Booni Valley, District Chitral Pakistan. *Pakistan Journal of Weed Science Research* 12(3): 115-118 (2006).

- 183-190 (2006).
33. A. Khan., S.S. Gilani, F. Hussain, and M.J. Durrani. Ethnobotany of Gokand valley, District Bunner, Pakistan. *Pakistan Journal of Botany* 6: 363-369 (2003).
 34. F. Hussain., I. Iqbal, and M.J. Durrani. Ethnobotany of Ghalegay, District Sawat, Pakistan. *Acta Botanica Yunnanica* 28: 305-314 (2006).
 35. A. Mannan., N. Shaheen, W. Arshad, R.A. Qureshi, M. Zia, and B. Mirza. Hairy roots induction and artemisinin analysis in *Artemisia dubia* and *Artemisia indica*. *African Journal of Biotechnology* 7(18): 3288-3292 (2008)
 36. A.A. Sardar, and Z.U.D. Khan. Ethnomedicinal studies on plant resources of tehsil shakargarh, district narowal, Pakistan. *Pakistan Journal of Botany* 41: 11-18 (2009).
 37. S. Khan, and S Khatoon. Ethnobotanical studies on some useful herbs of Haramosh and Bugrote valleys in Gilgit, Northern Areas of Pakistan. *Pakistan Journal of Botany* 40: 43-48 (2008).
 38. A. Noor., K. Khatoon, M. Ahmed, and A. Razaq. Ethnobotanical study on some useful shrubs of Astore valley, Gilgit-Baltistan, Pakistan. *Bangladesh Journal of Botany* 43: 19-25 (2014).
 39. A. Hussain., M.Q. Hayat, S. Sahreen, and S.A.I. Bokhari. Unveiling the foliar epidermal anatomical characteristics of genus *Artemisia* (*Asteraceae*) from northeast (Gilgit-Baltistan), Pakistan. *International Journal of Agriculture and Biology* 21: 630-638 (2019a).
 40. A. Hussain., D. Potter., S. Kim., M.Q. Hayat, and S.A.I. Bokhari. Molecular phylogeny of *Artemisia* (*Asteraceae-Anthemideae*) with emphasis on undescribed taxa from Gilgit-Baltistan (Pakistan) based on nrDNA (ITS and ETS) and cpDNA (psbA-trnH) sequences. *Plant Ecology and Evolution* 152: 507-520 (2019b).
 41. A. Hussain., D. Potter, M.Q. Hayat, S. Sahreen & S.A.I. Bokhari. Pollen morphology and its systematic implication on some species of *Artemisia* L. from Gilgit-Baltistan Pakistan. *Bangladesh Journal of Plant Taxonomy* 26: 157-168 (2019c)
 42. A. Hussain., M.Q. Hayat, and S.A.I. Bokhari. New distribution report on the alien species *Artemisia verlotiorum* Lamotte (*Asteraceae- Anthemideae*) from Gilgit-Baltistan region of Pakistan. *Pakistan Journal of Weed Science Research* 26:167-178 (2020a)
 43. A. Hussain., M.Q. Hayat, and S.A.I. Bokhari. *Artemisia chamaemelifolia* Vill: a rare species of genus *Artemisia* (*Asteraceae-Anthemideae*) now present in the northeast (Gilgit-Baltistan) region of Pakistan. *Biologia* (2020b) <https://doi.org/10.2478/s11756-020-00610-y>
 44. A. Hussain. (2020). The Genus *Artemisia* (*Asteraceae*): A Review on its Ethnomedicinal Prominence and Taxonomy with Emphasis on Foliar Anatomy, Morphology, and Molecular Phylogeny. *Proceedings of the Pakistan Academy of Sciences: B. Life and Environmental Sciences* 57 (1): 1-28 (2020c)