



Ethnobotany of the Genus *Artemisia* L. (Asteraceae) in Pakistan

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Research

Abstract

Pakistan hosts rich biodiversity, including 38 species of the genus *Artemisia* L. (Asteraceae). Plant morphological descriptions were noted by means of observations and ethnobotanical details were documented through questionnaires and meetings, with herbalists and local inhabitants. Twelve *Artemisia* species are popularly used among Pakistani people as food, ornaments, fumigants and medicines. These are *Artemisia absinthium* L., *Artemisia annua* L., *Artemisia brevifolia* Wall. ex DC., *Artemisia dracunculoides* L., *Artemisia dubia* Wall. ex Besser, *Artemisia herba-alba* Asso., *Artemisia japonica* Thunb., *Artemisia maritima* L. Ex Hook.f., *Artemisia roxburghiana* Wall. ex Besser, *Artemisia santolinifolia* Turcz. ex Krasch., *Artemisia scoparia* Waldst. & Kit., and *Artemisia vulgaris* L.

Introduction

Artemisia L. is a large, diverse and economically important genus of the family Asteraceae. It has more than 500 species (the number fluctuate depending on authors: Bremer & Humphries 1993, Ling 1982, 1991a,b, 1994, 1995a,b, Mabberley 1990, McArthur 1979, Oberprieler 2001, Valles & Garnatje 2005, Valles & McArthur 2001). *Artemisia* is a wind pollinated cosmopolitan genus, mainly distributed in temperate areas of mid to high latitudes of the northern hemisphere, colonizing in arid and semiarid environmental landscape, with only a few representatives in the southern hemisphere. Central Asia is its center of diversification, while the Mediterranean region and North West America are two secondary speciation areas (McArthur & Plummer 1978, Valles & McArthur 2001). A few species are also reported in Africa and Europe (Ling 1994, Shultz 2006, Tutin *et al.* 1976). Many species are economically important as medicines, food, forage, ornamentals or soil stabilizers in disturbed habitats. Some taxa are toxic or allergenic and some others are invasive weeds which can adversely affect harvests (Pareto 1985, Tan *et al.* 1998).

Most of the species are perennial with only ten being annuals or biannual (Valles *et al.* 2003). *Artemisia* is considered as an indicator of steppe climate (Erdtman 1969) and moderate precipitation (El-Moslimany 1990). Due to high number of species, ecological and economic importance, the genus *Artemisia* has been the object of a diversity focused studies (Valles *et al.* 2003).

Artemisia is a taxonomically complex genus because some species have different morphological forms and others closely resemble each other. These traits make it quite difficult to correctly identify a sample without detailed morphological review. *Artemisia* species are mostly herbs, and sometimes shrubs, usually with strong aroma. Plant bodies are often densely hairy. Leaves are pinnatifid to pinnatisect with variable dimensions. Capitulum inflorescence is generally in the form of a paniculate-raceme arrangement. Herbaceous involucral bracts are present. Receptacles are convex or flat and naked or covered by hairs. Ray florets are pistillate. Corolla color is yellow or green and rarely brown. Disk florets are bisexual. Cypselas are obovoid to oblong and mostly brown (Ghafoor 2002).

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Figure 2 (to left). Provinces and some major cities of Pakistan.

Figure 3 (below). Other locations in Pakistan with *Artemisia*. A. Astor; B. Attock; C. Azad Jammu; D. Baltistan; E. Chitral; F. Deosai plains; G. Hunza; H. Jhelum; I. Kalat; J. Khagan; K. Khuzdar; L. Kohat; M. Kurram; N. Ladakh; O. Malakand; P. Mansehra; Q. Muzafarabad; R. Parachinar; S. Peshawar; T. Ponch; U. Quetta; V. Rawalpindi; W. Skardu; and X. Swat.

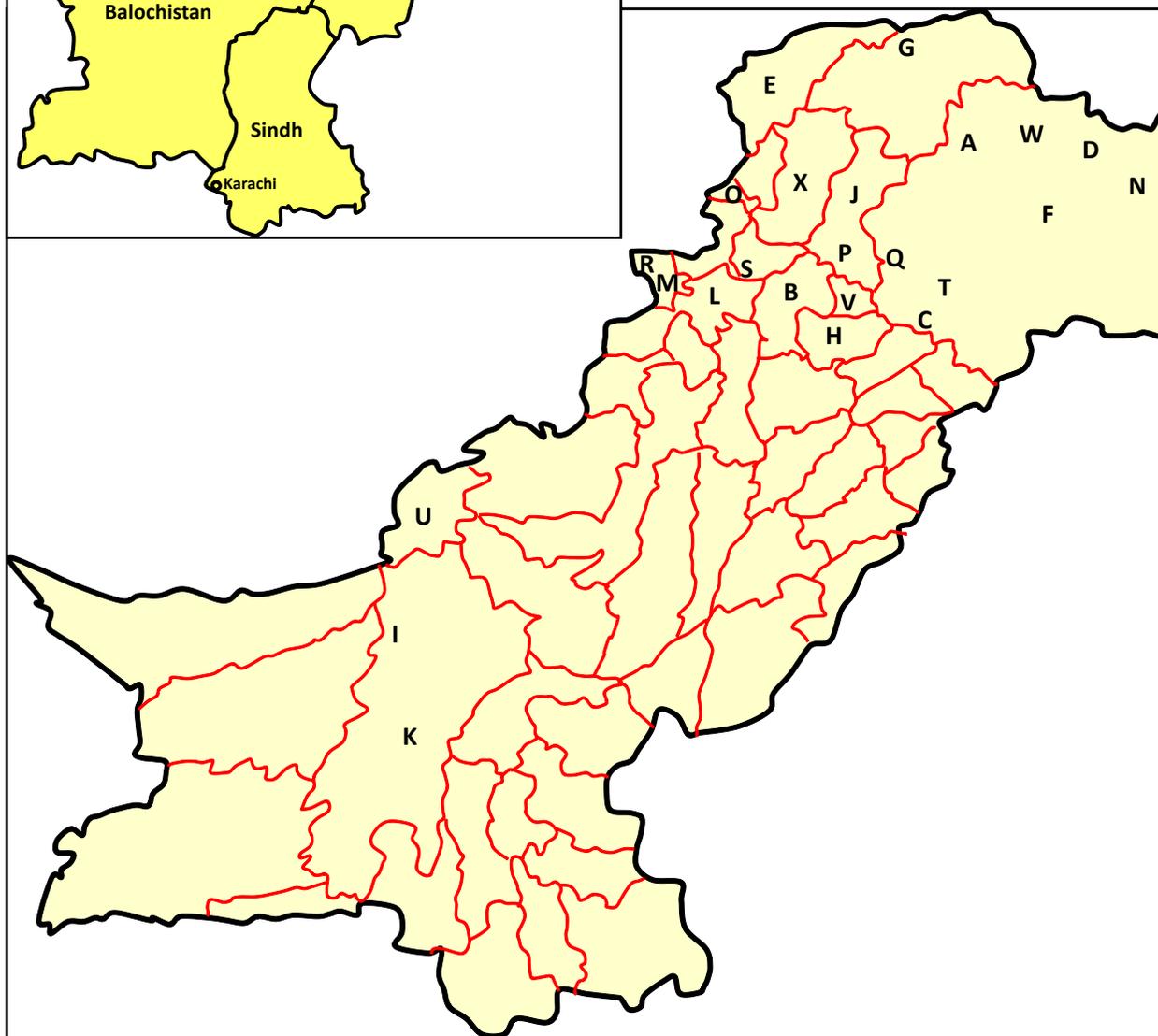


Table 1. List of taxa studied ethnobotanically and their herbarium vouchers. ISL: Herbarium, Quaid-i-Azam University, Islamabad. PUP: Herbarium, University of Peshawar, Peshawar.

Taxon	Collection data	Herbarium voucher
<i>A. absinthium</i> L.	Gilgit: Nattar valley. M.Q. Hayat, 2007	PUP, PH004 (ART004)
<i>A. annua</i> L.	Skardu. M.Q. Hayat, 2008	ISL, 16253
<i>A. brevifolia</i> Wall. ex DC.	Mansehra: Ujtar, Naran to Lalusar lake track. M.Q. Hayat, 2007	PUP, PH007 (ART007)
<i>A. dracuncululus</i> L.	Gilgit: Nattar valley. M.Q. Hayat, 2007	ISL, 19222
<i>A. dubia</i> Wall. ex Besser	Rawalpindi: Murree Hills, PLT, Ayubia National Park. M.Q. Hayat, 2007	PUP, PH002 (ART002)
<i>A. herba-alba</i> Asso.	Quetta: Hanna Lake. M.A. Khan, 2007	ISL, 28615
<i>A. japonica</i> Thunb.	Rawalpindi: Murree Hills, PLT, Ayubia National Park. M.Q. Hayat, 2007	PUP, PH008 (ART008)
<i>A. maritima</i> L. ex Hook.f.	Kurram Agency. M.Q. Hayat, 2007	ISL, 92830
<i>A. roxburghiana</i> Wall. ex Besser	Rawalpindi: Murree Hills, PLT, Ayubia National Park. M.Q. Hayat, 2007	PUP, PH001 (ART001)
<i>A. santolinifolia</i> Turcz. ex Krasch.	Gilgit: Nattar valley. M.Q. Hayat, 2007	PUP, 239 (1108)
<i>A. scoparia</i> Waldst. & Kit.	Islamabad: Quaid-i-Azam University campus. M.Q. Hayat, 2008	ISL, 32313
<i>A. vulgaris</i> L.	Azad Jammu & Kashmir: Pearl valley, Mutyal Mara. M.Q. Hayat, 2008	PUP, PH006 (ART006)

Shinwari and Khan (2000), Trotter (1981), and Vogl *et al.* (2004). *Artemisia* diversity was surveyed in 43 different localities (Figure 1, Table 1). Plant specimens were collected, identified and described morphologically. The voucher specimens were deposited in Quaid-i-Azam University Islamabad (ISL) and University of Peshawar, Peshawar (PUP) herbaria for future reference (Table 1).

A questionnaire was used to interview the local inhabitants during the field surveys and ethnobotanical information was gathered on *Artemisia* species which were commonly used in studied localities. Vernacular names, harvesting and processing methods and mode of administration of these plants to treat human ailments along with other uses were noted through the questionnaire. The questionnaire was completed by interviewing informants who were knowledgeable in traditional uses of *Artemisia*, and are native to the studied areas or have spent most of their lives there. These informants were selected as those recognized as having knowledge by the local community. The conversation was done in local languages (Urdu, Pashto, Shena, Punjabi, Hindco and Kashmiri). Local guides were approached for communication between the local communities and informants. A total of 173 key informants (66.92% men and 33.07% women) between the ages of 50-60 years were interviewed. Repeated queries were made to get the data confirmed.

Results

In this research work, we have identified twelve *Artemisia* species which are utilized by local communities of different localities in different ways. Plant descriptions, distributions, part used and folk uses are described below.

1. *A. absinthium* L. (**Vilayati afsantin, Afsantin, Kakamush, Afsantheen, Zoon**) (Figure 4)



Figure 4. *Artemisia absinthium* L. (A: Young plants, B: Flowers), Pakistan.

Phytography: The plant grows mostly in humid soils or near water in rocky terrain with the sandy clay soil. This herb is perennial with 70 to 150 cm tall hairy stems which are somewhat woody at the base. Petioles of basal leaves are 6 to 12 cm long. The leaf blade is ovate to elliptic or ovate, 9-12 cm X 7-9 cm, 3-pinnatisect in segments which are pinnately lobed. Lobules are lanceolate-elliptic or linear, 7-15 mm X 2-5 mm with obtuse apex. Petiole of middle cauline leaves is 2 to 6 cm long. Leaf blade is ovate or elliptic-ovate, 2-pinnatisect. Lobules are linear-lanceolate, 10-20 mm X 3-5 mm. Uppermost leaves are 4-7 cm X 2-5 cm, pinnatisect and lobed. Leafy bracts are 3-lobed and entire. Globose Capitula have paniculate arrangement which is 3.5 to 4 mm in diameter with short pedicel. Receptacle is semiglobose and densely hairy. Cypselas are oblong with minute upper crown.

Flowering period: June to September.

Local distribution: Found in Chitral, Skardo, Ladakh, Parachinar and Kurram Agency from 1000 to 3500 m altitude.

Distribution in the world: Afghanistan, China, India, Japan, Kazakstan, Kyrgyzstan, Russia, Europe, North Africa, SW Asia, and North America.

Part Used: Whole Plant, leaves and seeds.

Ethnobotanical uses:

1. The dried plant is used to protect clothes against insects and as an insecticide.
2. The whole plant decoction is used as a tonic for general health.
3. Leaf powder is used for gastric problems and intestinal worms.
4. Seed powder is taken orally to treat rheumatism.
5. Seed powder paste is applied on teeth for pain relief.

2. *A. annua* L. (**Afsantin, Afsantin jari**) (Figure 5)

Phytography: This herb is annual, up to 190 cm tall, much branched and with strong aromatic smell. Stems are sparsely hairy. Leaves have punctate glands. Petiole of middle cauline leaves are 1.5-2.5 cm long. Lowermost cauline leaves are ovate or triangular-ovate, 3.5-6 cm X 2.5-6.5 cm. 3-pinnatipartite leaves have 6-10 segments in pairs. lobules are deeply serrate with triangular teeth, 1.5-2 X 0.5 mm. Mid vein is prominent adaxially. Middle cauline leaves are 2 to 3 pectinatisect. Uppermost leaves and leafy bracts are 2-pinnatipartite. Globose capitula in a broad pyramidal with paniculate arrangement, which

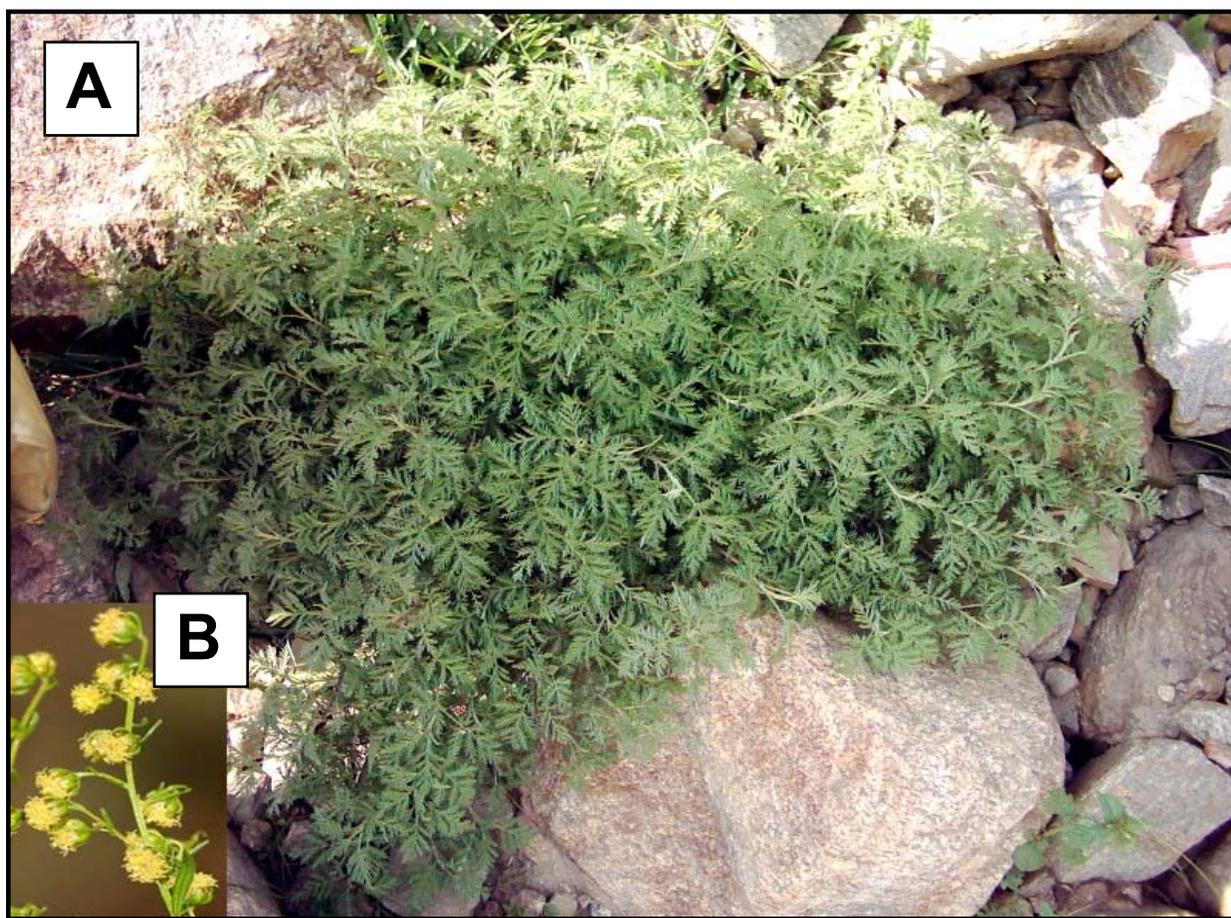


Figure 5. *Artemisia annua* L. (A: Young plants, B: Flowers), Pakistan.

is 1.5—2.5 mm in diameter with nodding and have short pedicels. Ray florets are 10-15 in number and disc florets are 15-25, with dark yellow or yellow color. Cypselas are ellipsoid-ovoid in shape.

Flowering Period: August to September.

Local distribution: Found in Gilgit, Baltistan, Skardu and Kohat from 1493 to 2286 m altitude.

Distribution in the world: Asia, Europe, North Africa, and North America.

Part used: Whole plant.

Ethnobotanical uses:

1. A decoction of the whole plant is used for treatment of Malaria.
2. Leaves are used for fever, cough and common cold.
3. Dry powder of leaves is taken to treat diarrhea.
4. Oil of **afsantin** is used in local perfumes (**ettar**) due to its pleasant fragrance.

3. *A. brevifolia* Wall. ex DC. (**Mori, Tarkha, Zoon**) (Figure 6)

Phytography: This woody rooted species grows in stony terrain with sandy soils and low humidity. It covers sun facing slopes of dry mountains. The plants are herbs or subshrubs with slight aromatic fragrance. Plant height var-

ies from 14-35 cm. Color of whole plant is whitish green. Stems often have a purplish tinge. Lower leaves are petiolate with ovate leaf blades, with 3-pinnatisect segments which are arranged in 2 to 4 pair. Middle cauline leaves are 2-pinnatisect and upper leaves are pinnatisect or entire. Heads are in the form of narrow panicle. Involucral bracts are densely hairy. Florets are 3 to 8 in number. Cypselas are oblong-ovoid to ellipsoid in shape.

Flowering period: August to September.

Local distribution: Found in Chitral, Gilgit, Khaghan, Swat, Baltistan, Astor, Deosai plains and Ladakh above 2500 m altitude.

Distribution in the world: Afghanistan and Northern India.

Part used: Whole plant.

Ethnobotanical uses:

1. The plant extract is used as a vermifuge.
2. The leaves and inflorescence are ground to form powder (**phaki**) which is used for gastric problems.
3. Dried stems of the plant are used for fire purposes.

4. *A. dracuncululus* L. (**Targoan, Sheni tarkha**) (Figure 7)

Phytography: This plant is a small shrub, 50-200 cm tall, densely or some time sparsely hairy. Leaves are sessile and sparsely hairy or some time glabrescent in appear-

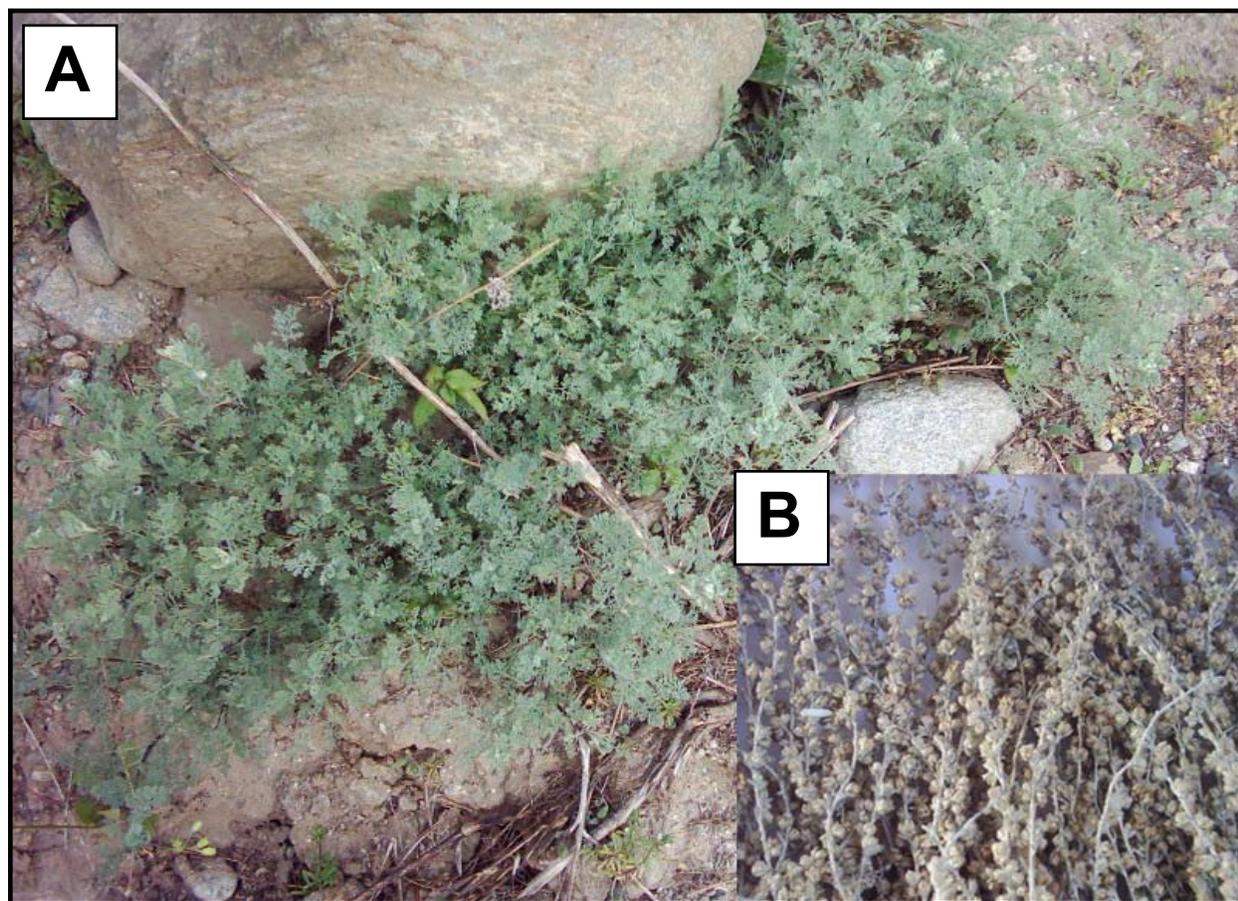


Figure 6. *Artemisia brevifolia* Wall. ex DC. (A: Young plants, B: Flowers), Pakistan.

ance. Middle cauline leaves are linear-lanceolate to elliptic-lanceolate, 20-70 mm X 2.5-6 mm, 3-partite or apartite and cleft apically with small 1 to 2 lateral lobes. Uppermost leaves and leafy bracts are minute, linear to lanceolate, 5.5-25 cm X 1.5-2.5 mm. Subglobose to ovoid capitula in broad panicles and 3-4 mm in diameter with short pedicels or some times sessile. Involucral bracts are glabrescent. Ray florets are 8-10 in number and disc florets are 5-15 in number. Cypselas are obovoid to obovoid-ellipsoid in shape.

Flowering period: August to September.

Local distribution: Found in Chitral, Gilgit and Kashmir, from 3000 to 4000 m altitude.

Distribution in the world: Central & Western Asia (particularly Afghanistan, North India, Kazakstan, Mongolia, China, Russia, Tajikistan), Central, East & Western Europe, and North America.

Part used: Leaves.

Ethnobotanical uses:

1. Gastronomic herb.
2. Fodder for sheep.

5. *A. dubia* Wall. ex Besser (**Tarkha**) (Figure 8)



Figure 7. *Artemisia dracunculus* L., Pakistan.

Phytography: This species is easily identified from the closely related species by the leaves with many white small dots on the upper surface, categorized as Subshrubs which are 70-110 cm tall, much branched. Branch-



Figure 8. *Artemisia dubia* Wall. ex DC. (A: Young plants, B: Flowers), Pakistan.

es are 10-25 cm or rarely 30 cm long, some time flexuous with hairs or without hairs. Lowermost leaves are ovate to oblong and 5-partite. Middle cauline leaves are ovate, 4.5-10 cm X 4-8 cm, abaxially densely hairy or some time glabrescent, 5-partite with elliptic to lanceolate lobes, 40-70 cm X 8-12 mm. Uppermost leaves are 3-partite with leafy bracts which are entire and elliptic-lanceolate to lanceolate in shape. Numerous ovoid to globose capitula in panicles, which are much branched, 1-2 mm in diameter with short pedicel to sessile. Ray florets are 6-8 in number and disc florets are 4-12. Cypselas are oblong to obovoid in shape.

Flowering period: August to October.

Local distribution: Found in Rawalpindi, Muzafabad, and Ponch, from 1200 to 2000 m altitude.

Distribution in the world: Bhutan, China, India, Japan, Nepal, and Thailand.

Part used: Leaves.

Ethnobotanical uses:

1. Leaf powder is used for gastric problems and intestinal worms.
2. Paste of fresh leaves is applied externally for the treatment wounds and skin infections.

6. *A. herba-alba* Asso. (**Mushki afsantheen**) (Figure 9)



Figure 9. *Artemisia herba-alba* Asso., Pakistan.

Phytography: This plant is a perennial strongly aromatic grayish green herb which is 25 to 40 cm tall with numerous branches. Tiny stipuliform pinnatifid auricles are present at base of petioles. Basal leaves are much incised, 2-3 X 1-2 mm. Oblong capitula are 3-4 mm in diameter. Florets are 2-4 in number.



Figure 10. *Artemisia japonica* Thunb. in a association with *Cannabis sativa* L. (A: Young plants, B: Flowers, C: Leaves), Pakistan.

Flowering period: August to November.

Local distribution: Quetta.

Distribution in the world: Iran, Turkey, Middle East, and North Africa.

Part used: Whole plant.

Ethnobotanical uses:

1. Whole plant powder is used for diabetes.
2. A plant decoction is utilized for cooling purposes.
3. Fumigation with plant is used for muscular pain.
4. Dry plants are used for fire purposes.

7. *A. japonica* Thunb. (**Kanyarts, Burmar, Basna tashang, Kharkhaliech**) (Figure 10)

Phytography: This herb is perennial, 40-100 cm tall, strongly aromatic and glabrescent. Leaves are sessile, sparsely hairy. Basal and lowermost leaves are obovate to broadly spatulate, 3-6 cm X 2-3 cm. Middle leaves are 3-fid epically, 20-30 mm X 5-8 mm. Uppermost leaves are 3-cleft to entire and leafy bracts are elliptic to lanceolate. Numerous subglobose capitula are in narrow to slightly broad paniculate arrangement and 1-2 mm in diameter. Ray florets are 5-9 in number and disc florets are 5-10 in numbers. Cypselas are minute and obovoid in shape.

Flowering period: July to September.

Local distribution: Found in Chitral, Gilgit, Khagan, Skardu, Muzafabad, Baltistan, Ponch, Rawalpindi, Swat and Kurram Agency from 1500 to 3500 m altitude.

Distribution in the world: Afghanistan, Bhutan, China, Japan, Korea, Laos, Myanmar, Nepal, North India, Philippines, Russia, Thailand, and Vietnam.

Part used: Stem and leaves.

Ethnobotanical uses:

1. Plant is browsed by goats and sheep.
2. A plant decoction is used against malaria.

8. *A. maritima* L. ex Hook.f. (**Tarkh, Zoon, Rooner**) (Figure 11)

Phytography: This plant is a strongly aromatic shrub with numerous erect, up to 100 cm tall branches. Basal and middle leaves are whitish cottony appearance, 2-2.5 X 3.5-4 cm, 2-pinnatisect, with numerous small segments, linear with obtuse apex. Upper most leaves are simple and linear in shape. Oblong to ovoid capitula, present in the axil of upper leaves forming a raceme and 10 mm in diameter. It contains 3-10 florets. Receptacle is without hairs. Minute cypselas are oblong to obvoid in shape.

Flowering period: August to September.



Figure 11. *Artemisia maritima* L. ex Hook.f., Pakistan.

Local distribution: Found in Swat, Skardu, Chitral, Gilgit, Kurram Agency, Baltistan and Ladakh from 2000 to 4000 m altitude.

Distribution in the world: Afghanistan.

Part used: Leaf and stem.

Ethnobotanical uses:

1. Plant is used as antiseptic and anti-inflammatory.
2. Leaves are utilized for cooling purposes.
3. Plant decoction is used against malaria.
4. Plant powder is used for intestinal worms.

9. *A. roxburghiana* Wall. ex Besser (**Garrotra**) (Figure 12)

Phytography: This Subshrub is 50-100 cm tall and densely hairy. Bifacial leaves are densely hairy beneath and whitish, upper surface is dark greenish and punctate glands are present on its both surfaces. Petioles of lowermost and middle cauline leaves are 1-3 cm long. Leaf blade is ovate to oblong-elliptic in shape, 6-10 cm X 4-6 cm, 2-pinnatisect. Its segments are in 2 to 3 pairs, elliptic to oblong in shape. Lateral lobes have 1-3 pairs of lobules. Lobules are lanceolate to linear-lanceolate, 0.5-1.5 mm X 2-2.5 mm with narrowly winged rachis. Uppermost leaves

and leafy bracts are pinnatisect with 3-4-lobes. Lobes and entire bracts are linear-lanceolate to lanceolate. Ovoid to subglobose capitula are in broad panicle arrangement, 2-3 mm in diameter. The involucral bracts are purple and hairy. Ray florets are 4-8 in number and disc florets are 8-15 in number. Cypselas are obovoid to oblong in shape.

Flowering period: August to October.

Local distribution: Found in Rawalpindi, Islamabad, Ladakh and Kurram Agency from 2500 to 3000m altitude.

Distribution in the world: Afghanistan, China, India, Nepal, and Thailand.

Part used: Whole plant

Ethnobotanical uses:

1. Plant decoction is used in fever.
2. Plant powder is used for the removal of intestinal worms.

10. *A. santolinifolia* Turcz. ex Krasch. (**Dron**) (Figure 13)

Phytography: This plant is a basally woody perennial with numerous, some times very straight, up to 50 cm tall glabrous branches. Stems have groves. Middle leaves petiole is up to 2.5 cm long, articulate, leaf blade sparsely

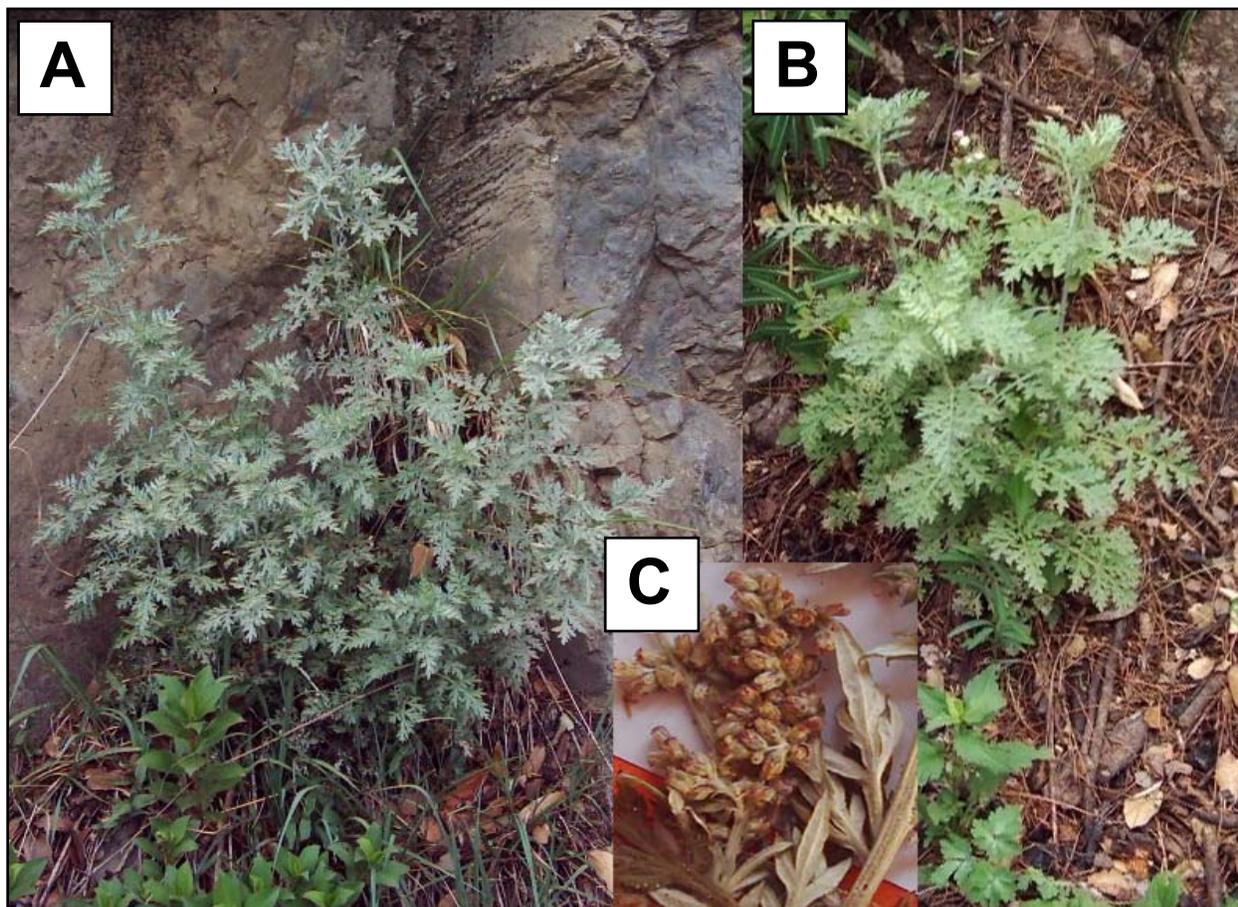


Figure 12. *Artemisia roxburghiana* Wall. ex Besser (A, B: Young plants in different seasons, C: Flowers), Pakistan.



Figure 13. *Artemisia santolinifolia* Turcz. ex Krasch., Pakistan.

hairy to glabrous above, hairy beneath, ovate to broadly triangular-ovate, 2.5-5 X 1-3 cm. Lower leaves are 3-pinnatisect, elliptic to lanceolate in shape. They have primary segments and lobules on both sides. Uppermost leaves are 1-2-pinnatisect with segments, 1-4 X 0.5-1 mm, lanceolate-linear in shape with acute tips. Many globose capitula with short peduncle, 3-5 mm in diameter, arrange in paniculate arrangement. Involucre bracts are 3-seriate. Receptacle is convex and glabrous. Ray florets 10-12 in numbers and disc-florets are 50-60 in numbers. Cypselas are obovoid to oblong in shape.

Flowering period: July to September

Local distribution: Found in Chitral, Hunza, Ladakh, Swat, Gilgit and Baltistan, from 2500 to 3500 m altitude.

Distribution in the world: Afghanistan, China, India, Mongolia, and Russia.

Part used: Whole plant

Ethnobotanical uses:

1. Plant extract is used against intestinal worms.

11. *A. scoparia* Waldst. & Kit. (**Jhau, Lasaj, Dona, Marua, Churi-Saroj, Jaanh, Jaukay**) (Figure 14)

Phytography: A very common plant which grows after rainfall in hot seasons in sandy clay soil of arid areas along



Figure 14. *Artemisia scoparia* Waldst. & Kit., Pakistan.

road sides and on low hills, stony ground, waste lands, field borders and rural tracks, from 400 to 2200 m altitude. This herb is perennial and slightly aromatic, 40-120 cm high, and much branched from the lower stem. Young stem branches and leaves are sea green and when mature become yellowish. Stem often has a purple tinge. Petiole of basal leaves is 2-3 cm long and leaf blade is ovate-oblong to elliptic, 2-4 cm X 1-3 cm and 2 to 3-pinnatisect. Segments are in 3 to 4 pairs with 1 to 2 pairs of lobules. Middle cauline leaves are sessile, oblong to ovate-oblong in shape, 15-20 mm X 10-15 mm, 2-pinnatisect with 2 to 3 pairs of segments. Leaf lobules are filiform, 4-8 mm X 0.3-0.5 mm, mostly curved. Uppermost leaves and leafy bracts are 3-4-sect. Subglobose numerous capitula are in broad paniculate arrangement, 1-2 mm in diameter with or without shortly pedicel. Ray florets are 5-7 in number and disc florets are 5-10 in number. Cypselas are obovoid to oblong in shape.

Flowering period: July to November.

Local distribution: Found in Gilgit, Astor, Peshawar, Swat, Malakand, Khagan, Rawalpindi, Skardu, Baltistan, Kurram, Attock, Jahelum, Quetta, Khuzdar and Kalat.

Distribution in the world: Central and SW Asia (Afghanistan, Russia, Thailand), China, India, Japan, Korea, and Europe.



Figure 15. *Artemisia vulgaris* L. (A: young plants, B: Inflorescence), Pakistan.

Ethnobotanical uses:

1. Considered as fodder for goats.
2. Treats pain in the ear.
3. The smoke of twigs is considered good for burns and an infusion of it is given as a depurative.

12. *A. vulgaris* L. (**Tatwan, Nagdowna, Tarkha**) (Figure 15)

Phytography: A highly variable and extensively spreading species in which a number of subordinant taxa have been identified. This herb is perennial, 50-150 cm tall, and sparsely hairy. Lowermost leaves are shortly petiolate and 2-pinnatisect. Leaf blade is densely hairy beneath. Middle cauline leaves are sessile and leaf blade elliptic to ovate-elliptic, 10-12 cm X 6-10 cm with bipinnatisect segments which are 4 to 5 cm long, elliptic-lanceolate to linear-lanceolate in shape, 3-5 cm X 1-1.5 cm wide, with a narrowly winged rachis. Uppermost leaves are pinnatifid and leafy bracts are 3-lobed which are entire. Leafy bracts are lanceolate in shape. Oblong capitula are in dense narrow to broad panicles, 2-3 mm in diameter. The involucre bracts are densely hairy. Ray florets are 7-10 in numbers

and disc florets 8-20 in numbers. Cypselas are obovoid to ovoid in shape.

Flowering period: August to November.

Local distribution: Found in Muzafarabad, Rawalpindi and Islamabad from 1000 to 2000m altitude.

Distribution in the world: Afghanistan, India, Iran, Siberia, Turkey, Africa, Europe, and North America.

Part used: Leaves and tomentum.

Ethnobotanical uses:

1. A leaf infusion is used in fever.
2. The tomentum is used as moxa.

Discussion

The genus *Artemisia* has a therapeutic history reaching back over two millennia (Zinczuk *et al.* 2007) and it is widely used in folk remedies (Negahban *et al.* 2007). In Pakistan, the use of *Artemisia* based folk remedies is also common practice in the studied localities. Uses of these *Artemisia* species, for the treatment of various medicinal problems along with the other uses by the local inhabitants were passed down from generation to generation but

rapid cultural transformation is causing old traditions to become extinct (Hayat *et al.* 2008).

We have recorded some common human ailments (diabetes, gastric problems, intestinal worms, skin infections, thorax illness) that have been treated using *Artemisia*. Most of the *Artemisia* species, which were studied, are widely used in the other parts of the world in similar or different ways. For example, *A. dubia* leaf juice is used in Madhupur, Tangail, Bangladesh for the treatment of leprosy and in preparation of a fermenting medium for their traditional liquor (Anisuzzaman *et al.* 2007). Similarly, *A. dubia* whole plant is utilized in Magar of Bukini, Baglung, Western Nepal for stomachic, purgative, hysteria asthma, skin diseases like scabies and on ulcers (Sapkota 2008). Iriadam *et al.* (2006) reported that *A. herba-alba* possess antidiabetic effects. It was also found that *Artemisia* species have been used in many countries of the Middle East and Turkey as treatments of diabetes, high blood pressure and gastrointestinal ailments. Additional properties of some of the *Artemisia* are supported by scientific findings such as: fumigant toxicity of *A. scoparia* (Negahban *et al.* 2004, Negahban & Moharrampour 2005); antimalarial activity of *A. japonica*, *A. maritima* and *Artemisia nilagirica* (C.B. Clarke) Pamp. (Valecha *et al.* 1994), *Artemisia indica* Willd. (Chanphen *et al.* 1998), and *A. annua* (Duke *et al.* 1994); selective killing of human breast cancer cells by artemisinin from *A. annua* (Singh & Lai 2001); and anthelmintic activity of *A. brevifolia* in sheep (Iqbal *et al.* 2004). Many of the *Artemisia* identified in this study (e.g., *A. absinthium*, *A. annua*, *A. dubia*, *A. herba-alba* and *A. maritima*) are part of traditional ethnobotanical knowledge of many countries and marketed internationally.

Our study results confirm other studies in these same areas of Pakistan. Ibrar *et al.* (2007) investigated the knowledge of use of *Artemisia* species by the indigenous people in the Ranyan hills Shangla District of Pakistan. Hayat *et al.* (2008) reported *A. scoparia* as a purgative and also used to treat burns in Tehsil Pindigheb, (Attock District) Pakistan. Gilani *et al.* (2003) found *A. brevifolia* as anthelmintic and also used for stomach problems in Kurram Agency, Pakistan. Aziz (1996) recorded that *A. maritima* is used against abdominal pain, fever and intestinal worms in Chitral valley. *Artemisia parviflora* Roxb. ex D. Don (now *A. japonica*) and *A. santolinifolia* are described as therapeutic plants of Booni valley of district Chitral, Pakistan (Ahmed *et al.* 2006). Qurashi *et al.* (2006) reported *A. absinthium* and *A. maritima* as medicinal plants of Gilgit. Khan *et al.* (2003) discussed the ethnobotanical uses of *A. scoparia* and *A. vulgaris*. Mannan *et al.* (2008) reported *A. dubia* as a source of artemisinin, which is used as an antimalarial drug. Sardar and Khan (2009) found *A. annua* as a treatment for jaundice, fever and as a blood purifier. Hussain *et al.* (2006) observed the ethnobotanical uses of *A. scoparia*. Khan and Khatoon (2008) collected ethnobotanical observations of *A. absinthium*, *A. brevifolia* and *A. scoparia*. However, our research also unveiled

some new aspects of *Artemisia* based therapies. For example, *A. scoparia* is used for thorax illness.

This research also indicates that inhabitants of the studied localities were not using *Artemisia* species against modern day ailments like cancer, HIV-AIDS, etc. This is a sign of the disappearance of ethnobotanical knowledge because local people were practicing what they inherited from their forefathers as a remnant of earlier information. There is no expectation that people will use this acquaintance in the future to develop new remedies even in remote localities.

The economics of *Artemisia* species have been previously investigated. Gilani *et al.* (2003) reported on the economic importance of *A. brevifolia* in Pakistan. Zaidi (1996) investigated the market value of *A. maritima*. Anderson (1988) identified *A. absinthium*, *A. maritima* and *A. vulgaris* as economically important medicinal plants of Pakistan. Rauf *et al.* (2007) investigated the status, utilization and trade of Hazara (Northern Pakistan) areas healing plants including *Artemisia* species. But many other *Artemisia* species of commercial potential still exist as wild plants in different regions of the country. Therefore, they need proper attention in the future for both evaluation of conservation management and development of commercialization strategies. Many *Artemisia* species are becoming threatened (e.g., *A. amygdalina* Decne. in Kashmir) or may be threatened in the near future due to eco-environmental changes (Dar *et al.* 2006). Similarly, Khan (2004) discussing six *Artemisia* species and their potential, constraints in their conservation, and future prospects. There is an immediate need to adopt a proper conservation strategy for protection of this medicinal plant resource for future generations.

Conclusion

Our study reveals that genus *Artemisia* species possess therapeutic potential and are still part of culture of Pakistan. Conservation and study of *Artemisia* plants at biochemical levels are called for to provide a significant contribution to pharmacology industry and economy of the nation. Results of this ethnobotanical survey can provide bases for such projects.

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