

Full Length Research Paper

***Artemisia* L. species recognized by the local community of northern areas of Pakistan as folk therapeutic plants**

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Due to exclusive ecological conditions, northern areas of Pakistan hosts many species of the genus *Artemisia* L. (Asteraceae) of great medicinal importance. In this paper we describe ethnobotanical details concerning with the folk medicinal uses of *Artemisia* in northern areas of Pakistan. The indigenous knowledge was obtained through questionnaires and meetings, with the local herbalists and rural community. Eight *Artemisia* species are isolated which are popularly used among local inhabitants as folk therapeutics. These species include *A. absinthium*, *A. brevifolia*, *A. dubia*, *A. japonica*, *A. maritima*, *A. moorcroftiana*, *A. roxburghiana* and *A. vulgaris*.

Key words: *Artemisia*, ethnobotany, Northern areas of Pakistan, medicinal plants.

INTRODUCTION

Artemisia L. is a widespread and varied genus of the family Asteraceae with great therapeutic and economic importance. It has greater than 500 species (the number vary depending on the authors: McArthur, 1979; Mabberley, 1990; Ling, 1982, 1991a, b, 1994, 1995a, b; Bremer and Humphries, 1993; Oberprieler, 2001; Valles and McArthur, 2001; Valles and Garnatge, 2005). It is a well recognized wind pollinated cosmopolitan genus, chiefly spread in temperate areas of mid to high latitudes of the northern hemisphere, settled in arid and semiarid environments landscape and has only few representatives in the southern hemisphere. Central Asia is its center of diversification, while the Mediterranean region and North West America are two derived speciation areas (McArthur and Plummer, 1978; Valles and McArthur, 2001). A small number of species are also reported in Africa and Europe (Ling, 1994; Tutin et al., 1976; Shultz, 2006). Many species of the genus have a high economic value as medicines, food, forage, ornamentals or soil stabilizers in disturbed habitats; some taxa are toxic or allergenic while some others are invasive weeds which can adversely affect crop yield (Pareto, 1985;

Tan et al., 1998). Most of the species of this genus are perennial; only 10 species are annuals or biannual (Valles et al., 2003). *Artemisia* is considered as a sign of steppe climate (Erdtman, 1969) and reasonable precipitation (El-Moslimany, 1990). Due to high number of species, ecological and economic importance, the genus *Artemisia* has been the object of many diversity focused studies (Valles et al., 2003).

Artemisia is a taxonomically difficult genus because majority of its species often have different morphological forms and some species have close resemblance with each other. These characteristics make it reasonably difficult to appropriately identify without exhaustive morphological review. After various taxonomic rearrangements, the genus was divided into five large groups, *Absinthium* DC., *Artemisia* (= *Abrotanum* *besser*), *Dracunculus* *besser*, *Seriphidium* *besser* and *Tridantatae* (Rydb.) McArthur (Torrell et al., 1999). *Tridantatae* is only restricted to North America. *Artemisia* species are mostly herbs and sometimes shrubs, usually with strong aromatic aroma. Plants body is often densely hairy. Leaves are pinnatifid to pinnatisect with great variable dimensions. Capitulum inflorescence is generally in the form of paniculate-racemose arrangement. Herbaceous involucre bracts are present. Receptacle is convex or flat and naked or covered by hairs. Ray florets are pistillate.

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Corolla color is yellow or green and rarely brown. Disk florets are bisexual. Cypselas are obovoid to oblong and mostly brown (Ghafoor, 2002).

Artemisia species (Asteraceae) are widely used medicinal plants in folk medicine. Some species such as *A. absinthium* L., *A. annua* L. or *A. vulgaris* L. have been incorporated into the pharmacopoeias of several European and Asian countries (Proksch, 1992). Ko et al. (2006) scientifically proved that sheep digestibility performance was enhanced when rice straw was replaced with wormwood (*Artemisia* sp.) in her diet. *Artemisia brevifolia*, locally named as 'afsanteen' is widely used in ethno-veterinary medicine system of Pakistan as an anthelmintic plant (Iqbal et al., 2004). Many *Artemisia* species are reported to possess antidiabetic effects and have been used in many countries of Middle East and Turkey as a herbal medicine for the treatment of diabetes, high blood pressure and gastrointestinal ailments (Mossa, 1985; Al-Shamaony et al., 1994; Subramoniam et al., 1996). Wright (2002) discussed traditional use of *A. annua* for fever and malaria in China. In Thailand, *A. indica* Willd. stem extract is used as folk remedy for malaria (Bunyapraphatsara, 1986; Farnsworth, 1992). The traditional Chinese medicine 'Herba Artemisiae Scopariae' is the dried sprout of *A. scoparia* Waldst. et Kit. It can clear away heat, promote diuresis, normalize the function of the gallbladder and cure jaundice (Committee of National Pharmacopoeia, 2005). Herb *A. scoparia* has been frequently used as an important ingredient in many traditional prescriptions (Xu, 1995; Zhang, 2002). Besides having a cholagogic effect, it also has other pharmacological actions, such as protecting liver, lowering the blood pressure, eliminating fever, sedation and anti-inflammation, antibacteria, anti-pathogenic-microbes and antitumor action (Yao, 2007). It has found wide clinical applications in the treatment of acute icteric infectious hepatitis, hyperlipemia and oral ulcer (Yao, 2007). The *Artemisia aucheri* is an indigenous plant very abundant in north of Iran and used to cure leishmaniasis in folk medicine of Iran (Furtado et al., 1960; Azadbakht et al., 2003). *A. dubia* whole plant is utilized for stomachic, purgative, hysteria asthma, skin diseases like scabies and ulcers in Magar of Bukini, Baglung, Western Nepal (Sapkota, 2008).

"Pakistan has great diversity of both climate and terrain ranging from the scorching deserts of Sand, to the relatively moist temperate forest of North West Frontier Province (NWFP). This rich and varied habitat is a home to rich biodiversity" (Nasir and Rafiq, 1995).

Presently, 38 species of *Artemisia* has been identified and botanically reported in Pakistan, which are distributed mainly in arid and semiarid areas of Boluchistan, NWFP, Northern Punjab and Kashmir forming an important component of *Artemisia* steppes (Ghafoor, 2002). Utilization of these *Artemisia* species for the treatment of various medicinal problems is inherited from

generation to generation but rapid cultural shifting is causing vanishing of old traditions. Therefore, it is immediate need to document them for future pharmacological applications (Hayat et al., 2008). Due to highly suitable climatic conditions Northern Areas of Pakistan are considered to be hot spot areas for *Artemisia* diversity. In this research work, we presented various ethnobotanical aspects related to the genus *Artemisia* in Northern Areas of Pakistan.

MATERIALS AND METHODS

In this ethnobotanical study, field surveys were conducted throughout the Northern Areas Pakistan (Figure 1), where *Artemisia* has been reported by previous authors (Ghafoor, 2002; Sterwart, 1972), over a three year period (2006-2008), following the procedure as described by Jain (1967), Trotter (1981), Shinwari and Khan (2000) and Hayat et al. (2008). *Artemisia* diversity was surveyed in 43 different localities. Specimens were collected and identified. The voucher specimens have been deposited in herbarium of Quaid-i-Azam University Islamabad (ISL) for future reference. Questionnaires were used during field surveys to gather ethnobotanical information on *Artemisia* species used by the local people. Vernacular names, harvesting and processing methods and mode of administration of these plants to treat human ailments along with other ethnobotanical uses were collected. The questionnaires were given to the informants who were knowledgeable in traditional uses of *Artemisia*. A total of 173 inhabitants of which 103 were men, 43 women and 27 male key informants were interviewed. Repeated queries were made to get the data confirmed. Results from the field surveys were rechecked and compared with the literature.

RESULTS

In this research work, we have identified eight *Artemisia* species, which are utilized by local community of Northern areas of Pakistan in different localities in variety of ways for therapeutic purposes. Detail of each plant species (Figures 2 - 9) including scientific name, voucher number, common name, local distribution, distribution in the world, habit and habitat, flowering period, part used and disease cure are presented in Table 1.

DISCUSSION

For many centuries species of *Artemisia* L. has been widely used as therapeutic plants in the conventional medication (Zinczuk et al., 2007; Negahban et al., 2007) and several authors reported many examples of traditional uses of *Artemisia* across the world. *A. dubia* leaf sap is used for the cure of leprosy and in formation of fermenting medium for their folk liquor in Bangladesh (Anisuzzaman et al., 2007). In the same way, *A. dubia* whole plant extract is used for stomachic, purgative, hysteria asthma, skin diseases like scabies and on ulcers in Western Nepal (Sapkota, 2008). Iriadam et al. (2006) founded that *A. herba-alba* contain antidiabetic effects. It was also determined that *Artemisia* species have been used

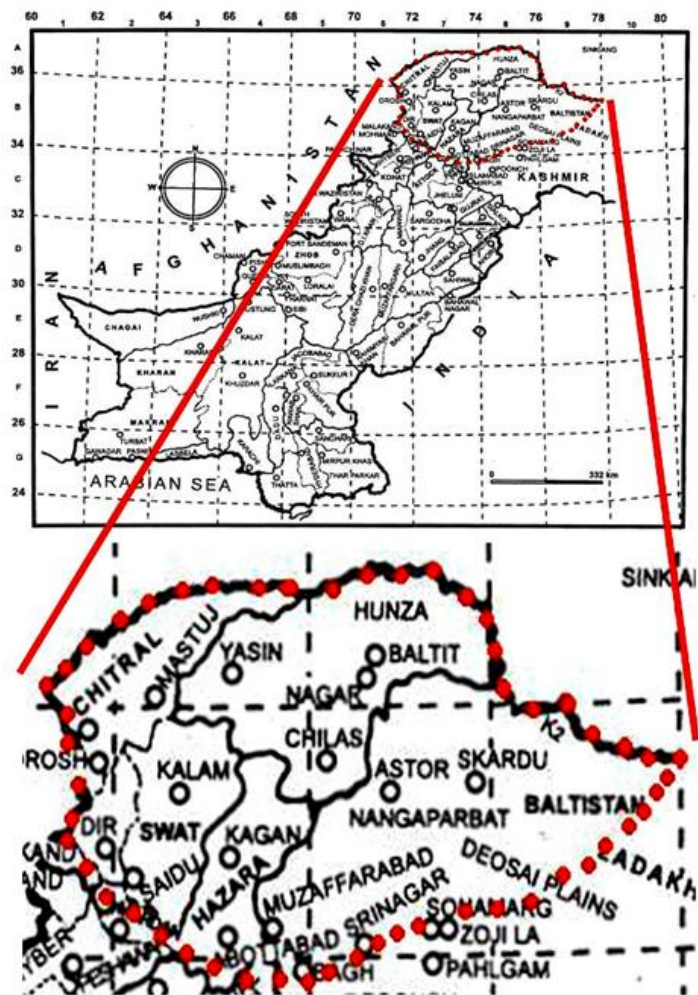


Figure 1. Study area map showing the northern areas of Pakistan.



Figure 2. *Artemisia brevifolia* (Locality: Naran).



Figure 3. *Artemisia absinthium* (Locality: Lake Saf-ul-Malooq track).



Figure 4. *Artemisia japonica* in association with *Cannabis sativa* L. (Locality: Shugran).



Figure 5. *Artemisia dubia* (Locality: Galiat).



Figure 6. *Artemisia roxburgiana* (Locality: Galiat).



Figure 7. *Artemisia vulgaris* (Locality: Sawat).



Figure 8. Dried *Artemisia maritima* (Locality: Skardu).



Figure 9. *Artemisia moorcroftiana* (Locality: Galiat).

Table 1. *Artemisia* L. species recognized by the local community of Northern Areas of Pakistan and their folk medicinal applications.

| SECTION I: <i>Absinthium</i> (Tournefort) de Cand. | |
|---|--|
| 1. | <p>Scientific name <i>Artemisia absinthium</i> L.</p> <p>Voucher No. ART01</p> <p>Figure 3</p> <p>Common names Afsantin, Zoon</p> <p>Distribution in Pakistan Chitral, Skardo, Ladakh, Parachinar, Naran, Kurram Agency</p> <p>Distribution in the world Afghanistan, India, China, Japan, Kazakhstan, Kyrgyzstan, Russia, N Africa, SW Asia, Europe, North America, Pakistan</p> <p>Habit and habitat Herbs grow on mostly on the humid soils or near water in rocky terrain with the sandy clay soils</p> <p>Flowering period June to September</p> <p>Part used Whole plant, leaves and seeds</p> <p>Disease cure</p> <ol style="list-style-type: none"> 1. Powder of seeds is taken for rheumatism pain relief. 2. Gastric problems and intestinal worms, 3. Plant water extract is used as tonic for general body health, 4. Decoction of plant is used to treat malaria. |
| SECTION II: <i>Artemisia</i> Tournefort | |
| 2. | <p>Scientific name <i>Artemisia dubia</i> Wall. ex Besser</p> <p>Voucher no. ART02</p> <p>Figure 5</p> <p>Common name(s) Valati afsanthin, Tarkha</p> <p>Distribution in Pakistan Muzafrabad, Ponch, Galiat</p> <p>Distribution in the world Bhutan, India, China, Japan, Nepal, Thailand, Pakistan</p> <p>Habit and habitat Sub-shrubs found on humus rich rocky soils of foot hills</p> <p>Flowering period August to October</p> <p>Part used Leaves</p> <p>Disease cure</p> <ol style="list-style-type: none"> 1. Leaf extract and leaf powder are used for gastric problems and intestinal worms respectively. 2. Paste of leaf is applied externally for cure of wounds and skin infections. |
| 3. | <p>Scientific name <i>Artemisia moorcroftiana</i> Wall. ex DC.</p> <p>Voucher no. ART03</p> <p>Figure 9</p> <p>Common name Mushqi booti</p> <p>Distribution in Pakistan Naran, Murree hills, Galiat</p> <p>Distribution in the world China, India, Pakistan</p> <p>Habit and habitat Herb, spreads on stony soils and rocky hills</p> <p>Flowering period July to October</p> <p>Part used Vegetative parts</p> <p>Disease cure Extract of vegetative parts of plant is used to cure malaria fever.</p> |
| 4. | <p>Scientific name <i>Artemisia roxburghiana</i> Wall. ex Besser</p> <p>Voucher no. ART04</p> <p>Figure 6</p> <p>Common name Chota Afsantin, Garrotra</p> <p>Distribution in Pakistan Galiat, Ladakh and Kurram Agency</p> <p>Distribution in the world Afghanistan, India, Nepal, China, Thailand, Pakistan</p> <p>Habit and habitat Herbs grow on shady rocky humid soils on foot hills</p> <p>Flowering period August to October</p> <p>Part used Whole plant</p> <p>Disease cure</p> <ol style="list-style-type: none"> 1. Whole plant extract is used for fever and malaria. 2. Powder of whole plant is taken for intestinal worms. |

Table 1. Cont'd.

| SECTION II: <i>Artemisia</i> Tournefort | |
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| 5. | <p>Scientific name <i>A. vulgaris</i> L.</p> <p>Voucher no. ART05</p> <p>Figure 7</p> <p>Vernacular names Tatwan, Nagdowna</p> <p>Distribution in Pakistan Muzaffarabad, Galiat, Sawat</p> <p>Distribution in the world Africa, Europe, Turkey, Siberia, India, North America, Afghanistan, Iran, Pakistan</p> <p>Habit and habitat Perennial herbs on shady rocky humid soils on foot hills</p> <p>Flowering period August to November</p> <p>Part used Leaves, Tomentum</p> <p>Disease cure 1. Leaf extract is used for malaria and fever. 2. Tomentum is used for moxa treatment.</p> |
| SECTION III: <i>DRACUNCULUS</i> BESSER | |
| 6. | <p>Scientific name <i>Artemisia japonica</i> Thunb.</p> <p>Voucher no. ART06</p> <p>Figure 4</p> <p>Vernacular names Kanyarts, Burmar, Basna Tashang</p> <p>Distribution in Pakistan Chitral, Gilgit, Kaghan, Skardu, Muzaffarabad, Baltistan, Ponch, Rawalpindi, Sawat, Kurram Agency</p> <p>Distribution in the world Afghanistan, Bhutan, N India, Japan, Korea, Laos, Myanmar, Nepal, China, Philippines, Russia, Thailand, Vietnam, Pakistan</p> <p>Habit and habitat Perennial herb, on rocky humid soils of foothills</p> <p>Flowering period July to September</p> <p>Part used Stem and leaves</p> <p>Disease cure 1. Extract of stem and leaf is used to treat malaria. 2. Skin diseases are cured by applying paste of leafs on infection.</p> |
| SECTION IV: <i>SERIPHIDIUM</i> BESSER EX HOOKER | |
| 7. | <p>Scientific name <i>A. brevifolia</i> Wall. ex DC.</p> <p>Voucher no. ART07</p> <p>Figure 2</p> <p>Vernacular names Mori, Tarkha, Azhanr</p> <p>Distribution in Pakistan Chitral, Gilgit, Khaghan, Swat, Baltistan, Astor, Deosai Planes, Ladakh</p> <p>Distribution in the world Afghanistan, Northern India, Pakistan</p> <p>Habit and habitat Woody rooted herbs grows in stony terrains with the sandy soils with low humidity and covers sun facing slopes of dry mountains</p> <p>Flowering period August to September</p> <p>Part used Whole plant</p> <p>Disease cure 1. Whole plant powder is taken for gastrointestinal problems including intestinal worms.</p> |
| 8. | <p>Scientific name <i>A. maritima</i> L.</p> <p>Voucher no. ART01</p> <p>Figure 8</p> <p>Vernacular names Tarkh, Zoon</p> <p>Distribution in Pakistan Swat, Skardu, Chitral, Gilgit, Kurram Agency, Baltistan, Ladakh</p> <p>Distribution in the world Afghanistan, Pakistan</p> <p>Habit and habitat Strongly aromatic shrub on rocky soils</p> <p>Flowering period August to September</p> <p>Part used Leaf and stem</p> <p>Disease cure 1. Leaf paste is utilized for skin infections. 2. Ice cold leaf paste is used for inflammation of skin. 2. Leaf and stem powder is used against intestinal parasites.</p> <p>Flowering period August to September</p> <p>Part Used Leaf and stem</p> |

used in many states of Middle East and Turkey in folk remedies for the treatment of diabetes, high blood pressure and gastric problems. Several other properties of some of the *Artemisia* species were also explored by the scientific research, for example: fumigant toxicity of *A. scoparia* (Negahban et al., 2007); antimalarial activity of *A. japonica*, *A. maritime* and *A. nilegarica* (Valecha et al., 1994), *A. indica* (Chanphen et al., 1998), *A. annua* (Duke et al., 1994); selective killing of human breast cancer cells by 'artemisinin' from *A. annua* (Singh and Lai, 2001); antihelmintic activity of *A. brevifolia* in sheep (Iqbal et al., 2004).

In the northern areas of Pakistan, the use of *Artemisia* based therapeutics is also common practice. Previous authors, who worked in different areas of Pakistan reported many folk uses of *Artemisia*. Ibrar et al. (2007) investigated the knowledge to use *Artemisia* species by the indigenous people in Ranyan hills in district Shangla, Pakistan. Hayat et al. (2008) reported *A. scoparia* as purgative and also used to treat burns in Tehsil Pindigheb, District Attock, Pakistan. Gilani et al. (2003) founded *A. brevifolia* as anthelmintic and also used for stomach problems in Kurram Agency, Pakistan. Aziz (1996) recorded that *A. maritime* is used against abdominal pain, fever and intestinal worms in Chitral valley. Galani et al., (2003) reported economic importance of *A. brevifolia* in Pakistan, Zaidi (1996) investigated the market value of *A. maritime* and Anderson (1988) enlisted *A. absinthium*, *A. maritime* and *A. vulgaris* as economically important medicinal plants of Pakistan.

In present ethnobotanical study it was revealed that the primary function of *Artemisia* based folk remedies, is to cure the intestinal worms specially helminthes and malaria fever. According to the inhabitants of the area *A. absinthium*, *A. japonica*, *A. moorcroftiana*, *A. roxburghiana* and *A. vulgaris* are found to be antimalarial while *A. absinthium*, *A. brevifolia*, *A. dubia*, *A. maritima*, *A. roxburghiana* possesses antihelmintic properties. Other ailments include pain relief in rheumatism, gastric problems, skin infections, fever and inflammation which are cured by *Artemisia* species. Therefore, *Artemisia* of northern areas of Pakistan play an important role in primary health care of rural community. It was also noted that different *Artemisia* spp. are used to treat same disease, this indicates the therapeutic value of the genus and point out that these different spp. contain the same constituents. It was also observed in this study that for the treatment of malaria, we can alternate the *A. annua* L. (world renowned antimalarial plant recognized by World Health Organization: WHO, 2003) with other spp. of the genus as possibility of cultivation of *A. annua* is not feasible every where.

This research also reveals that rural community of the studied area was not using the *Artemisia* species against recently origin ailments like cancer, hepatitis, AIDS etc. This indicates the gradual vanishing of ethnobotanical information exploration because local people were keen what they innate from their forefathers as a remnant of earlier

knowledge. People are not trying further these plant species for the cure of modern day diseases. There is no expectation that people will use this association in future even in remote areas. In addition, many *Artemisia* species are become threaten like *A. amygdalina* of Kashmir (Dar et al., 2006) or may be threaten in near future due to eco-environmental changes like global warming. So, there is an urgent requirement to adopt a proper conservation plan for conservation of this mega therapeutic plant resource (along with the indigenous knowledge which is associated with it by documenting) not only for up coming generations but also for future health challenges.

Conclusion

From this study, it is clear that the *Artemisia*'s of Northern Areas of Pakistan have high therapeutic potentials and constitutes a valuable natural resource. Therefore, this conserved knowledge provides bases for scientists to explore their chemistry for future health challenges especially in the field of paracytology, dermatology, pharmacology and malarial studies.

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REFERENCES

- Al-Shamaony L, Al-Khazraji MS, Twajji, HA (1994) Hypoglycemic effects of *Artemisia herba-alba* L. Effect of a valuable extract on some blood parameters in diabetic animals. *J. Ethnopharmacol.* 43(3): 167-171.
- Anderson JW (1988) Medicinal plants in Pakistan in *Unani Materia Medica*. Hamdarad Medicus 31(4): 61-83.
- Anisuzzaman M, Rahman AHMM, Harun-or-Rashid M, Naderuzzaman ATM, Islam AKMR (2007) An ethnobotanical study of Madhupur, Tangail. *J. App. Sci. Res.* 3(7): 519-530.
- Azadbakht M, Ziaei H, Abdollahi F, Shabankhani B (2003) Effect of essential oils of *Artemisia*, *Zataria* and *Myrtus* on *Trichomonas vaginalis*. *J. Medicinal Plants* 8: 35-40.
- Aziz A (1996) 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.
- Bremer K, Humphries CJ (1993) Generic Monograph of the Asteraceae-Anthemideae. *Bull. Nat. His. Mus. London (Bot.)* 23: 71-177.
- Bunyaphatsara N (1986) Thai medicinal plants used in primary health care system. Vol. 2. Medicinal Plant Information Center: Mahidol University, pp. 32.
- Chanphen R, Thebtaranonth Y, Wanauppathamkul S, Yuthavong Y (1998) Antimalarial principles from *Artemisia indica*. *J. Nat. Prod.* 61(9): 1146-1147.
- Committee of National Pharmacopoeia (2005) Pharmacopoeia of People's Republic of China, Vol. 1. Press of Chemical Industry, Beijing, pp. 166.
- Dar AR, Dar GH, Reshi Z (2006) Conservation of *Artemisia amygdalina*

- A critically endangered endemic plant species of Kashmir Himalaya. *Endangered Species Update* 23: 34-39.
- Duke MV, Paul RN, Elsohly G, Sturtz, G, Duke SO (1994) Localization of attemisinin and attemisitene in foliar tissues of glanded and glandless biotypes of *Artemisia annua*. *Int. J. Plant Sci.* 155: 365-372.
- El-Moslimany AP (1990) Ecological significance of common non arboreal pollen: examples from dry lands of the Middle East. *Rev. Palaeobot. and palynol.*, 64: 343-350.
- Erdtman G (1969) *Hand book of palynology: morphology, taxonomy, ecology.* Copenhagen, Munksgaard.
- Farnsworth NR, Bunyapraphatsara N (1992) Thai medicinal plants recommended for primary health care system. *Medicinal Plant Information Center: Mahidol University* pp. 48.
- Furtado TA, Cisalpino EO, Santos UM (1960) In vitro studies of effect of amphotericin B on *Leishmania brasiliensis*. *Antibiot. Chemother.* 10: 692-693.
- Ghafoor A (2002) Asteraceae (I)-Anthemideae In: Ali, S. I. & M. Qaiser (eds.), *Flora of Pakistan*, Missouri botanical garden, St. Louis, Missouri, U.S.A. 207: 93-161.
- Gilani SS, Abbas SQ, Shinwari ZK, Hussain F, Nargis K (2003) Ethnobotanical studies of Kurram Agency, Pakistan through rural community participation. *Pak. J. Biol. Sci.* 6(15): 1368-1375
- Hayat MQ, Khan MA, Ahmad M, Shaheen N, Yasmin G, Akhter S (2008) Ethnotaxonomical approach in the identification of useful medicinal flora of Tehsil Pindigheb (District Attock) Pakistan. *Ethnobot. Res. Applications* 6: 35-62.
- Ibrar M, Hussain F, Sultan A (2007) Ethnobotanical studies of plant resources of Ranyal Hills, District Shangla, Pakistan. *Pak. J. Bot.* 39(2): 329-337.
- Iqbal Z, Lateef M, Ashraf M, Jabbar A (2004) Anthelmintic activity of *Artemisia brevifolia* in sheep. *J. Ethnopharmacol.* 93: 265-268.
- Iradam M, Musa D, Gumusan H, Baba F (2006) Effects of two Turkish medicinal plants *Artemisia herba-alba* and *Teucrium polium* on blood glucose levels and other biochemical parameters in rabbits. *J. Cell Mol. Biol.* 5: 19-24.
- Jain SK (1967) *Ethnobotany: Its Scope and Study.* Indian Mus. Bull. 2:39-43.
- Ko, YD, Kim JH, Adesogan AT, Ha HM, Kim SC (2006) The effect of replacing rice straw with dry wormwood (*Artemisia* sp.) on intake, digestibility, nitrogen balance and ruminal fermentation characteristics in sheep. *Animal Feed Sci. Technol.* 125: 99-110.
- Ling, YR (1982) On the systematics of genus *Artemisia* L. and the relationship with its allies. *Bull. Bot. Lab. N. E. For. Inst.* 2: 1-60.
- Ling YR (1991a) The old world *Seriphidium* (Compositae). *Bull. Bot. Lab. N.E. For. Inst.* 11: 1-40.
- Ling YR (1991b) The old world *Artemisia* (Compositae). *Bull. Bot. Lab. N. E. For. Inst.* 12: 1-10.
- Ling YR (1994) The genera *Artemisia* L. and *Seriphidium* (Bess.) Poljak. in the world. *Compositae Newsletter* 25: 39-45.
- Ling YR (1995a) The new world *Artemisia* L. In: Hind, D.J.N., C. Jeffrey and G.V. Pope (eds.), *Advances in Compositae Systematics.* Royal Botanical Garden, Kew, UK. 255-281.
- Ling YR (1995b) The new world *Seriphidium* (Besser) Fourr. L. In: Hind, D.J.N., C. Jeffrey and G.V. Pope (eds.), *Advances in Compositae Systematics.* Royal Botanical Garden, Kew, UK. 283-291
- Mabberley DJ (1990) *The plant-book.* 2nd Ed.: Cambridge University Press, Cambridge.
- McArthur ED, Plummer A (1978) Biogeography and management of the native western shrubs: A case study, section *Tridentatae* of *Artemisia*. *Great Basin Nat.* 2:229-243.
- McArthur ED (1979) Sagebrush systematics and evolution. In: Sagebrush Ecosystem Symposium. Logan: Utah State University, 14-22.
- Mossa JS (1985) Phytochemical and biological studies on *Artemisia abyssinica*: An antidiabetic herb in Arabian folk medicine. *Phytotherapy* 56: 311-314.
- Negahban M, Moharrampour S, Sefidkon F (2007) Fumigant toxicity of essential oil from *Artemisia sieberi* Besser against three stored-product insects. *J. Stor Prod. Res.* 43: 123-128.
- Nasir YJ, Rafiq RA (1995) *Wild flower of Pakistan.* Robert, T. J. (ed.), Oxford University Press, Karachi, Pakistan.
- Oberprieler C (2001) Phylogenetic relationships in *Anthemis* L. (Compositae, Anthemideae) based on nrDNA ITS and cpDNA trnL/trnF IGS sequence variation. *Plant Syst. Evol.* 255: 145-170.
- Pareto G (1985) *Artemisie. Ricerca ed applicazione.* Quaderni Agricoli suppl., 2: 1-261.
- Proksh P (1992) *Artemisia.* In: Hansel, R. Keller, K. Rimpler, H. Schneider, G. and Hrsg (Eds.), *Hagers Handbuch der Pharmazeutischen Praxis.* Springer-Verlag, Berlin, pp. 357-377.
- Sapkota PP (2008) Ethno-ecological observation of Magar of Bukini, Baglung, Western, Nepal. *Dhulagiri. J. of Sociol. and Anthropol.* 2: 227-252.
- Shinwari MI, Khan MA (2000) Folk Use of Medicinal Herbs of Margalla Hills National Park, Islamabad. *J. Ethnopharmacol.* 69: 45-56.
- Shultz LM (2006) *Artemisia* L. *Flora of the North America* North of Mexico 12+ vols. Vol. 19. Oxford University Press, New York, 503-534.
- Singh N, Lai H (2001) Selective toxicity of dihydroartemisinin and holotransferin towards human breast cancer cells. *Life Sci.* 70: 49-56.
- Sterwart RR (1972) An annotated catalogue of the vascular plants of West Pakistan and Kashmir, In: Ali, S. I. & M. Nasir (eds.), *Flora of West Pakistan*, Fakhri Printing Press Karachi, Pakistan. 207: 93-161.
- Subramoniam A, Pushpangadan RS, Rajasekharan S, Evans DA, Latha PG, Valsaraj R (1996) The effects of *Artemisia pallen* Wall. on blood glucose level in normal and alloxan-induced diabetic rats. *J. Ethnopharmacol.* 1: 13-17.
- Tan RX, Zheng WF, Tang HQ (1998) Biologically active substances from the genus *Artemisia*. *Planta Medica* 64: 295-302.
- Torrell M, Garcia-Jacas N, Susanna A and Valles J (1999) Infrageneric Phylogeny of the genus *Artemisia* L. (Asteraceae, Anthemidae) based on nucleotide sequences of nuclear ribosomal DNA internal transcribed spacers (ITS). *Taxon*, 48: 721-736.
- Tutin TG, Persson K, Gutermann W (1976) *Artemisia* L. In: T.G. Tutin, V.H. Heywood, N.A. Burges, D.M. Moore, D.H. Valentine, S.M. Walters, D.A. Webb (eds.), *Flora Europaea.* Vol. 4. Cambridge University Press, Cambridge, 178-186.
- Valecha N, Biswas S, Badoni V, Bhandari KS, Sati OP (1994) Antimalarial activity of *Artemisia japonica*, *Artemisia maritima* and *Artemisia nilegarica*. *Indian J. Pharmacol.* 26: 144-146.
- Valles J, McArthur ED (2001) *Artemisia* systematics and phylogeny: cytogenetic and molecular in sights. In proceedings: McArthur, ED, DJ. Fairbanks (eds.), *Shrubland ecosystem genetics and biodiversity*; 2000 June 13-15 Provo, UT Ogden: US department of agriculture forest service, Rocky Mountain research station pp. 67-74.
- Valles J, Garnatje T (2005) *Artemisia* and its allies: genome organization and evolution and their biosystematic, taxonomical and phylogenetic implications in Artemisiinae and related subtribes (Asteraceae, Anthemideae). In: Sharma A. (ed.), *Plant Genome: Biodiversity and Evolution*, vol. 1B, Phanerogams. Science Publishers, Enfield, New Hampshire pp. 255-285.
- Valles J, Torrell M, Garnatje T, Garcia-Jacas N, Vilatersana R, Susanna A (2003) Genus *Artemisia* and its allies, phylogeny of the subtribe Artemisiinae (Asteraceae, Anthemideae) based on nucleotide sequences of nuclear ribosomal DNA internal transcribed spacers (ITS). *Plant Biol.* 5: 274-284.
- WHO (World Health Organization) (2003) *Guidelines for Good Agricultural and Collection Practices (GACP) for Medicinal Plants.*
- Wright WC (2002) *Artemisia.* Taylor and Francis, London pp. 1-344.
- Xu GJ (1995) *Pharmacognosy.* People's Medical Publishing House, Beijing, pp. 220-224.
- Yao X, Chen G (2007) Simultaneous determination of p-hydroxyacetophenone, chlorogenic acid, and caffeic acid in Herba *Artemisiae Scopariae* by capillary electrophoresis with electrochemical detection. *Anal. Bioanal. Chem.* 388: 475-481.
- Zaidi SH (1996) Quarterly progress report on "Medicinal Plant Survey" under 'biodiversity project' of IUCN, Islamabad, Pakistan.
- Zhang QW, Zhang YX, Zhang Y, Xiao YQ, Wang ZM (2002) Studies on chemical constituents in buds of *Artemisia scoparia*. *China J. Chin. Mater. Med.* 27: 202-204.
- Zinczuk J, A. Ruveda EA, Thompson HW, Lalancette RA (2007) (+)-Santonide, a sesquiterpenoid enol lactone derived from *Artemisia*. *Acta crystallographica Section E*, 63: 1490-1491.