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ETHNOBOTANICAL AND PHYSIOLOGICAL STUDIES OF SOME ENDANGERED PLANT SPECIES COLLECTED FROM TWO DIFFERENT ALTITUDES IN GILGIT BALTISTAN

SHAH FAHAD AND ASGHARI BANO*

Department of Plant Sciences,
Faculty of Biological Sciences, Quaid-i-Azam University, Islamabad
**Corresponding author: banoasghari@gmail.com*

Abstract

This paper was aimed to study the endangered plant species collected from two different altitudes in GilgitBaltistan. There were total 105 identified species from the field areas of Naltar (2700-4350 ma.s.l) and Karga (1400-1700 ma.s.l) belonging to 36 families. The important families were Asteraceae (27 species), Poaceae (6 species), Fabaceae (8 species), Lamiaceae (8 species) and Rosaceae (3 species).The observed species richness pattern in the field areas showed that Naltar with 60 species had the highest species richness while Karga with 45 species inhabit minimum number of species. There are few species *Artemisia laciniata*, Artemisia *maritiama*, *Aconitum napellus*, *Angelica glauca*, *Betula utilis* var. D. Don, *Bergenia himalacia*, *Carum carvi*, *Onosma hispidum*, *Ephedra gerardiana*, *Glycyrrhiza glabra*, *Hippophae rhamnoides*, *Picrorhizza kurrooa*, *Podophylum emodi*, *Sussurea lappa*, *Thymus serphylum*, *Valeriana walllichii* that are endangered due to endemic nature of plants, high domestic as well as export demand. In above endangered plant species 10 belong to Naltar while 6 belong to Karga. *Artemisia laciniata*is used for jaundice, gall bladder and for high fever. Leaf paste of *Artemisia maritiama* is utilized for skin infections. *Angelica glauca* is being used for such diverse medical problems as chest congestion, insomnia, flatulence, headache, fever, skin rashes and wounds. *Betula utilis* var. D. Don is used for ear pain and its related problems. It was observed that there was increase in sugar, protein and proline contents of medicinal plant leaves at high altitude which were lower at low altitude. Similarly ABA contents also increased at high altitude while IAA and GA contents were found maximum at lower altitude.

Introduction

Men have always used natural resources of healing substances to cure human diseases. Effort to cure the diseases by means of traditional phyto-therapy has been made in all parts of the world (Heinrich, 2003; 2005; Abella *et al*., 2000; Bodeker *et al*., 2005). At present, ethno botanical and ethno pharmacological experiences of certain nation are used in the treatment of wide range of diseases (Sheng-Ji, 2001; Uniyal *et al*., 2006; Hameed *et al.*, 2011) including as cancer, AIDS, Alzheimer'sdisease, alcoholism, etc. (Perry *et al*., 1999; Bailly *et al*., 2005; Sajem & Gosai, 2006).

Northern Areas of Pakistan has extreme climatic condition (Ahmad 1951; Ahmad *et al.*, 2011a). Consequently, it has diverse climatic and vegetation zones which had distinct ethno botanically important plants are important for the economy of a country (Ahmad *et al.*, 2008; Ahmad *et al*., 2011b).

Gilgit-Baltistan (GB) formerly known as Northern Areas of Pakistan, possess peculiar geographic and climatic conditions and a diverse range of biodiversity, spreading across an area of 72,496 square kilometres bordering China, Afghanistan and India. Situated between longitude 72°-75° North and latitude 35°-37°East, the region has been administratively divided into seven districts: Gilgit, Baltistan, Ganche, Diamer, Ghizar, Astore and Hunza-Nagar. The region represents sundry range of natural ecosystems comprising wetlands and globally exceptional fauna and diverse flora with endemic plants.

According to an estimate given by the locals about 4000 kg of *Carum bulbocastanum* is collected every alternate year from Rattu and adjacent areas of upper Astore. Another important plant is *Picrorhiza kurrooa*, which has become endangered due to over exploitation from Qamri, Burzil pass and Deosai plains (Rasool, 1998). *Podophylum emodi* (bankakri) exploited from the forests of Astore has already been overexploited and now become endangered (Rasool, 1998).

Over harvesting is common for the more valuable plants such as Kurth, Ephedra, Artimesia, Sea buckthorn, and Berberis species. Increasing population and enhanced awareness about very few side effects of medicinal plants also encourage their over harvesting (Ahmad *et al.*, 2008b). Therefore, this study was conducted to record indigenous knowledge of some endangered plant species collected from different altitudes in Gilgit Baltistan.

Materials and Methods

The vegetation survey was conducted during summer 2010 along different mountain sites at various locations from Kargha (1400-1700 m.a.s.l) and Naltar (2700-4500 m.a.s.l), Gilgit-Baltistan. The selected areas differ in having slight plains with continuous and gently sloping hills. Different quadrate sites were established by selecting sites where least human activity was carried out, however influenced by frequent grazing. While collecting data at particular site care was taken to place a quadrate having a similar aspect. The total number of plant species, their presence or absence was recorded from each quadrate. Quadrate data were collected by $1m^2$while in upper area of Naltar data were taken in 10 cm^2. Number of plants occurring in every quadrate was identified and their population were recorded.

Information regarding traditional uses of medicinal plants was gathered through questionnaires, interviews, and group discussions with local farmers, elders, students and traditional healers.

A floristic checklist (alphabetical order) was compiled form extensive field collections. Place of collection, date of collection, were noted on the spot. Blotting papers and a presser was used for drying and preservation of specimens. The fully dried specimens were mounted on herbarium sheet and specimens were identified with the help of the herbarium of Quaid-e-Azam University, Islamabad and compared with the available literature (Stewart, 1972; Nasir & Ali (1971-2001).

Protein content of leaves was determined following the method of Lowery *et al.,* (1951) using BSA as standard. Sugar estimation of fresh leaves was done following method of Dubois *et al.,* (1956). The proline contents of leaves were measured by the method of Bates *et al.,* (1973). The ABA, IAA and GA concentration were determined by the method of Kettner and Doerffling (1995).

Results and Discussion

Some plants species have long used by human as a source of food and others for curing diseases and injuries. During our present investigations 16 endangered species of medicinal importance were collected and identified. All the species were used by the local people to cure different diseases. Plants collected belonged to 14 different plant families. The dominant families were Asteraceae and Apiaceae, each with two species while the remaining families have single species.

All the plant species were collected at the range of 1400 and 4500 m a.s.l. Species of *Artemisia* (*Artemisia laciniata*Willd, *Artemisia maritiama*) have been widely used for many centuries as therapeutic plants in the conventional medication (Zinczuk *et al*., 2007; Negahban *et al*., 2007; Ahmad *et al.*, 2010). Use of *Artemisia* based therapeutics is also common practice in the northern areas of Pakistan. Aziz (1996) reported that *A. maritime* was used against abdominal pain, fever and intestinal worms in Chitral valley. The species of *Angelica glauca* have been assigned as endangered for the Himalayan region due to grazing pressure (Ved *et al.,* 2003; Ahmad *et al.,* 2009). On the basis of population survey from Garhwal Himalaya the status of *Angelica* spp., as endangered was reported by Vashistha *et al.,* (2006).

Rajkumar *et al.,* (2010) extracted and evaluated the antioxidant activities from *Bergenia ciliata*. Bergenin is one of the most researched organic compounds among the many bioactive ingredients (Singh *et al*., 2007; Dhalwal *et al.,* 2008), due to quite high medicinal value. *Bergenia himalacia* has also been used for food as presence of many kinds of amino acids and mineral elements which are helpful in health care (Yang *et al*., 2009). For cosmetic application, Arbutin is used in cosmetics to make skin whiten (Guo *et al*., 2004).

Traditionally, *Onosma* plants are used as stimulant in rheumatism, bladder pain, kidney irritation and palpitation of heart (Ahmed, 2005). Hispidone, a new flavanone has been isolated from *Onosma hispidum* that have choline esterase inhibitory activity (Ahmad *et al*., 2003). *Onosma hispida* can be used as colorant (Shahina, 2005). While anticancer activity of *Onosma limitaneum* and antioxidant and antimicrobial activities of *Onosma argenatum* have been reported (Ahmad *et al.,* 2005).

Glycyrrhiza glabra is one of the most commonly used herbs in Western and Eastern herbal medicine and has a very long history of use, both as a medicine and also as a flavouring to disguise the unpleasant flavour of other medications (Mitscher *et al.,* 1978). It is a very sweet, moist, soothing herb that detoxifies and protects the liver and is also powerfully anti-inflammatory,used in arthritis and mouth ulcers (Fujioka *et al.,* 2003).

Hippophae rhamnoides oil effectively combats wrinkles, dryness and other symptoms of malnourished or prematurely aging skin and is utilized in anti-aging skin creams and lotions (Lanev*et al.,* 1995; Zhou Yuanpeng, 1998). All these beneficial compounds are derived from the berry of the *Hippophae rhamnoides* bush, which originally grew in the harsh climate of the Himalayan Mountains but has now spread all over the world.

Picrorhiza kurroa Royle ex. Benth native to Western Himalayan region, between 3000-5000 m elevation (Agrawal 2003) was valued as hepato-protective, anti-periodic, cholagouge, stomach pain, anti-amoebic, anti-oxidant, anthelmintic, anti-inflammatory, cardio-tonic, laxative, carminative and expectorant, etc. (Prajapati, 2003).

In order to fulfil the increasing national and international demand, the raw drug was largely extracted from wild species that have very limited cultivation so it has made them critically endangered (Rai *et al*., 2000).

Sugar, protein and proline content of leaves were significantly higher in all plants species collected at 4350 m a.s.l. All the three contents were found to be maximum in *Angelica glauca* at altitude of 4350 m a.s.l, while minimum was found in *Artemisia maritiama* at altitude of 1650 ma.s.l. (Fig.1). Plants adopted to low temperature stress involve changes in several metabolic pathways, including carbohydrates synthesis (Guy *et al*., 1992). Sugar played an important role in plant stress tolerance. In many plants sucrose was accumulated during cold stress (Kandler & Hopf, 1982). Protein content of leaves with respect to altitudinal variation was studied in many plant species. It was observed that during acclimation of cold, most freezing tolerant plant species produce new set of proteins that was correlated with the increase of cold hardiness (Guy, 1990). Altitudinal variation had also significant effect on proline contents of medicinal plant leaves. Different experiments had shown that, besides other solutes, the level of free amino acids, especially proline, increased during cold hardening (Galiba *et al*., 1994).

Variations in altitude had significant effect on endogenous level of ABA, IAA and GA contents of plant leaves. Endogenous ABA content of the plant was found to be higher collected from 4350 m a.s.l as compared to that plant collected from1650 m a.s.l. *Angelica glauca* showed highest content of ABA which was collected from altitudinal range of 4350 m a.s.l as compared to that collected at altitude of 1650 m a.s.l.

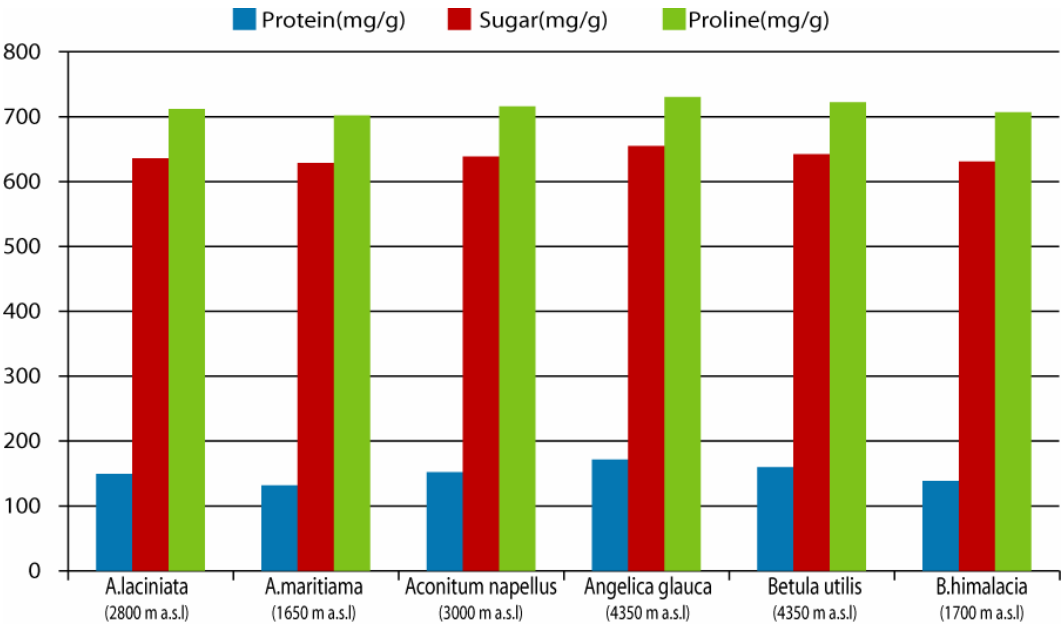

Fig. 1. Effect of altitudinal variation on Protein, Sugar and Proline contents of medicinal plant leaves.

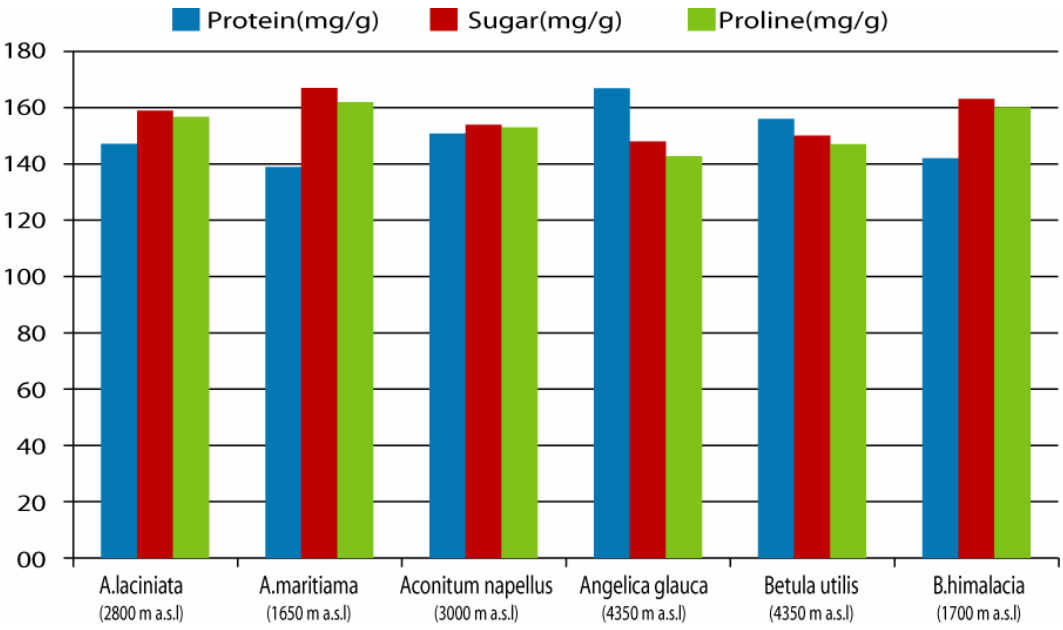

Fig. 2. Effect of altitudinal variation on ABA, IAA and GA contents of medicinal plant leaves.

The IAA and GA contents were found maximum in plant leaves collected from altitude of 1650 m a.s.l as compared to that collected from altitude of 4350 m a.s.l. Both the contents were found maximum in *Artemisia maritiama* collected from 1650 m a.s.l while in *Angelica glauca* exhibited least IAA and GA contents (Fig. 2).

During stress reactions, the concentration of phytohormones-inhibitors increased (Neumann *et al.*, 1989). Changes in the hormonal balance were thought to be responsible for the cessation of plant growth in the cold (Kacperska- palacz, 1978). Abscisic acid (ABA) accumulates in plants with response to a range of environmental stresses, including low temperature and water stress and evidence demonstrate that adaption of plants to low temperature is mediated, at least in part, by ABA (Quarrie *et al*., 1994, Wilkinson & Davies 2002).

Conclusion

There is dire need for the sustainable utilization of these plant resources. Efforts have to be made to protect and conserve rare and endangered species by adopting methods such as tissue culture,control of grazing and over exploitation.

Table 1. Plants used for different ailments by the inhabitants of Gilgit–Baltistan.

1.	Botanical name	*Artemisia laciniata* Willd
	Family	Asteraceae
	Local name	Khampa
	Habit	Herb
	Part used	Leaves
	Folk use	Plants used for wound healing
2.	Botanical name	Artemisia *maritiama*
	Family	Asteraceae
	Local name	Zoon
	Habit	Shrub
	Part used	Leaves
	Folk use	Leaf paste is utilized for skin infections
3.	Botanical name	*Aconitum napellus*
	Family	Ranunculaceae
	Local name	SaiBooma
	Habit	Herb
	Part used	Whole plant used
	Folk use	Used for Anodyne, diuretic and diaphoretic
4.	Botanical name	*Angelica glauca*
	Family	Apiaceae
	Local name	Choro
	Habit	Herb
	Part used	Root is aromatic and is used as a food flavouring
	Folk use	Used as a cordial stimulant in the treatment of dyspepsia and constipation
5.	Botanical name	*Betula utilis* var. D. Don
	Family	Betulaceae
	Local name	Halli
	Habit	Tree
	Part used	Bark
	Folk use	Butter is wrapped in the bark paper and stored. Also used as a substitute for writing paper
6.	Botanical name	*Bergenia himalacia*
	Family	*Saxifragaceae*
	Local name	Sanspur
	Habit	Herb
	Part used	Root
	Folk use	Headache and wound healing
7.	Botanical name	*Carum carvi*
	Family	Apiaceae
	Local name	Filizooh
	Habit	Herb
	Part used	seeds
	Folk use	Seeds are used for stomach problems, ulcers, uterine tumors, internal wounds and dysentery
8.	Botanical name	*Onosma hispidum*
	Family	Boraginaceae
	Local name	Gaowzoban
	Habit	Herb
	Part used	Roots
	Folk use	It is used to treat pelvic inflammatory disease in combination with alum
9.	Botanical name	*Ephedra gerardiana*
	Family	Ephedraceae
	Local name	Sopat
	Habit	Shrub
	Part used	Aerial parts
	Folk use	Used for the healing of wounds and for the Asthma.
10.	Botanical name	*Glycyrrhiza glabra*
	Family	Fabaceae
	Local name	Shalako
	Habit	Herb
	Part used	Rhizome
	Folk use	Used in treating cervical cancer, kidney and bladder disorders, HIV, hepatitis B, herpes, inflammation of mucous membrane, food poison, stomachaches, coughs, horse-voice, bronchitis
11.	Botanical name	*Hippophae rhamnoides*
	Family	Elaeagnaceae

	Local name	Buru
	Habit	Shrub
	Part used	Fruits
	Folk use	Used for cytoprotective, anti-stress, immunomodulatory, hepatoprotective, radioprotective, anti-atherogenic, anti-tumor, anti-microbial and tissue regeneration
12.	Botanical name	*Picrorhizza kurrooa*
	Family	Scrofulariaceae
	Local name	Karroo
	Habit	Herb
	Parts used	Leaf, bark, root and rhizomes
	Folk use	Protects the liver against hepatotoxins, hepatoprotective properties, Potent antioxidant activity, Modulates liver enzyme levels, anti-inflammatory action anti-allergy action
13.	Botanical name	*Podophylum emodi*
	Family	Podophyllaceae
	Local name	Shingoy
	Habit	Herb
	Parts used	Rhizome and root
	Folk use	Used for Cancer and hepatic stimulant
14.	Botanical name	*Sussurea lappa*
	Family	Compositae
	Local name	Minal
	Habit	Herb
	Part used	Root
	Folk use	Cough with cold, stomach ache, dysmenorrhea, and altitude sickness
15.	Botanical name	*Thymus serphylum*
	Family	Labiatae
	Local name	Tumuro
	Habit	Herb
	Parts used	Aerial part
	Folk use	Use for the treatment of flu, colds, sore throat, coughs, bronchitis, chest infections and sinusitis
16.	Botanical name	*Valeriana walllichii*
	Family	Valerianaceae
	Local name	Musk bala
	Habit	Herb
	Part used	Root
	Folk use	Used for diuretic,brain and nervous Conditions andcardiovascular conditions

References

Abella, L., A.R. Cortella, A. Velasco-Negueruela and M.J. Pérez-Alonso. 2000. Ethnobotany, volatile oils and secretion tissues of *Werneri apoposa* from Argentina. *Pharm. Biol*., 38: 197-203.

Ahmad, I., I. Anis, A. Malik, S.A. Nawaz and M.I. Choudhary. 2003. Cholinesterase Inhibitory Constituents from *Onosma hispida Chem. Pharm. Bull*., 51(4): 412-414.

Ahmad, I., M.S.A. Ahmad, M. Ashraf, M. Hussain and M.Y. Ashraf. 2011b. Seasonal variation in some medicinal and biochemical ingredients in a potential medicinal plants *Mentha longifolia* (L.) Huds. *Pak. J. Bot.*, 43(SI): 69-77.

Ahmad, I., M.S.A. Ahmad, M. Hussain, M. Ashraf, M.Y. Ashraf and M. Hameed. 2010. Spatiotemporal aspects of plant community structure in open scrub rangelands of sub-mountainous Himalayan plateaus. *Pak. J. Bot*., 42(5): 3431-3440.

Ahmad, I., M.S.A. Ahmad, M. Hussain, M. Hameed, M.Y. Ashraf and S. Koukab. 2009. Spatio-temporal effects on species classification of medicinal plants in Soone valley of Pakistan. *Int. J. Agri. Biol*., 11(1): 64-68.

Ahmad, I., M.S.A. Ahmad, M. Hussain, M.Y. Ashraf, R. Ahmad and A. Ali. 2008b. Spatiotemporal variations in physiochemical parameters of *Adiantum capillus veneris* in Soone Valley of Salt Range in Pakistan. *Pak. J. Bot.*, 40(4): 1387-1398.

Ahmad, V.U., F. Kousar, A.Khan, M. Zubair, S. Iqbal and R.B. Tareen. 2005. A New Ketone and a known anticancer tri terpenoid from the leaves of *Onosma limitaneum*, Helv. *Chim. Acta.*, 88(2): 309-311.

Ali, S.I. and Y.J. Nasir. 1983. *Onosma griffithii* Vatke (Boraginaceae).

Bailly, F., C. Queffelec, G. Mbemba, J.F. Mouscadet and P. Cotelle. 2005. Synthesis and HIV-1 integrase inhibitory activities of caffeic acid dimers derived from *Salvia officinalis*. Bioorg. *Med. Chem. Lett*., 15: 5053-5056.

Bates, L., S.R. Waldern and I.D. Teare. 1973. Rapid dertermination of free proline for water stress studies. *Plant Soil.*, 39: 205-207.

Bodeker, C., C.K. Ong, C. Grundy, G. Burford and K. Shein. 2005. WHO Global atlas of traditional, complementary and alternative medicine. World Health Organization, Centre for Health Development, Kobe, Japan.

Dhalwal, K., V.M. Shinde, Y.S. Biradar and K.R. Mahadik. 2008. Simultaneous quantification of bergenin, catechin, and gallic acid from *Bergenia ciliate* and *Bergenia ligulata* by using thin-layer chromatography. *J. Food Composition Anal*., 21: 496-500.

Dubois, M., K.A.Gilles, J.K. Hamilton, P.A. Rebers and F. Smith. 1956. Colorimetric methods for determination of sugars and related substances. *Anal. Chem.*, 28: 305-356.

Fujioka, T., T. Kondou and A. Fukuhara. 2003. Efficacy of a glycyrrhizin suppository for the treatment of chronic hepatitis C: A pilot study. *Hepatol. Res*., 26(1): 10-14.

Galiba, G., J. Sutka, J.W. Snape, R. Tuberosa, S.A. Quarrie, L. Sarkadi and O. Veisz. 1994. The association of forest resistance gene Frl with stress induced osmolyte and ABA

accumulation in wheat. In: *Proceedings of the workshop on crop adaptation to cool climates*. Oct 12-14, Hamburg Germany, pp. 389-401.

Guo, H.Y., K.K. Song and Q.X. Chen. 2004. The synthesis of two Arbutin derivatives and inhibitory effect of them on tyrosinase. *J. Xiamen University (Natural Science*), 43: 1-4.

Guy, C.L. 1990. Cold acclimation and freezing stress tolerance: Role of protein metabolism. *Annu. Rev. Plant Physiol. Plant Mol. Biol*., 41: 187-223.

Guy, C.L., J.L.A. Huber and S.C. Huber. 1992. Sucrose phosphate and sucrose accumulation at low temperature. *Plant Physiol.*, 100: 502-508.

Hameed, M., M. Ashraf, F. Al-Quriany, T. Nawaz, M.S.A. Ahmad, A. Younis A. and N. Naz. 2011. Medicinal flora of the Cholistan desert - A review. *Pak. J. Bot.*, 43(SI): 39-50.

Heinrich, M. and P. Bremner. 2006. Ethnobotany and Ethnopharmacy –Their Role for Anti-Cancer Drug Development. *Curr. Drug Targets*, 7: 239-245.

Kandler, O. and H. Hopf. 1982. Oligo saccharides based on sucrose. In: *Encyclopedia of plant Physiology*, New series 13 A, (Eds.): F.A. Loewus and W. Tanner. Berlin: Springer, pp. 348-382.

Lanev, 1995. The effect of an extract of Sea buckthorn on the healing of experimental skin wounds in rats. *Dermatology*, 48(3): 30-33.

Lowery, O.H., N.J. Poesen brough, A.L. Fal and R.J. Randall. 1951. Protein measurment with Folin Phenol reagent, *J.Bio. Chem.*, 193: 265-275.

Mitscher, L.A., S. Park, S. Omoto, G.W. Clark and D. Clark. 1978. Antimicrobial agents from higher plants, Glycyrrhiza glabra L. I.Some antimicrobial isoflavans, isoflavenes, flavanones and isoflavones. *Heterocycles*, 9: 1533-1537.

Nasir, E. and S.I. Ali. 1971-1995. Flora of Pakistan. Pakistan Agri. Research Council, Islamabad.

Negahban, M.S. Moharramipour and F. Sefidkon. 2007. Fumigant toxicity of essential oil form *Artemisia sieberi Besser* against three stored product insects. *J. Stor Prod. Res*., 43: 123-128.

Neumann, D., L. Nover, B. Parthier, R. Reiger, K.D. Scharf, R. Wollgienn and U. Neiden. 1989. Heat shock and other stress response systems of plants. *Biologisches Zentralblatt*, 6:1-55.

Perry, E.K., A.T. Pickering, W.W. Wang, J. Houghton, P. Perry NSL. 1999. Medicinal plants and Alzheimer's disease: from ethno botany trophy therapy. *J. Pharm. Pharmacol*., 51: 527-534.

Prajapati, N.D., S.S. Purohit, A. K. Sharma and Tarun Kumar. 2003. .A handbook of medicinal plants: A complete source book, 396-397. Jodhpur: *Agro bios*.

Quarrie, S.A., G. Galiba, J. Sutka, J.W. Snape, A. Semikhodski, A. Steed, M. Gulli and C. Calestani. 1994. Assocaition of a mojor vernalization gene of wheat with stress induced ABA production. In: *Proceedings of the workshop on crop adaptation to cool climates*. Oct. 12-14, Hamberburg Germany, 403-414.

Rai, L.K., P. Prasad and E. Sharma. 2000. Conservation threats to some important medicinal plants of the Sikkim Himalaya. *Biological Conservation*, 93: 27-53.

Rajkumar, V., G. Guha, R.A. Kumar and L .Mathew. 2010. Evaluation of antioxidant activities of *Bergenia ciliate* rhizome. *Records Natural Prod*., 4(1): 38-48.

Rasool, G. 1998. Saving the plants that save us. Medicinal plants of the northern areas of Pakistan.–xi+92 pp., BASDO, Gilgit.

Sajem, A.L. and K. Gosai. 2006. Traditional use of medicinal plants by theJaintia tribes in North Cachar Hills district of Assam, Northeast India. *J. Ethnobiol. Ethnomed*., 2: 33.

Shahina, N. 2005. Structure and functionality of the pigments isolated from *Onosma hispidum* (ratanjot) *Terminalia catappa* (janglibadam) and other tropical plant. Ph. D thesis, University of Karachi, Karachi.

Sheng-Ji, P. 2001. Ethno botanical approaches of traditional medicine studies: some experiences from Asia. *Pharm. Biol*., 39(1): 74-79.

Singh, D.P., S.K. Srivastava, R.Govindarajan and A.K.S. Rawat. 2007. High performance liquid chromatographic determination of bergenin in different *bergenia* species. *Acta Chromatographica.*, 19: 246-52.

Stewart, R.R. 1972. Flora of West Pakistan an annotated catalogue of the vascular plants of West Pakistan and Kashmir. Fakhri Printing Press, Karachi, pp. 110-250.

Uniyal, S.K., K.N. Singh, P. Jamwal and L. Lal. 2006. Traditional use of medicinal plants among the tribal communities of Chhota Bhangal, Western Himalaya. *J. Ethnobiol. Ethnomed*., 2: 14.

Vashistha, R., B.P. Nautiyal and M.C. Nautiyal. 2006. Conservation status and morphological variations between populations of *Angelica glauca* Edgew and *A. Archangelica* Linn. In Garhwal

Ved, D.K., G.A. Kinhal, K. Ravikumar, V. Prabhakaran, U. Ghate, R.V. Sankar and J.H. Indreasha. camp. 2003. Report: 206. Workshop, Shimla, Himachal Pradesh, FRLHT, Bangalore, India.

Yang, X.M., Z.K. Wang, Z.H. Wang and R.X. Li. 2009. Analysis of nutritive components and mineral element of Bergenae pacumb is in Tibet Sejila. *J. Changjiang Vegetables*, 22: 57-58.

Zhou, Y.P. 1998. Study on the effect of Hippophae seed oil against gastric ulcer. Institute of medicinal plants Resource Development.The Chinese Academy of Medical Sciences, Beijing.

Zinczuk, J.A., E.A. Ruveda, H.W. Thompson and R.A. Lalancette. 2007. (+)- Santonide, a sesquiterpenoidenol lactone derived from *Artemisia*. Actacrystallographica Section E, 63: 1490-1491.

Ahmad, K.S. 1951. Climatic regions of Pakistan. *Pak. J. Forest*., 6: 1-35.

Kacperska-Palacz, A. 1978. Mechanism of cold acclimation in herbaceous plants, In: plant cold hardiness and freezing stress. (Eds.): P.H. Li & A.Sakai. pp. 139-152. Academic press, New York.

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.

Agrawal, V.S. 2003. *Directory of Indian economic plants*. Dehradun: Bishen Singh Mahendra Pal Singh.

Heinrich, M. 2005. Ethno botany and natural products: the search for new molecules, new treatments of old diseases or a better understanding of indigenous cultures? *Front Med. Chem.*, *Online*, 2: 431-450.

Ahmad, I., M. Hussain, M.S.A. Ahmad and M. Hameed. 2008a. Spatio-temporal effects on association of plant species in soone valley of Pakistan. *Pak. J. Bot.*, 40(5): 1865-1876.

Ahmad, I., M.S.A. Ahmad, M. Hussain and M.Y. Ashraf. 2011a. Spatiotemporal variations in soil characteristics and nutrient availability in open scrub type semi-arid rangelands of typical sub-mountainous Himalayan tract. *Pak. J. Bot.*, 43(1): 565-571.

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