



Research Article

Polygonatum verticillatum (L.) All: AN ASTAVARGA MEDICINAL HERB OF ETHNOPHARMACOLOGICAL APPROACH

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Abstract- The ethnomedicinal overviews and studies contributed a heap of information on different indigenous traditional systems. Such types of studies are essential for re-assessment of wild populations of medicinal plants at the regional, national and global level to further amplify their current therapeutic potential. The re-emergence of open enthusiasm of people in plant-based medicine combined with fast extension of pharmaceutical ventures resulted in expanded demand of medicinal plants. Blending of traditional knowledge with modern health care practices definitely provide effective health care services to people. *Polygonatum verticillatum*, an immensely valued medicinal herb finds tremendous use in traditional and folklore system of medicine for treatment of plethora of health problems. Hence, this communication deals with the documentation of indigenous knowledge regarding ethnopharmacological importance of *P. verticillatum* confined within tribal communities of rural and remote localities. It helps to reaffirm the faith in indigenous system of medicine and will surely help to restore it before modernization system. Documentation and protection of such precious traditional knowledge will definitely provide an impressive support to its subsequent clinical use in advanced medicine and bestow opportunity for its future applications.

Keywords- *Polygonatum verticillatum*, Ayurveda, Indigenous medicines, Astavarga, Ethnomedicine.

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Introduction

Plants, since the dawn of human civilization are globally known as a natural source of therapeutics. Our present knowledge about plants for traditional and folklore medication is based on the vast experiences of healers over time. Plants have a prominent role in curing various health problems and complications through their inherent active constituents. Easy availability, reasonable market prices, lesser side effects and strong faith in traditional and folklore medicines make them preferable choice over modern pharmaceuticals. This has led to increased commercialization of herbal medicines in both developing and developed countries. Botanical surveys have estimated approximately 250,000 to 350,000 plant species on the planet. About 35,000 species have been used for treating various ailments by different communities of the world [1]. Traditional system of medicine (TSM) includes certain health approaches based on beliefs and experiences practiced in different cultures. TSM emphasizes on incorporating the use of medicinal herbs and changes in life styles with a view to diagnose and treat both physical and mental illness. Such indigenous system of traditional knowledge descended from generation to generation or developed through personal experiences over centuries. Thus, it preserves cultural diversity besides community healthcare. During past few years there has been an increased global interest in traditional system of medicine. Some well-known traditional systems of medicine i.e., Ayurveda, Siddha, Yunani, Naturopathy, Homeopathy and Traditional Chinese Medicine have been practiced since ancient times with appreciable success. Collection and documentation of traditional knowledge plays an important role in scientific research on drug development [2]. *Polygonatum* (King Solomon's seal, Solomon's seal), a genus of about 57 species is widely distributed in the warm temperate, subtropical and boreal zones of the Northern Hemisphere [3]. From historical times, *Polygonatum* has been used in both Oriental (especially Chinese) and European natural folklore remedies [4]. It is also

used as food and medicine in India, China, northern and eastern United States, south-central Canada and Korea [5,6]. *P. verticillatum*, popularly known as whorled Solomon's seal is a distinguished medicinal herb of temperate Himalaya. It has a worldwide distribution in Europe, Turkey, Central and North Asia, Pakistan, Afghanistan and Tibet and has been considered as the most important medicinal herb of Himalayan region [7]. Different extracts of *P. verticillatum* is known to have remarkable therapeutic potential and is utilized in different parts of world to cure number of health problems. Henceforth, the present study aims with exploring and documenting the traditional and ethnopharmacological activities of *P. verticillatum*, a highly valued medicinal herb widely used as a folklore medicine in Ayurvedic system of medicine.

P. verticillatum in Ayurvedic system of medicine

Ayurveda is one of the oldest medical systems in the world aimed with prevention of health problems and enhancement of life values by using the inherent principles of nature. It always tends to restore equilibrium among body, mind and spirit. The health promoting and disease preventing approach of Ayurveda is procuring greater recognition and popularity in global market. Several formulations of Ayurvedic origin are found to be effective for therapeutic purposes. Astavarga, a group of eight miraculous medicinal herbs have occupied a prominent place in Ayurvedic system of medicine and is known for jeevaniya (Vitality promoting), Vaysthan (restoring of youthful condition), body nourishment, antioxidant and invigorating properties [8]. In Ayurvedic pharmacy, Astavarga plants are used in various forms, e.g. Taila (oil), Ghritam (medicated clarified butter), Churana (powder) and formulations including Chyavanprasha, a health-promotive tonic [9]. According to ancient literatures, Chyavanprash, an Ayurvedic formulation was prepared from Astavarga medicinal herbs to cure old and weak body of rishi Chyavan. Since then it is well known for its cell regenerating and health promoting

properties. *P. verticillatum* is an important ingredient of Astavarga group of medicinal plants. Being an important constituent of this miraculous group, *P. verticillatum* is used in the preparation of Chyavanprash, a polyherbal Ayurvedic formulation. In Charak Samhita, an ancient Ayurvedic literature, Chyavanprash has been revealed as an influential preparation to treat *kasa*(cough), *kshaya* (consumption), *svasa* (dyspnea), *hrdroga* (cardiac problems) and *svarabheda* (voice problems) [10, 11]. Chyavanprash has also been found to possess radioprotective effects, [12] alleviate geriatric complaints [13] and have genoprotective efficacy against tobacco smoke by minimizing the genotoxic risk induced by mutagenic agents present in tobacco smoke [14]. *P. verticillatum* is an important ingredient of diverse Ayurvedic formulations viz., Chyavanprash, Triphalaghrit, Bramhrasayan and Mahanarayantel [15]. It is extensively used in folk system of medicine for different healthcare needs. *P. verticillatum* is one of the important ingredients of the admirable group of herbomineral formulations called 'Amruth Jeevan Rasayan' which is composed of purely herbal jam named avaleha along with the mineral-rich tablets. Both of these are well known for their rejuvenating and nourishing properties on the human body, preventing disease, preserving complete health, supporting convalescence (regaining of comprehensive health after getting cured from ailments) and promoting long-life by treating age associated diseases [16]. Being an important component of

Brahmarasayan, an Ayurvedic formulation, it is used to preserve youth, stamina and cognitive function and develop a disease free state with no dementia [17].

Ethnopharmacological uses of *P. verticillatum*

P. verticillatum is a herb of great medicinal importance. Its chemical constituents i.e., β -sitosterol, santonin, 2-hydroxybenzoic acid, diosgenin and quinine bestows it with different pharmaceutical properties viz., analgesic, antipyretic, antimalarial, diuretic, sex stimulant and energizer etc [18-21]. *P. verticillatum* can be a good source of diosgenin for pharmaceutical industry as it contains about 2.2% diosgenin [18]. *P. verticillatum* is also utilized as a vegetable and are eaten roasted in India, China and Nepal [22-24]. *P. verticillatum* is tremendously used in traditional and folkloric systems of medicine for treating gastric problems, sexual disorders, pulmonary problems, pain, diabetes, leucorrhoea, gonorrhea, as general tonic, nervine tonic, appetizers, healing wounds and fractures [Table-1] [25-50]. Rhizomes of *P. verticillatum* have been found potent for improving liver conditions, curing diverse health troubles viz., headache and eye disease, gastric troubles, throat pain, high blood pressure and epilepsy. As a complex administration, *P. verticillatum* together with *P. sibiricum* improved chronic hepatitis B [18].

Table-1 Ethnopharmacological uses of *P. verticillatum*

S.No.	Indigenous uses	Tribes/Communities/Areas
1	Rhizome is used in the treatment of cancer	China [25]
2	In the treatment of leucorrhoea, 1 gm dried root powder is taken with water, twice a day for 3 days	Bhotiyas (Central Himalaya, India) [26].
3	As decoction in pregnancy, child birth and post pregnancy care	Rural areas of Kerala, South India [27].
4	Root extract is taken with honey as tonic, and appetizers	Local inhabitants of Kalimath valley, Uttarakhand, India [28].
5	Rhizomes of <i>P. verticillatum</i> are eaten as aphrodisiac	Chamba and Kangra district of Himanchal Pradesh, India [29].
6	Rhizomes are used for rheumatism, general body weakness	Shangla district, Pakistan [30].
7	Powder of roots used in diabetes, leucorrhoea and as tonic in general weakness	Vaidhyas (faith herbal healer) of Nanda Devi Biosphere Reserve, India [31].
8	1-2 gm rhizome powder is taken twice a day for 7-8 days in the treatment of leucorrhoea, gonorrhea and amenorrhea	Traditional herbalist (Amchi) in Ladakh, India [32].
9	Included in shukrajanana group of drugs which accelerates spermatogenesis	Ayurvedic system of medicine [33].
10	Rhizome in powder form (2-4 g) is taken with milk for treating general weakness and oligospermia whereas in paste form to heal wounds and as plaster in bone fracture	Bhotiya tribe inhabiting Niti valley, Uttarakhand, India [34].
11	Roots are powdered along with other herbs, minerals and salts to make tablets which are taken together with boiled water to promote appetite and to treat digestive problems	Boto (the Buddhist) tribal community of Ladakh, India [35].
12	Plant as a whole to cure appetite, kidney trouble, as nervine tonic and also restores body strength	Tibetan Amchi System of medicine (Lahaul Valley of Himanchal Pradesh) India [36].
13	Small pieces of fresh roots are kept in water overnight. Next day these are ground in the same water and about 10 ml of this solution is taken regularly empty stomach in the morning to cure spermatorrhoea (locally called <i>dhat</i>) and piles.	Tribal communities of Chhota Bhangal, India [37].
14	Shoot is used in indigestion	Local inhabitant of Shiwalik region of Uttarakhand [38].
15	Tubers/leaves are baked with ghee, dried and powder and taken with milk for increasing sexual potency	Northwest Himalaya, India [8].
16	Rhizome paste is taken with milk as tonic to get relief in body pain in household remedies	Chamoli, Uttarakhand, India [39].
17	In gastrointestinal disorders, skeleton-muscular problems, genital and sexual disease.	Pakistan [40].
18	For treating leucorrhoea, piles and diabetes, ½ teaspoonful powdered rhizomes of <i>Polygonatum verticillatum</i> along with <i>Dactylorhiza hatagirea</i> is taken twice a day for a month	Faith herbal healers of Uttarakhand Himalaya, India [41].
19	Rhizome of <i>P. verticillatum</i> along with <i>Ficus religiosa</i> (leaf), <i>Artemisia parviflora</i> (whole plant), <i>Cinnamomum zeylanicum</i> (leaf), <i>Embellica officinalis</i> (fruit), minerals and medicinal stones are mixed to form tablets and given thrice a day for 10-15 days to promotes urine discharge and removes painful urination	Ladakh, India [42].
20	Aphrodisiac, appetizer, general tonic and nervine tonic	Local inhabitant of Mornaula Reserve Forest, Kumaun Himalaya India [43].
21	Powdered root along with <i>Dactylorhiza hatagirea</i> , <i>Bombax ceiba</i> , <i>Asparagus fillicinus</i> roasted with clarified butter to make pills which is taken twice a day for the treatment of sexual incapability	Bhotiyas, Tolchhas and other local communities of Nanda Devi Biosphere Reserve, Uttarakhand, India [44].
22	Use to cure kidney problems	Gujars, Gaddis, Malanis, Kulluvis and others communities of the Parvati valley of Kullu district in Western Himalaya of India [45].
23	Paste prepared from root applied on wounds for early healing	Western Himalaya, India [46].
24	Rhizome is used to cure disturbed menstruation, uterine tumor and swelling	Pakistan [47].
25	Anthelmintic, appetizer, tranquilizer and in the treatment of excessive watery fluid accumulation in joints	Bhutanese traditional medicine system [48].
26	Bulbs of <i>P. verticillatum</i> are dried, powdered and taken after mixing with honey to cure tuberculosis	Uttarakhand, India [49].
27	Together with bhang (<i>Cannabis sativa</i>) and ash is used for ethno veterinary treatment of fracture/sprain of sheep	Marwar region of Uttarakhand, India [50].

Ethnopharmacological uses of *P. verticillatum* in the treatment of painful conditions, fever, malaria, diarrhea, asthma, as diuretic and sex stimulant have been validated [9], [19], [49-53]. Presence of significant amount of essential life nutrients like proteins, fats, carbohydrates, ascorbic acid along with ash, fibres and moisture contents and macro and micronutrients validated the ethnobotanical uses of plant as tonic and energizer [54]. Various pharmacological activities of *P. verticillatum* validate its ethnopharmacological importance to cure various health disorders [Table-2]. It is a herb of therapeutic importance which is not allowed to use without prescription [55]. Although all parts of *P. verticillatum* offers medicinal

properties but mainly the rhizomes are used in preparation of folklore and Ayurvedic formulations. Hence, collection of *P. verticillatum* for medicinal purpose destructs the whole plant resulting in rapidly dwindling populations. Moreover, there is injudicious large scale uprooting of the plant from the wild without devising any strategy for its cultivation. There are several reports of destructive harvesting of *P. verticillatum* from different parts of India. Therefore, to conserve this medicinally valuable herb both *ex situ* and *in situ* methods should be scientifically practiced.

Table-2 Various pharmacological activities of different parts of *P. verticillatum*

S.No.	Activities	Parts used	Remarks
1	Aphrodisiac	Leafs	Aqueous leaf extracts (500mg/kg) facilitates several aspects of copulatory behavior [10].
2	Diuretic	Rhizomes	Mild diuretic activity at 300mg/kg compare to saline [20].
3	Antinociceptive	Rhizomes	Opioid dependent central effect of rhizome extract has synergistic effect by enforcing the peripheral analgesic effects [20].
4	Antimalarial	Aerial parts	Due to the presence of α -Bulnesene, Linalylacetate, eicosadienoic, docosane, pentacosane, piperitone [52].
5	Antipyretic	Aerial parts and rhizomes	Protection elicited by rhizome extracts (82.20%) at 200mg/kg was comparable with aspirin (88.48%) at 100mg/kg [53].
6	Anti-inflammatory	Aerial parts	Augmented by its prominent Lipoxygenase inhibitory activity [54].
7	Bronchodilator	Aerial parts	Attenuation of calcium channel activity, analogous to that produced by verapamil [54].
8	Antispasmodic	Rhizomes	Predominantly through the activation of adenosine triphosphate sensitive K ⁺ Channels [55].
9	Antidiarrheal	Rhizomes	Similar to loperamide at the doses of 500 and 1000mg/kg [55].
10	Antimicrobial	Rhizomes	Diosgenin and santonin have antimicrobial potential supported by strong inhibition on protein denaturation [56], [57].
11	Lipoxygenase and Urease inhibition	Aerial parts	Ethyl acetate (IC ₅₀ : 97 μ g/mL) and n- butanol (IC ₅₀ : 97 μ g/mL) fraction was found most potent to possess lipoxygenase and urease inhibition activity respectively [58].
12	Tyrosinase inhibition	Rhizomes	Showed by compounds propyl pentadecanoate 1 and 2', 3' - dihydroxypropyl pentadecanoate 2, isolated from therhizome [59].

Conclusion

In the past few decades, people have become much conscious about the side effects of synthetic medication. Hence, there is increasing inclination towards herbal products for the betterment of their health and wellbeing. Consequently, it has widened the scope and demands of medicinal plants in global market. In the recent years, our knowledge on plant assets has risen above the conventional heritable knowledge. Local inhabitants and ethnic communities residing in remote localities meet their primary health needs by practicing their own indigenous traditions using plants. The traditional knowledge regarding pharmacological utilities of plants has been vanishing due to present day modernization, commercialization, socio-economic changes, lack of proper documentation and transmission of this knowledge. Therefore, there is an emerging need to encourage and popularize the traditional approach at one hand and to validate the potent traditional therapeutic knowledge on the other hand. Habitat fragmentation, deforestation, imprudent over exploitation for commercial needs are some of the serious threats to wild plants. There is serious need to promote awareness among people for sustainable utilization of medicinal plants as well as to value the biodiversity for the sustainability of ecosystem services. An appropriate strategy and collaborative action plan should also be made to conserve economically important threatened medicinal herbs to meet out the market demand.

Application of research: Reviewing and documentation of medicinal/ethnopharmacological importance of *P. verticillatum* will provide a rationale for its scientific investigation and exploration of novel phytoconstituents of clinical utility.

Research Category: Phytomedicine

Abbreviations: TSM: Traditional system of medicine

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References

- [1] Khan H. (2014) *Biol Med*, 6, 3. doi: 10.4172/0974-8369.1000e110.
- [2] Ragupathy S., Newmaster S.G., Maruthakutti M., Velusamy B. and Ul-Huda M.M. (2008) *J Ethnobiol Ethnomed*, 27, 8-15.
- [3] Meng Y., Nie Z.L., Deng T., Wen J. and Yang Y.P. (2014) *Bot J Linn Soc*, 176, 435-451.
- [4] Motohashi N., Zhang G.W. and Shirataki Y. (2003) *Orient Pharm Exp Med*, 3, 163-179.
- [5] Wujisguleng W., Liu Y. and Long C. (2012) *Acta Soc Bot Pol*, 81, 239-244.
- [6] Misra S., Maikhuri R.K., Kala C.P., Rao K.S. and Saxena K.G. (2008) *J Ethnobiol Ethnomed*, 4, 15 <http://dx.doi.org/10.1186/1746-4269-4-15>.
- [7] Dhyani A., Nautiyal B.P. and Nautiyal, M.C. (2010) *Int J Biodivers Sci Ecosyst Serv Manage*, 6, 13-19.

- [8] Buchake V.V., Bachhav R.S., Rode R.B., Aher S.S., Muthal A.P., Dhokchawle B.V. and Saudagar R.B. (2010) *Research J Pharmacognosy and Phytochemistry*, 2, 260-263.
- [9] Kazmi I., Afzal M., Rahman M., Gupta G. and Anwar F. (2012) *Asian Pac J Trop Dis*, S841-S845.
- [10] Baliga M.S., Meera S., Vaishnav L.K., Rao S. and Palatty P.L. (2013) *Integr Cancer Ther*, 12, 455-463.
- [11] Nadkarni A.K. (1976) *Indian Materia Medica*. 3rd ed. Mumbai, India: Popular Press.
- [12] Jagetia G.C. and Baliga M.S. (2004) *Phytother Res*, 18, 14-18.
- [13] Alam M., Varadarajan T.V. and Venkatbushna D.D. (1977) *J Res Indian Med Yoga Homeopathy*, 2, 63-73.
- [14] Yadav J.S., Thakur S. and Chadha P. (2003) *Int J Hum Genet*, 3, 33-38.
- [15] Rawat R. and Vashistha D.P. (2011) *Int J Pharmacognosy and Phytochem Res*, 3, 64-73.
- [16] Louis T., Cheriyan S. and Gopinath N. (2014) *IJAHM*, 4, 1622-1633.
- [17] Bala V. and Manyam M.D. (1999) *J Altern Complement Med*, 5, 81-88.
- [18] Motohasi N., Zhang G.W. and Shirataki Y. (2003) *Orient Pharm Exp Med*, 3, 163-179.
- [19] Khan H., Saeed M., Gilani A.H., Khan M.A., Dar A. and Khan I. (2010) *J Ethnopharmacol*, 127, 521-527.
- [20] Tariq A., Mussarat S. and Adnan M. (2015) *J Ethnopharmacol*, 164, 96-119.
- [21] Virk J.K., Kumar S., Singh R., Tripathi A.C., Saraf S.K., Gupta V. and Bansal P. (2016) *J Adv Pharm Tech Res*, 7, 153-158.
- [22] Boesi A. (2014) *J Ethnobiol Ethnomed*, 10, 75. doi: 10.1186/1746-4269-10-75.
- [23] Wujisguleng W., Liu Y. and Long C. (2012) *Acta Soc Bot Pol*, 81, 239-244.
- [24] Phondani P.C., Maikhuri R.K., Rawat L.S., Farooquee N.A., Kala C.P., Vishvakarma S.C.R., Rao K.S. and Saxena K.G. (2010) *Ethnobotany Research & Applications*, 8, 233-244.
- [25] Anvar K. and Haneef J. (2015) *Internat J Res Pharm Chem*, 5, 570-581.
- [26] Semwal D.P., Bhatt K.C., Mangain A., Uniyal P.L. and Bahuguna Y.M. (2013) *Medicinal plants*, 5, 223-230.
- [27] Thakur M., Asrani, R.K., Thakur S., Sharma P.K., Patil R.D., Lal B. and Parkash O. (2016) *J Ethnopharmacol*, 191, 280-300.
- [28] Razzaq A., Hadi F., Rashid A., Ibrar M. and Ali U. (2015) *Am-Eurasian J Agric Environ Sci*, 15, 328-331.
- [29] Rana C.S., Tiwari J.K., Dangwal L.K. and Gairola S. (2013) *Indian J Tradit Know*, 12, 308-314.
- [30] Ballabh B. and Chaurasia O.P. (2011) *Ethnobotany Research & Applications*, 9, 59-66.
- [31] Biswas T.K., Pandit S. and Jana U. (2015) *Andrology*, 4, 148. doi: 10.4172/2167-0250.1000148.
- [32] Ratha K.K., Joshi G.C., Rungsung W. and Hazra J. (2015) *WJPPS*, 4, 1042-1061.
- [33] Ballabh B. and Chaurasia O.P. (2015) *Indian J of tradit know*, 8, 185-190.
- [34] Sharma P.K., Thakur S.K., Manuja S., Rana R.K., Kumar P., Sharma S., Chand J., Singh A. and Katoch K.K. (2011) *Chinese Medicine*, 2, 93-102.
- [35] Uniyal S.K., Singh K.N., Jamwal P. and Lal B. (2006) *J Ethnobiol Ethnomed*, 2, 1-8.
- [36] Gaur R.D. and Sharma J. (2011) *J Forest Sci*, 27, 23-31.
- [37] Bisht V.K., Kandari L.S., Negi J.S., Bhandari A.K. and Sundriyal R.C. (2013) *J Med Plants Res*, 7, 918-929.
- [38] Akhtar N., Rashid A., Murad W. and Bergmeier E. (2013) *J Ethnobiol Ethnomed*, 9, 25. doi:10.1186/1746-4269-9-25.
- [39] Tiwari R. and Rana C.S. (2015) *Annals of Phytomed*, 4, 108-110.
- [40] Singh D., Singh B. and Goel R.K. (2011) *J Ethnopharmacol*, 134, 565-583.
- [41] Pant S. and Samant S.S. (2010) *Ethnobot Leaflets*, 14, 193-217.
- [42] Rana C.S., Tiwari J.K., Dangwal L.R. and Sundriyal R.C. (2012) *Indian J Tradit Know*, 11, 646-651.
- [43] Sharma P.K., Chauhan N.S. and Brij L. (2004) *Indian J Ethnopharmacol*, 92, 167-176.
- [44] Kumari P., Joshi G.C. and Tewari L.M. (2012) *IJAHM*, 2, 661-678.
- [45] Khan S.W. and Khatoon S. (2008) *Pak J Bot*, 40, 45-58.
- [46] Wankchuk P., Ugyen S., Thinley J. and Afaq S.H. (2008) *Ethnobot*, 20, 54-64.
- [47] Bhatt D., Kumar, R., Tewari L.M. and Joshi G.C. (2014) *J Med Plant Res*, 8, 253-259.
- [48] Meena M.L., Sharma N.K. and Singh D. (2015) *Indian J Anim Res*, 49, 662-670.
- [49] Khan H., Saeed M., Gilani A.H., Khan M.A., Khan I. and Ashraf N. (2011) *Phytother res*, 25, 1024-1030.
- [50] Khan H., Saeed M., Muhammad N., Tariq S.A., Ghaffar R. and Gul F. (2013) *Pak J Bot*, 45, 497-500.
- [51] Khan H., Saeed M., Gilani A.H., Muhammad N., Haq I., Ashraf N., Rehman N. and Haleemi A. (2013) *Phytother res*, 27, 2468-471.
- [52] Khan H., Saeed M., Gilani A.H., Mehmood M.H., Rehman N., Muhammad N., Abbas M. and Haq I. (2013) *Phytother res*, 27, 1288-1292.
- [53] Khan H., Saeed M., Gilani A.H., Muhammad N., Rehman N.U., Mehmood M.H. and Ashraf N. (2016) *Toxicol Ind Health*, 32, 677-685.
- [54] Khan H., Saeed M., Muhammad N., Khan F., Ibrar M., Hassan S. and Shah W.A. (2012) *Pak J Pharm Sci*, 25, 871-875.
- [55] Kala C.P. and Ratajc P. (2012) *Biodivers Conserv*, 21, 1115-1126.
- [56] Khan H., Saeed M., Muhammad N., Ghaffar R., Khan S.A. and Hassan S.A. (2012) *Pak J Pharm Sci*, 25, 463-467.
- [57] Khan H., Saeed M., Rauf A., Khan M.A. and Muhammad N. (2015) *Nat Prod Res*, 29, 2160-2163.
- [58] Khan H., Saeed M., Muhammad N., Ghaffar R., Gul F. and Raziq N. (2015) *Toxicol Ind Health*, 31 (2015) 758-763.
- [59] Khan H., Saeed M., Khan M.A., Haq I., Muhammad N. and Ghaffar R. (2013) *Med Chem Res*, 22, 2088-209.