Research Article

Comparative Study of Heavy Metals in *Albizia lebbeck*, collected from different Environmental Sites

Muhammad Ishaq, Ali Rehman, Muhammad Adnan, Najeeb Ullah, Ijaz ahmad *, Muhammad Aamir
Department of Chemistry, Kohat University of Science & Technology (KUST), Kohat-26000, Khyber Pakhtunkhwa, Pakistan.
***Corresponding author's E-mail:** drijaz_chem@yahoo.com

Accepted on: 20-03-2013; **Finalized on:** 31-05-2013.

ABSTRACT

Study of heavy metals including Fe, Zn, Mn, Ni, Cr, Cd and Pb in *Albizia lebbeck* collected from different environmental sites i.e. industrial site, heavy traffic site, residential site and non residential site of karak, Khyber Pakhtunkhwa, Pakistan was performed by Atomic Absorption Spectrometry. Dry digestion method was applied for the digestion of plant samples. Highest level of Fe (45.10 ppm), Zn (31.25 ppm) and Mn (23.89 ppm) were recorded in plant samples collected from non residential area while high concentration of Ni (5.08 ppm), Cr(1.10 ppm), and Cd (0.41 ppm) were found in plant samples collected from industrial area and lead content was high (12.19 ppm) in sample of heavy traffic site. The results showed that the accumulation of heavy metals in medicinal plants depends upon the climate of locality, air pollution, soil contamination and other environmental factors where the plants grow. The implication of the investigation was to make attentiveness among the community about the utilization of *Albizia lebbeck* containing high level of heavy metals and their adverse toxic effects.

Keywords: *Albizia lebbeck*, Heavy Metals, Environmental sites, Atomic Absorption Spectrometry.

INTRODUCTION

Medicinal plants are significantly useful and economically vital. They have active constituents that can be used to treat various chronic and infectious diseases[1]. Human depends fully or partially on herbal medicine because of their availability, low toxicity, effectiveness, affordability and acceptability. Worldwide plant extracts are employed for their antiviral activities, antibacterial and antifungal because biologically active compounds from natural sources are of great concern for scientists working on infectious diseases[2]. The therapeutic and dietary values as well as the toxicity of plants depend on the chemical composition including metal ions. These metals play a significant role in the formation of active compounds in these medicinal plants. Some metals are required for plants to complete their life cycle but they are toxic at high concentration. Medicinal plants are easily contaminated during growth, development and processing. Due to their non-biodegradable nature, these metals tend to accumulate in biological compartment and move through the food chain[3].

Herbs and herbal drugs have produced awareness in humans by clinically proven effects like antimutagenic, immunomodulatios and adaptogenic. Also the adverse reaction of synthetic drugs has motivated the human to return to nature for safer remedies. In this research work we have taken *Albizia lebbeck*, which is an important herbal drug and being used traditionally for a long time.

Albizia lebbeck belongs to a family Leguminosae commonly known as sreen. The plant is found throughout Pakistan, India, Bangladesh, tropical and subtropical Asia and Africa[4]. The different parts of *Albizia lebbeck* is traditionally used in bronchitis, piles, hemicranias, cough, topical pulmonary eosinophilia, leprosy, deafness, boils, scabies, syphilis, paralysis, weakness and asthma. It also has Antiseptic, antibacterial, antillargic, antidermatosis and antidysenteric action[5].

This medicinal plant was selected for our investigation having in mind their extensive use in traditional medicine for various ailments by local physicians in the area from where this plant was collected and such medicinal plants must be analyzed for heavy metals load before processing for further pharmaceutical purposes.

Another aim was to know the effect of different environmental sites on *Albizia lebbeck* on the basis of heavy metals contamination.

MATERIALS AND METHODS

Samples Collection

The different parts like root, stem, leaves and seeds of *Albizia lebbeck* as well as soil samples were collected from four different environmental sites i.e. industrial site, heavy traffic site, residential site and non residential site of district Karak, Khyber Pakhtunkhwa, Pakistan. The non residential site was selected in hilly and rocky area. Soil samples were taken from the upper 8-10 cm of soil. Plant parts were washed in tape water to remove dust and dirt, and then rinsed properly with deionized water. The rinsed plant parts were then dried under shed and were grinded by using pistol and mortar and then stored in clean, dried plastic bottles for further analysis.

Analysis of samples

(a) Acid Digestion of plant Samples:

Specific weight of crushed and powder portion from each part of plant like root, stem, leaves and seeds was taken

in china dish for heating in an oven at 105°C to remove moisture. Then the dried sample after charring was placed in furnace. The furnace temperature was gradually increased from room temperature to 550°C in 1 hour. The sample was washed for about 4 hr until a white or grey ash residue was obtained. The contents of china dish were cooled in desiccators and weighed. After cooling and weighing of samples, 2 mL of 6M HNO_3 solution was added into china dish and the mixture was heated slowly to dissolve its contents. The solution was filtered through whatman (#42) filter paper into 25 mL flask and diluted to the mark[6,7].

Estimation of heavy metals were carried out on Flame Atomic Absorption Spectrophotometer [FAAS] (Perkin Elmer 400 was used).

(b) Acid digestion of soil samples:

For heavy metals determination, all the soil samples were crushed lightly and were sieved to pass through 2-mm mesh. One gram of soil sample was treated with a mixture of 10 ml of HNO_3 and 5 ml of $HClO_4$ (70%) in a china dish. The contents of the china dish were heated on a hot plate until the volume of contents was reducing to 1 mL. The contents of the china dish were filtered through whatman (#42) filter paper into 25 mL volumetric flask and diluted to the mark with distilled water[7]. Heavy metals like Fe, Zn, Ni, Mn, Pb, Cr and Cd were analyzed with Flame Atomic Absorption Spectrophotometer [FAAS] (Perkin Elmer 400).

RESULTS AND DISCUSSION

In the current study heavy metals like Fe, Zn, Mn, Ni, Cr, Cd and Pb were determined in the roots, stem, leaves and seeds of *Albizia lebbeck*. Selection of the plant parts used for this study was based on their extensive use in traditional system of medicine. The plant was collected from different environmental sites like industrial site, heavy traffic site, residential site and non residential sit of Karak Khyber Pakhtunkhwa Pakistan. The concentrations of the studied metals are given in Table-1 & 2 and the comparisons of heavy metals in this different Environmental site have also been shown by Figures 1-7.

Table 1: Concentration of heavy metals (ppm) in Soil collected from different Environmental sites

Location	Fe	Zn	Mn	Ni	Pb	Cr	Cd
Industrial area	26.73±0.03	59.00±0.01	27.66±0.03	18.01±0.01	9.39±0.02	2.95±0.03	1.89±0.01
Heavy traffic area	19.05±0.13	32.95±0.13	28.28±0.14	11.95±0.09	16.24±0.04	2.45±0.11	1.39±0.05
Residential area	21.23±0.06	35.44±0.31	8.94±0.09	13.21±0.13	6.23±0.19	1.84±0.21	1.23±0.04
Non residential area	60.03±0.05	40.99±0.32	26.34±0.20	4.21±0.23	4.23±0.08	1.91±0.09	0.00

Table 2: Concentration of heavy metals (ppm) in *Albizia lebbeck* collected from different Environmental sites

Location	Title	Fe	Zn	Mn	Ni	Pb	Cr	Cd
Industrial area	Root	12.41±0.03	23.5±0.04	8.90±0.01	5.08±0.01	5.10±0.01	1.10±0.02	0.23±0.04
	Stem	22.13±0.01	21.6 ±0.02	6.72 ± 0.02	4.07±0.01	3.03 ± 0.01	0.99± 0.03	0.19±0.01
	Leaves	20.82±0.02	6.41 ±0.03	3.41 ±0.04	3.15±0.02	2.28±0.02	0.12 ±0.02	0.41±0.09
	Seeds	8.97±0.03	4.91 ±0.01	2.05±0.02	1.16±0.01	0.74±0.02	0. 07±0.0l	0.04±0.01
Heavy traffic area	Root	6.80±0.11	20.08±0.21	13.09±0.26	1.07±0.03	9.13±0.03	0.12±0.02	0.11±0.02
	Stem	10.46±0.15	19.13±0.17	4.17±0.21	1.17±0.02	12.19±0.04	0.75±0.11	0.21±0.01
	Leaves	18.22±0.12	11.06±0.10	9.15±0.23	1.21±0.04	11.17±0.08	0.79±0.20	0.34±0.03
	Seeds	7.64±0.09	6.60±0.19	4.06±0.12	1.09±0.08	5.00±0.07	0.40±0.11	0.02±0.01
Residential area	Root	14.13±0.04	21.16±0.11	2. 86 ±0.02	5.01±0.03	1.05 ± 0.03	0.51± 0.09	0.09±0.01
	Stem	12.12±0.07	20.11±0.21	3.56±0.03	3.07±0.11	2.11 ±0.04	0.61±0.09	0.04±0.01
	Leaves	13.32±0.09	26.9±0.12	5.13±0.05	2.21±0.04	1.09±0.02	0.40±0.10	0.04±0.01
	Seeds	2.36±0.03	2.39±0.02	1.03±0.01	1.05±0.03	1.15±0.02	0.09±0.03	0.02±0.00
Non residential area	Root	45.10±0.13	31.25±0.33	20.00±0.43	4.11±0.20	2.98 ± 0.11	0.32± 0.05	0.00
	Stem	23.01±0.10	22.76±0.43	21.01±0.34	3.08±0.09	2.23 ±0.09	0.09±0.03	0.00
	Leaves	26.27±0.13	18.44±0.34	23.89±0.21	1.23±0.12	1.14±0.04	0.40±0.02	0.00
	Seeds	5.11±0.09	4.59±0.05	4.56±0.23	1.05±0.07	0.75±0.03	0.07±0.01	0.00

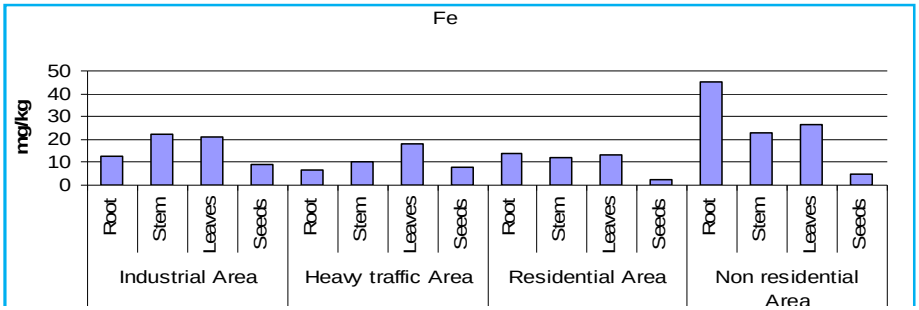

Figure 1: Comparative concentration of Iron in *Albizia lebbeck* of different sites

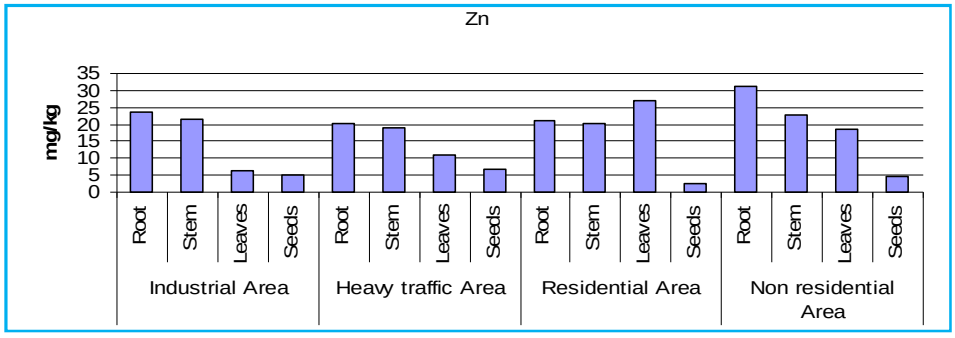

Figure 2: Comparative concentration of Zinc in *Albizia lebbeck* of different sites

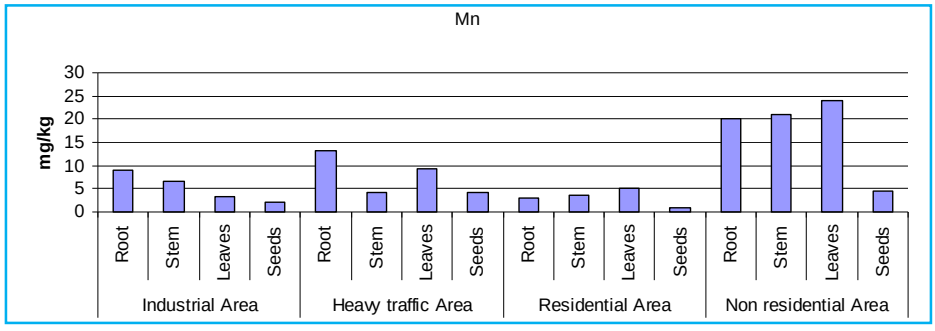

Figure 3: Comparative concentration of Manganese in *Albizia lebbeck* of different sites

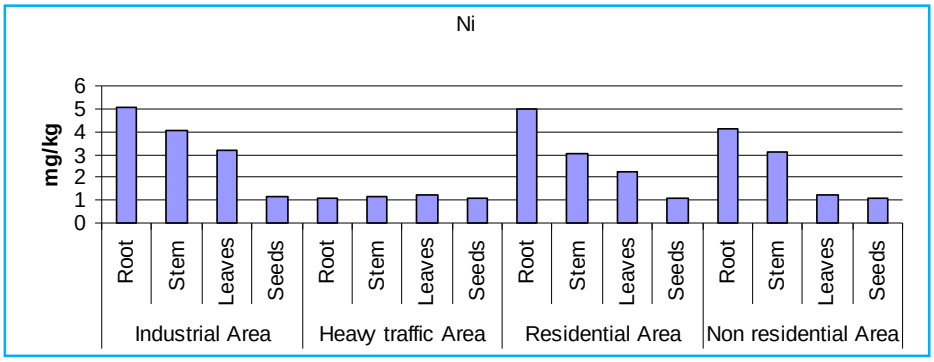

Figure 4: Comparative concentration of Nickel in *Albizia lebbeck* of different sites

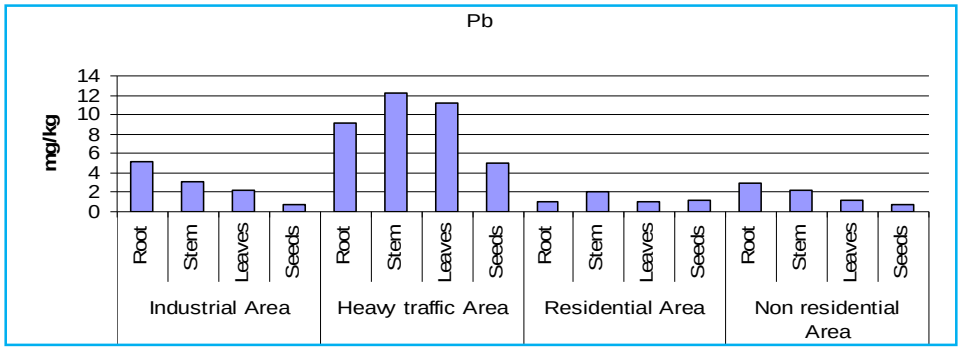

Figure 5: Comparative concentration of Lead in *Albizia lebbeck* of different sites

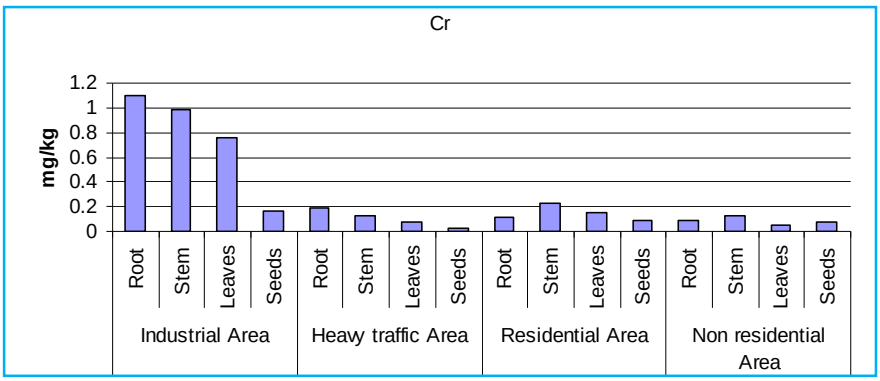

Figure 6: Comparative concentration of Chromium in *Albizia lebbeck* of different sites

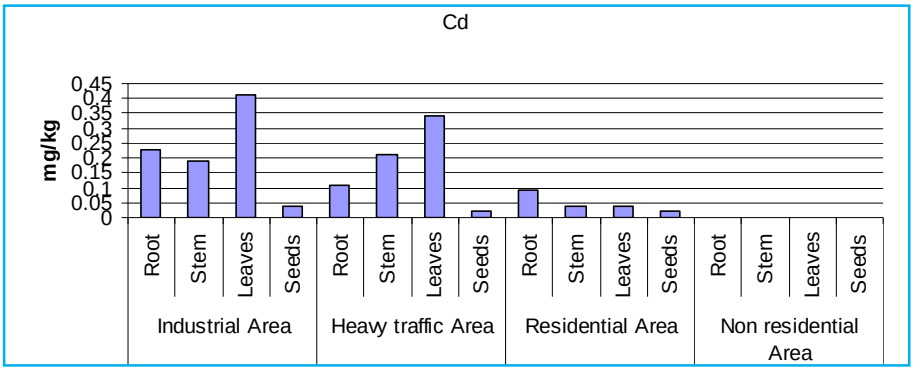

Figure 7: Comparative concentration of Cadmium in *Albizia lebbeck* of different sites

Iron

It is evident from table-1 that the level of iron in all selected soils was found in upper and lower limit of 19.05 ppm and 60.03 ppm respectively. The table-2 and figure-1 shows that the concentration of Iron in plant samples range from 2.36- 45.10 ppm. The concentration variety of Fe in Industrial area was 8.97-22.13 ppm, 6.80-18.22 ppm in heavy traffic area, 2.36-13.32 ppm in residential area and 5.11-45.10 ppm in non residential area. The highest concentration of iron was found in roots 45.10 ppm then in leaves 26.27 ppm and in stem 23.01 ppm of plant collected from non residential area. The high concentration of Fe in samples of non residential area may be due to soil contamination as this spot was selected in rocky and hilly area which is in rich of minerals. The least concentration of iron 2.36 pp m was found in seeds of plant collected from residential a rea.

Zinc

It is clear from the table-1 that zinc level in soil of selected spot was 59.00 ppm, 32.95 ppm, 35.44 ppm and 40.99 ppm in industrial area, heavy traffic area, residential area and non residential area respectively. The table-2 and figure-2 indicates that the concentration of zinc in all the selected spot was in the array of 2.39-31.25 ppm, in which the level of zinc in industrial area was found in the range of 4.91-23.5 ppm, 6.60-20.08 ppm in heavy traffic area, 2.39- 26.9 ppm in residential area and 4.59-31.23 ppm in non residential area. Among all the samples high level 31.25 ppm was recorded in the roots of plant collected from non residential area followed by in leaves 26.9 ppm from residential area then in root 23.5 ppm from industrial area. The high level in root may be due to soil contamination. The least concentration of zinc 2.39 ppm was found in seeds of plant collected from residential area.

Manganese

As we see in table-2 that the concentration of manganese ranges from 1.03-23.89 ppm. The manganese range 2.05- 8.90 ppm was recorded in Industrial area, 4.06-13.09 pm in Heavy traffic area, 1.03- 5.13 ppm in residential area and 4.56- 23.89 ppm in non residential area. The highest concentration was found in leaves 23.89 ppm collected from non residential area followed by stem 21.01 ppm and root 20.00 ppm. The high amount of Mn in roots leaves and stem of *Albizia lebbeck* may be due to soil and air contamination. The least concentration 1.03 ppm was found in seeds of residential area. As the concentration of manganese is below critical concentration so it does not cause any pollution or health hazardous effects.

Nickel

The Nickel level in soil was in the range 4.21- 18.01 ppm as shown in table-1. It is also clear from figure-4 that the concentration of Nickel in plants parts ranges in between 1.05-5.08 ppm. The concentration of nickel was found high in root 5.08 ppm of industrial area followed by root 5.01 ppm of residential area and then in root 4.11 ppm of non residential area. The least concentration was found in seed 1.05 ppm of both residential and non residential area. The higher concentration of nickel in plants from industrial area and residential area can be explained on

the basis that the soil get polluted by waste water from industries contain nickel and natural soil contamination.

Lead

As can be seen from the data in table -1 that level of lead in soil of industrial area was recorded 9.39 ppm, heavy traffic area 16.24 ppm, residential area 6.23 ppm and non residential area 4.23 ppm. The table-2 and figure-5 shows that the concentration of lead in the plant samples of selected spots was in the range 0.74-12.19 ppm. The concentration of lead was high in stem 12.19 ppm followed by leaves 11.17 ppm then in root 9.13 ppm of heavy traffic area. High level of lead was found in heavy traffic area followed by industrial area. Obviously, the accumulation of lead in heavy traffic area is due to emission of lead from automobiles and also its presence in soil polluted with wastes coming from different operations. The least amount of lead 0.74 ppm was recorded in stem of industrial area. The WHO recommended level of lead in medicinal plant is 10 ppm. [8]

Chromium

As we seen from figure- 6 that the concentration of chromium in different parts of plant collected from different spots ranges form 0.07-0.79 ppm. With respect to spots, the range of chromium was 0.07-0.58 ppm in industrial area, 0.12-0.79 ppm in heavy traffic area, 0.09-0.61 ppm in residential area and 0.07- 0.40 ppm in non residential area. The highest concentration of chromium was found in leaves 0.79 ppm, followed by stem 0.75 ppm collected from heavy traffic area while the lowest amount of chromium 0.07 ppm was found in seeds collected from non residential area. The high accumulation of chromium in leaves and stem of heavy traffic area is due to air dust blowing from automobiles and other operations. The food and drug administration (FDA) recommended level of chromium in medicinal plant is 0.12 ppm. [8]

Cadmium

The Figure-7 shows the concentration of cadmium in whole plant samples ranges from 0.02-0.4 ppm i.e. industrial area 0.04-0.41 ppm, heavy traffic area 0.02-0.34 ppm, and residential area 0.02-0.09 ppm. The concentration of cadmium was high in leaves 0.41 ppm collected from industrial area followed by leaves 0.34 ppm from heavy traffic area. The high concentration of cadmium in plant's parts collected from industrial area may be due to soil polluted by industrial's wastes while its high level in leaves of heavy traffic area may be due to air contamination. The least concentration was found in seeds 0.02 ppm collected from heavy traffic area and residential area. Most of the samples collected from Industrial and heavy traffic area showed high concentration of cadmium as compared to the samples from residential and non residential area. The plants parts collected from non residential area do not show cadmium concentration probably they are below detection limit. The WHO recommended level of cadmium in medicinal plant is 0.3 ppm. [8]

CONCLUSION

Heavy metals were estimated in *Albizia lebbeck* collected from four different environmental sites. The results showed that the accumulation of heavy metals in medicinal plants depends upon the climate of locality, air pollution, soil contamination and other environmental factors where the plants grow. As the heavy metals were fluctuate in plant as well as in soil samples from site to site therefore each medicinal plant should be analyzed before utilization for pharmaceutical or traditional medicinal purposes. The implication of the investigation was to make attentiveness among the community about the exploitation of *Albizia lebbeck* containing high level of heavy metals and their adverse toxic effects.

REFERENCES

1. Raza M, Fozia, Rehman A, Wahab A, Iqbal H, Ullah H, Ahmad S, Ahmad I, Shah SM, Comparative antibacterial study of *Convolvulus arvensis* collected from different areas of Khyber Pakhtunkhwa, Pakistan, International Research Journal of Pharmacy, 3(10), 2012, 220-222
2. Imtiaz B, Fozia, Waheed A, Rehman A, Ullah H, Iqbal H, Wahab A, Almas M, Ahmad I, Antimicrobial activity of *Malva neglecta* and *Nasturtium microphyllum,* International Journal of Research in Ayurveda and Pharmacy, 3(6), 2012, 808-810.
3. Rehman A, Ullah H, Fozia, Ahmad N, Rahman AU, Ullah N, Zeb S, Khan RU, Ahmad I, Profile of heavy metals in medicinal plants collected from Khyber Pakhtunkhwa, Pakistan**,** International Journal of Bioassays, 2(2), 491-496, 2013.
4. Rahul C, Pankaj P, Sharma KS, Jhajharia K M, Phytochemical screening and antimicrobial activity of *Albizzia lebbeck*, Journal of Chemical and Pharmaceutical Research, 2(5), 2010, 476-484.
5. Faisal M, Singh PP, Irchhaiya R, A review on *Albizia Lebbeck* A potent herbal drug, International Research of Pharmacy, 3(5), 2012, 63-68.
6. Khan SA, khan L, Hussain I, Marwat KB, Akhtar N, Profile of heavy metals in selected medicinal plants, Pakistan Journal of Weed Sciences and Research, 14(1-2),2008, 101-110.
7. khan I, Ali J, Ulllah H, Heavy metals determination in medicinal plant *Withania somnifera* growing in various areas of Peshawar, NWFP, Pakistan, Journal of Chemical Society of Pakistan, 39(1), 2008, 69-74.
8. World Health Organisation,. Quality Control Method for Medicinal Plant Materials. WHO Geneva Switzerland, 1998.

Source of Support: Nil, **Conflict of Interest:** None.