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Determination of Heavy Metals in *Mentha longifolia* of District Zhob, Balochistan

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Abstract

The current study aimed to analyze the metals in medicinal plant mentha longifolia. The samples of plant mentha longifolia were gathered from four different regions of District Zhob. These samples were analyzed using Atomic Absorption Spectrometer. Fe, Pb, Cd, Cu, Co, Mn, Ni, K and Na were detected but with different concentrations as the samples were collected from various locations. K and Mn were detected with the highest amount in sample from Zhob River Bank while the least amount of K and Mn were detected in Killi Tora Derga among all the samples. However, the highest concentrations of Ni, Cu and Fe were detected in Killi Naway Oba while the least amount of Ni and Cu were found in Killi Tora Derga and Fe in Zhob River sample. On other hand, the highest level of Cd and Pb were detected in the samples of Killi Tora Derga whereas the least amount of both metals were found in the sample of Zhob River. The maximum quantity of Co was detected in both Asghar Tangi and Killi Tora Derga samples while the minimum amount of Co was determined in Killi Naway Oba. The obtained results were compared with the acceptable values set by WHO which showed that all assessed metal concentrations were within the range. It is, therefore, concluded that mentha longifolia plant of concerned areas in District Zhob can be used in medicine as well as for home remedies without any hesitation.

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Keywords: Heavy Metals, Mentha Plant, Atomic Absorption Spectroscopy, Zhob District

INTRODUCTION

The peppermint (*mentha longifolia*) in the lamiaceae family is the water mint crossbreeds. It has a 30-90 cm thinner rhizome and is an annual grassy plant [1]. It needs half shadow-sunny areas, proper irrigation, and sandy soils. It comprises of phenols, tannins, and terpenes. It has vast applications as spices, green leafy vegetables, and vegetable contained oil. Various scientific studies have indicated further usage in medicine, cosmetics, alcohol, etc. Therefore, it is known as a medicinal plant [2 – 3].

Medicinal plant species are the natural resources for several herbal products and widely known medications. Herbal medication is used on a large scale globally due to low prices in recent times. A general perception of the people is that herbal remedies do not have any side effects because these are natural and considered safe for life. When weathering occurs, it releases heavy metals to the soil, due to which these metals enter into the plants [4 – 5]. The consumption of the contaminated plants is the main cause of the entrance of heavy metals in living organism.

Heavy metals appear to settle in the human tissues for long durations. Higher concentrations of heavy metals than permissible limits are the cause of metabolic disruptions. The absence and abundance of significant elements such as Fe, Zn, and Cu are also injurious to human health. The association of poisonous metals (Cd, Cr, Pb, etc.) and life-threatening trace elements may have considerable repercussions [6].

Mentha longifolia plant is medicinal plant which plays vital role in home remedies. Contamination of this plant with heavy metals to greater extent may cause severe problems for human beings. Therefore, this study was conducted to evaluate the concentrations of some heavy metals in *mentha longifolia* plant collected from various regions of District Zhob and compare the result with permissible limits given by authoritative organizations.

METHOD AND MATERIALS

Collection of Samples:

The samples of Mentha plants were collected from different regions of District Zhob such as the Bank of Zhob River, Killi Tora Derga, Asghar Tangi and Killi Naway Oba. These samples were put in polyethylene bags and were brought to the laboratory of Department of Chemistry, University of Balochistan, Quetta for further analysis.

Washing and Drying:

The collected samples of Mentha plant were washed with deionized water to eliminate pollutants. They were then cut to form almost identical small pieces. These minor pieces of Mentha plant were put in cleaned crucibles and were dried in the oven at 50 ^{o}C until converted to crunchy.

Grinding/ Sample Size Reduction:

The dried Samples of mentha plant were taken and homogenized by making a fine powder with help of mortar and piston. These were later kept in polyethylene bags for additional process.

Digestion of the Samples:

1 g of each sample was taken in 50 ml beaker. Then 10 ml concentrated HNO_3 was added to it and placed on the hot plate to oxidize it for 20 - 25 minutes. After this, sample was removed from hot plate and cooled it. Then 5 ml $HClO_4$ was added and was heated again on hot plate till white fumes emitted. Later, it was removed and cooled. Finally, the sample was filtered with whatman paper No. 42 and diluted to 50 ml with deionized water. The samples were analyzed by AAS.

Analysis of the Samples:

The analysis of the samples was conducted for metals such as Cd, Pb, Cu, Mn, Co, Ni, Fe, Na and K through Atomic Absorption Spectrometer at Department of Chemistry, University of Balochistan, Quetta.

RESULT AND DISCUSSION

The analytical findings of this analysis revealed that all heavy metals were found in the samples of *Mentha longifolia* plant that have been tested. The result of the detected metals such as Cd, Pb, Cu, Mn, Co, Ni, Fe, Na and K are displayed in table 1. The current study result indicates that the level of metal in *Mentha longifolia* plant is contingent on the areas from where the samples have been gathered. The cleaner the sampling site, the lesser amount of metal detection will be expected.

Table 1: Concentration of Metals in *Mentha* Plants with WHO permissible limits (ppm).

Metals	Samples ID				WHO** Permissible limit (ppm)
	Zhob River Bank	Asghar Tangi	Killi Naway Oba	Killi Tora Darga	
Cd	0.112	0.165	0.197	0.226	0.3
Pb	1.9063	2.4827	3.0037	3.1763	10
Cu	0.5593	0.5486	0.6065	0.5224	10
Mn	0.8402	0.5096	0.7810	0.4256	200
Co	0.1718	0.1932	0.1341	0.2009	-
Ni	0.2841	0.3271	0.3978	0.2989	1.5
Fe	12.2829	16.8609	18.2584	10.3987	20
Na	7.2451	12.1598	10.7896	5.3710	-
K	105.9779	96.7544	99.1230	75.6337	-

WHO =** World Health Organization

Cadmium (Cd):

Cadmium is a trace element and is very dangerous for the health. It may cause various diseases in human body like vomiting, diarrhea, and stomach discomfort etc. if found in greater amount. The accumulation of cadmium is increased in the soil by acid rain and agricultural wastes. It may transport from soil to the medicinal plant Mentha via root [7]. The current study detected the highest amount of Cd in the samples of Mentha plant taken from Killi Tora Derga and least amount was assessed in the sample of Mentha Plant collected from Zhob River Bank. While the level of Cd in Asghar Tangi and Killi Naway Oba was greater than the sample of Zhob River Bank but lesser than sample of Killi Tora Derga. However, the overall result was within the range of permissible limit given by WHO.

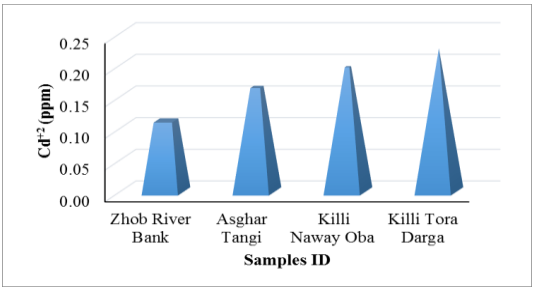

Figure 1: Graph for Cadmium

Lead (Pb):

Metal lead is very toxic even at very small amount. It can aggravate various problems to the environment and public health. The accumulation of lead in human body influences the children I.Q, and central nervous system. It can modify the sperms which become the cause of male fertility reduction and increases the birth defects and abortion in women [8]. The highest concentration of Pb was assessed in the samples of mentha plant gathered from Killi Tora Derga while the least amount of Pb was determined in the mentha plant samples collected from the Bank of Zhob River. The Killi Naway Oba and Asghar Tangi samples showed lesser amount of Pb than Killi Tora Derag While greater amount than the sample taken from the Bank of Zhob River. However, the samples taken from Killi Naway Oba were detected with higher level of Pb than Asghar Tangi samples. This variation may be due to the content of lead source in the study areas. Lead concentration was within the permissible limit (10 ppm) of WHO.

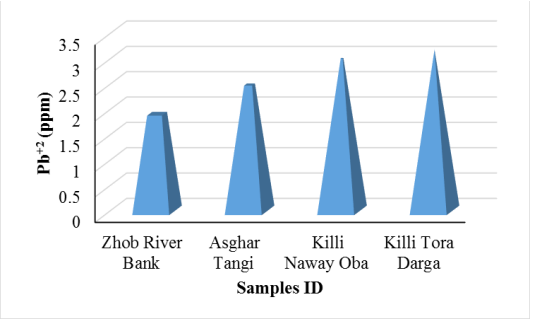

Figure 2: Graph for lead

Copper (Cu):

Copper is significant for human health. It provides energy to the cells of body. It also takes part in oxidative reactions when present in enzymes. Copper is imperative for estrogenic metabolism that plays role in female fertility for the maintenance of pregnancy. Disorder of thyroid function, central nervous system and hair problems may be due to copper shortage. It may become toxic at very high concentration and may cause reduction in hemoglobin, erythrocytes level. It can also induce cancer and even sometime death [9]. The copper concentration that was detected in the samples of mentha plant collected from four different areas are in the following order; Killi Tora Drga > Killi Naway Oba > Asghar Tangi > Zhob River Bank. However, the concentration of copper in all the samples were found below the acceptable limit (10 ppm) fixed by WHO/FAO.

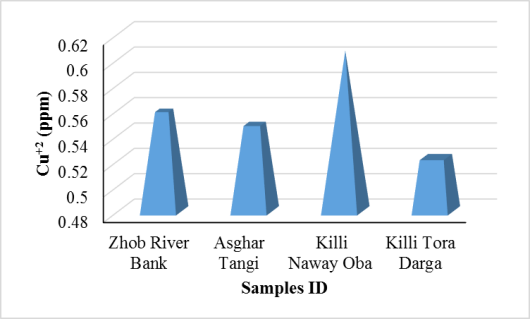

Figure 3: Graph for Copper

Manganese (Mn):

Manganese is a metal that functions as an antioxidant and has a key role in carbohydrate, protein and cholesterol metabolism. The storage site for manganese is liver, kidneys, skin and bones in human body [10]. The sample gathered from Zhob River Bank was assessed with the highest amount of Mn while least amount in the samples gathered from Killi Tora Derga among all the samples. On other hand, Killi Naway Oba samples was detected with higher amount of Mn than Asghar Tangi whch is in turn less than Zhob River Bank and Killi Tora Derga samples. Whereas, the level of Mn was below the WHO limit (200 ppm).

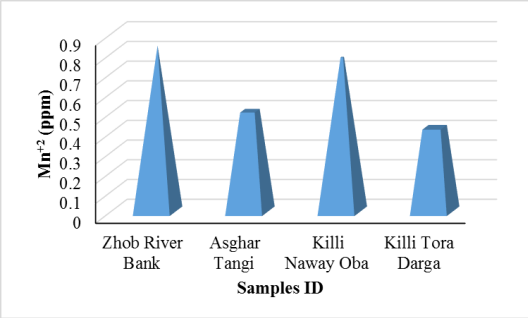

Figure 4: Graph for Manganese

Cobalt (Co):

Cobalt is an element that plays very imperative role in vitamin B_{12} and also generate red blood cells. It can act as a replacement for Zn. However, it may induce problem at very low level and as well as at very high level. The scarcity of cobalt may become the cause of anemia while it may become the cause of heart failure, digestive disorder etc. in human beings when found in higher concentration [11]. The least concentration of cobalt was determined in the sample collected from Killi Naway Oba while the highest amount of cobalt was detected in the samples taken from Killi Tora Derga among all the samples. The Asghar Tangi sample was found with greater amount of cobalt than the sample taken from the Bank of Zhob River which in turn found lesser quantity of cobalt than Killi Tora Derga and greater than Killi Naway Oba which is given in figure 5.

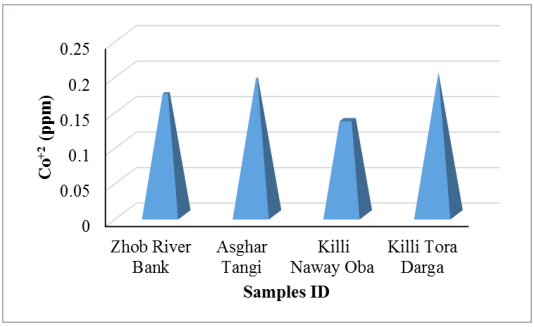

Figure 5: Graph for Cobalt

Nickel (Ni):

It is a heavy trace metal found in several enzymes in microbes, plants and men. It plays a significant part in bodily processes, acting as a catalyst in the absorption of iron from the intestine. It also has an effect on immune system, as too much nickel causes weight loss, increased heart rate and weight loss of the liver [12]. The greater amount of Ni was detected in the sample taken from Killi Naway Oba than Asghar Tangi which in turn was found greater than the samples of Zhob River Bank and Killi Tora Derga. However, there was no any significant difference in the concentration of nickel in the samples of Zhob River Bank and Killi Tora Derga (Figure 6). However, nickel was within range of WHO value (1.5 ppm).

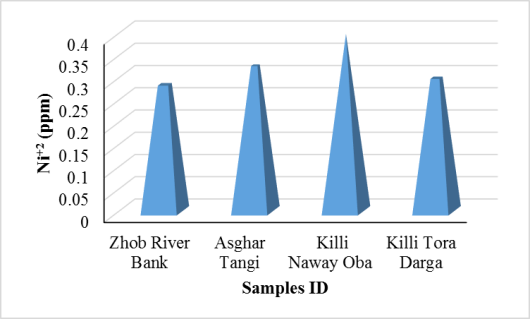

Figure 6: Graph for Nickel

Iron (Fe):

Iron is a trace metal and it is very important for the health of living things. Cells of living body needs very small amount of iron to perform their activities. Different proportions are needed for both men and women. Iron is the basic part of hemoglobin which is present in red blood cell and the function of iron is to transfer oxygen to various cell of living organisms. However, iron may cause various diseases at very low level such as anemia and at very high level may become the cause of heart diseases and liver cancer. It may also reduce the adsorption of Zn when present at very high level [13]. The current study showed the highest amount of Fe in Killi Naway Oba sample while least amount of Fe in Killi Tora Derga sample. On other hand, Asghar Tangi sample was found with greater amount of Fe than Zhob River Bank sample which in turn was detected with greater quantity of Fe than

Killi Tora Derga sample (Figure 7). Overall result of iron was within the range of WHO value (20 ppm).

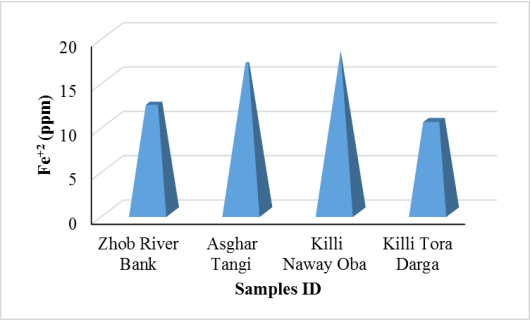

Figure 7: Graph for Iron

Sodium (Na):

The greatest quantity of Na was detected in the sample taken from Asghar Tangi while the least amount in the sample of Killi Tora Derga sample. Nevertheless, Killi Naway Oba sample was determined with higher concentration of Na than the sample collected from the Bank of Zhob River (Figure 7).

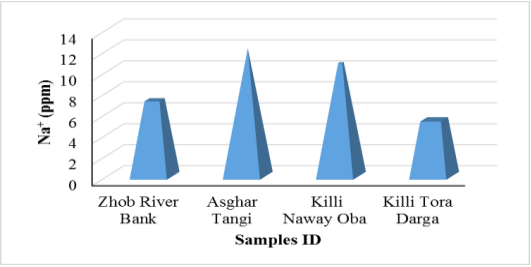

Figure 8: Graph for Sodium

Potassium (K):

The sample of Zhob River Bank showed the highest quantity of Potassium while the sample of Killi Tora Derga indicated the least concentration of Potassium among all the samples. In addition, the sample of Killi Naway Oba displayed higher amount of Potassium than the sample taken from the Bank of Zhob River (Figure 9).

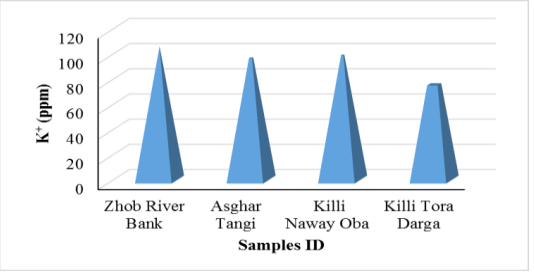

Figure 9: Graph for Potassium

CONCLUSION

The current study shows the presence of all selected metal concentrations in *mentha longifolia* plant grown in different areas. Heavy metals enter to the *mentha longifolia* plant via roots from the soil. Therefore, the plants of various locations showed different concentrations of metals. The highest concentration of K among all the samples was indicated in Zhob River and Killi Naway Oba samples while least amount of K detected in the samples of Killi Tora Derga. The highest level of Fe was assessed in Killi Naway Oba and the least quantity of Fe in Killi Tora Derga among all the four samples. The greatest amount of sodium was analyzed in Asghar Tangi sample while the least amount of Na was determined in Killi Tora Derga in all the four samples. Among all the used samples, the concentration of Pb was detected with highest concentration in Tora Derga sample and the least amount of Pb in Zhob River sample. The highest quantity of Mn was found in Zhob River sample and the least amount in Tora Derga sample among all. On other hand, copper was found with greatest quantity in sample of Killi Naway Oba while the least amount in Killi Tora Derga sample in the four samples. The highest amount of Ni detected in Killi Naway Oba whereas the least quantity was detected in Zhob River sample. The highest concentration of Co was assessed in Asghar Tangi and Killi Tora Derga samples while the least amount in Killi Naway Oba among all the samples. On the other hand, the highest level of Cd was found in Tora Derga sample while least amount of Cd in Zhob River sample among all. However, the overall result was within the range of WHO values.

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