J. Appl. Environ. Biol. Sci., 5(10)195-199, 2015

ISSN: 2090-4274
Journal of Applied Environmental and Biological Sciences
www.textroad.com

Heavy Metal Determination in Hair of Livestock in Lakan

Arshia Zandi[1*], Ali. Lotfi[2]

[1]Faculty of Natural Resources, Department of Environmental engineering, university of Arak, Iran
[2] Department of Natural Resources, Isfahan University of Technology, Isfahan 84156-83111, Iran

Received: May 1, 2015
Accepted: August 3, 2015

ABSTRACT

Heavy metal diffusion is one of environmental problems; in this context, mining is one of the most polluting industries; contaminating soil, water, and air at the same time proves that a great care is to be provided or the place will lose its qualities. Hygiene wise, it is crucial to human health that livestock and their products be devoid of heavy metals. Heavy metals have evident poisonous effects and my cause mutation. It is possible to measure components of heavy metals in hair of living beings. After consideration new methods and cost, 127 samples were taken from around cattle of study area. After digestion for atomic absorption spectrometer, results were compared with Sterner's standard, and were higher than the standards; in addition, zinc level was higher than FAO's standard which is 0.5 ppm for internal organs too. These excessive numbers suggest high concentration of pollutant, which can be linked to mining activities; In addition, with usage of SPSS, positive relationship between zinc and lead was apparent; moreover, there was a slight correlation between ages of the sheep, and lead levels in their fur.
KEYWORDS: *hair; heavy elements; mining industry; pollution; cattle*

INTRODUCTION

In the recent centuries considerable industrial and agricultural activities, have upset environmental balance, and caused dispersion of toxic elements, which were subsequently in normal quantities and this results in environmental imbalance either locally and globally. Most prominent sources of water pollution are heavy metals, acid rains, and organic matter; among these, heavy metals due to their poisonous effects, causing mutation, being insoluble, carcinogenic and their accumulative toxic effect are the note worthiest of them all. (Mossavi et al. 2011). Heavy metals are metals that have high density and are poisonous in low amounts (Erfanmanesh and Afuni, 2000). Metal captions can cause problems in three major manners, for human and terrestrial wildlife, for marine animals and for plants (Samiee, et al. 2007). Cadmium, lead and copper are the main factors of water pollution; being durable, toxic and substantially bio-accumulative these elements are found in food chain. (Haiao and Jinglu2013). Cd, Ld and other heavy metals are of more interest due to their numerous applications in vast array of industries (Karbassi et al., 2007; Gueu et al.,2007). From transport, electrical industries, mechanical engineering to civil engineering and building construction sector (Hillenbrand, Toussiant and Bohm, 2005). One of the earliest effects of heavy metals excessive exposure is disruption of trace element metabolism (Goyer, 1977; Lopez and Alonzo et al.,2002). As iron, selenium, zinc and chrome are related to growth and reproduction; zinc and selenium to immune system; zinc, selenium and iron to lean body mass; chrome to bone density; copper, zinc and chrome to cognitive functions; zinc and selenium to insulin sensitivity; zinc, selenium and copper influence cellular antioxidant defenses and protect cells against accelerated aging (Roussel, 2015). Exposure to Ld may result in variety of physiological and biochemical processes (Pilot and Dragan, 1996). It is known that 10-100 ppmLd in hair is considered high and in toxic level (Puls, 1988);cattle Hair analysis can be used to detect deficiencies of some minerals, toxicities, and exposure to heavy metals. Determination of Ld concentration by analyzing hair has proven to be useful in discovering of chronic toxicity. A survey conducted by Ghomi "et al., (2008) reveled that Lakan tailing dam impacts on Contaminant transportation in forms of particles and sewage. Due to that, it is sensible to measure these metals directly in living being rather than soil and plants near the mine and its tailing dam; thus, the merit of this approach to those that measure heavy metals in plants and soil, is being more precise to illustrate the amount of heavy metals that is consumable by humans. Near the mine is Lakan village in which livestock are reared and it is a pivotal source of income for the residents. There is an amount of uptake of Ld by plants from soil, if there is constant source of it; therefore, it is most likely that grazing cattle are exposed to Ld. Thus, Lakan mine can be considered a dominant source of pollution in the area. Results of this study will prove if it is necessary to relocate the mine or village also it discusses if the livestock have excessive heavy metal pollution levels and reveals if it is necessary to stop rearing livestock in those places. It reveals if pollution control programs and system used by the mine is acceptable. This

***Corresponding Author:** Arshia Zandi, Faculty of Natural Resources, Department of Environmental engineering, university of Arak, Iran

research also can be used as an indicator to figure out if the village residents are exposed to heavy metals or not, by measuring pollution level in their food. The selected areas for investigation were around Lakan mine and its tailing dam within 46 Km from southwestern of Khomein, Iran, and less than two kilometers from Lakan village.

MATERIALS AND METHOD

Definitions:
Ld: Lead_ Zn: zinc_ ppm: parts per million
Sampling

The risks caused by heavy metals are traditionally determined by quantifying total metals after digestion with strong acids (Liao et al., 2006). These Conventional methods, including chemical precipitation, ion exchange, chelation, membrane separation (Samarghandi et al., 2007; Malakootian et al., 2009) and cold vapour atomic adsorption spectrometry, inductively coupled plasma mass spectrometry, UV visible spectrometry and X-ray absorption spectroscopy (Franson, 1994 ; Townsend, 1998); although these methods suffer from high cost, but they are significantly precise. (Mulchandani and Bassi, 1995; D'Souza, 2001). Contents of Ld in hair of cattle which were exposed to airborne pollution can be used as an indicator of Ld concentration in body (Sterner 1972), and for that finding an affordable sampling method according to the cattle sizes and number of cattle is prominent.

Samples were taken on the thesis that there are only four grazing areas in the region. Impacting variables in the grazing areas are very numbered and this fact widens the acceptable margin of error. For approximately 800 sheep divided into to four flocks, which graze in four permanent grazing areas around Lakan mine and its factory; these four areas in the field have the same altitude, Uniform vegetation, and relatively same distance from pollution source, and for that, 50 for percentage and 7.9 % margin of error were chosen. By SPSS with 95% confidence level, sample size was calculated 127. Moreover, for possible sampling error, 150 samples were taken. This study examines stratified random samples of cattle hair and fur taken from all cattle around Lakan within two steps with two months interval. The first samples were taken in April 29/2013, and the second sampling was conducted in July 07/ 2013 and each was taken in rather sunny and dry weather. In the first sampling 80 samples and in the second 70 samples were taken. Samples were wrapped in paper and were labeled then put into plastic bags until they were delivered to environment laboratory of the University of Tehran.

Moreover, their ages were asked to figure out if there is any relation between age and pollution concentration in their fur. There were three numbers, which indicate their life spans. One is less than two years. Number two indicates Between two and four years old. Number three stands for more than four years

127 samples for the whole of approx 800 sheep were needed for sheep, which graze in four different grazing areas. Two of these areas are less than 0.5 Km (A) apart from the center of the factory. The others are in at least 0.8 Km and the maximum of 1.5 Km (B) distance from the factory. Although for 354 sheep taking 61 samples, means 6.8 confident interval and for 446 sheep, 69 means 6.57 confident interval, but the differentiating factor are very numbered because the scale of sites are very small and invariable and for that, 90 was chosen for percentage.

Technical

After washing samples with acetone, then they were washed with distilled water three times, and one more time with acetone, then each sample was placed in oven at 110°C for sixteen hours, then they were ***sonicated*** for 10 min (Pengping and Sukjit Kungwankunakorn, 2013). After they were dried, nine samples did not have the required weight of 0.1gr. 0.1 of hair with 10 cc Hno3 were blended together and was put on heater to let the hair digest with the acid. After the liquid was left to reach the room temperature, then 10 cc of Hydrogen Peroxide 30% was added to the liquid then the liquid was brought to 25 cc, so it was ready for atomic absorption spectrometer. Digested samples, which had enough transparency, were left in laboratory to be dealt with by absorption device. However, six samples did not come to have that transparency. By the use of SPSS, extreme data were omitted and trimmed data were used.

RESULTS AND DISCUSSION

The trimmed mean of Ld in samples is 569 ppm, and for Zn it is 233 ppm. The standard of sterner, mentions 500 ppm as a permissible content for Ld and 120 ppm for Zn, while acquired results in this study exceed these numbers. To compare these results with the mean of 120 samples of Pourjafar (2008) which is 8.7 ppm for Ld it is much higher. Although, to compare them with Shariati's (2004), whose result for a mean of ten hair samples is 783 is lesser and for his Zn result, which mean is 185 is slightly lesser than the result acquired in this study. Zn mean content in the study of Maria Verônica et al. (2014) in horses' hair sample are from172 ppm for forty samples taken in

non-industrial area, and for forty samples taken from industrial areas, it is185 ppm in the summer, and for Ld it is 0.022. Ld content of 35 dogs' hair sample in Atanaskova's study (2011) is 930.15ppm, which were taken in urban areas. Nicholson (1999) has stated Zn and Ld in manure of cattle in commercial farms in England in sequence are 152 ppm and 3.62 ppm. In hair of foxes, Pd mean is 0.640 and for Zink, the mean is not higher than 110 ppm. (Filistowicz, A., 2011). As we see in many cases apart from those conducted in more urbanized areas, Ld content is to 1000 fold lesser. In developed areas there has been a significant decrease in Ld contents in animals bodies (Jorhem et al., 1996; Skalicka' et al., 2012; Tahvonen and Kumpulainen, 1994) which is related to phasing in unleaded petroleum. (Belle's et al., 1995). According to Karrari, P et al. (2012) Iran petrol is one of the major ways of exposing to high Ld levels and for that we may relate part of this problem to the road of Arak_ Brojerd, which is not more than 1.5 km away from farthest grazing areas. Mean of these numbers exceed the maximum permissible levels for Ld, that indicates the common pollution in the area. In addition, there is a noticeable correlation between Zn and Ld and for that, after normalizing data, the P value was about 0.741. Moreover, the table below represents the mean of pollution in each distance level for each pollutant, In which B represents less than.5 Km and A means 0.8 to 1.5 Km distance from central point of t factory. In addition, sites A and B show a noticeable change in pollutant levels; nevertheless, the distance difference is not much.

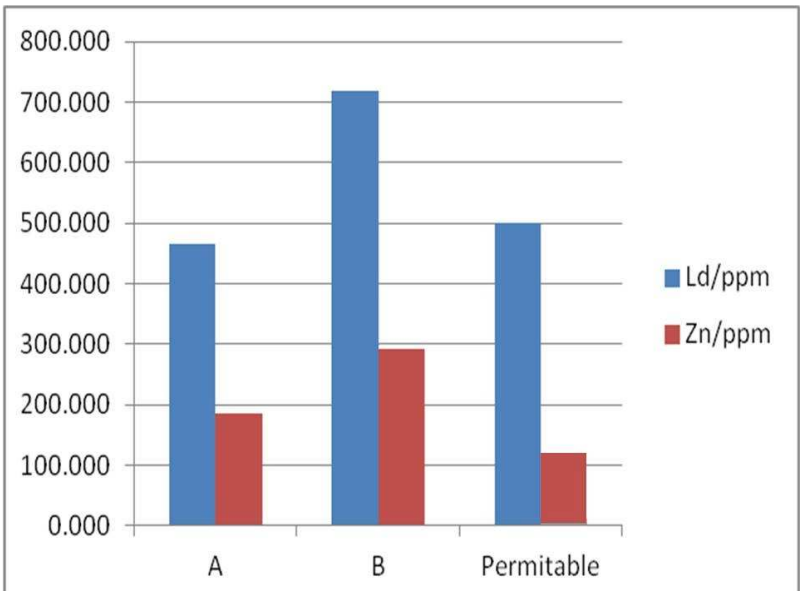

Figure1.*Mean of pollutant in sites A and B*

Conclusion

There was a slight positive correlation of 0.220 between age and Ld levels, but there was no correlation between age and Zn levels. As residents of ***Lakan*** *village* and their cattle live in lower altitude than the mine, and the village is in a short proximity from the mine, probability is that ***Lakan*** mine has negative effects on both livestock and people in terms of Ld and Zn. Calculating the diameter of the pollution may prove useful to avoid contaminated area in grazing, and finding clean patches. Utilizing pollution-absorbing plants is suggested. Using roofed container and smooth asphalted road to lessen the dispersion in transportation is required. With the reported condition, ranching is not sensible and replacing village or using industrial ranching in which, chaff is brought from other places is suggested. Merging circular buffer of long, durable trees around the mine and tailing dam might be viable

REFERENCES

[1]. Atanaskova, E., Nikolovski, G., Ul, I. and Enimiteva, a. (2011). Examination of the content of heavy metals using hair samples in dogs of urban areas of Macedonia. *Veterinary World*, p.368.

[2]. Bells, M., Rico, A., Schuhmacher, M., Domingo, J. and Corbella, J. (1995). Reduction of lead

concentrations in vegetables grown in Tarragona Province, Spain, as a consequence of reduction of lead in gasoline. *Environment International*, 21(6), pp.821-825.

[3]. D'Souza, S. (2001). Microbial biosensors. *Biosensors and Bioelectronics*, 16(6), pp.337-353.

[4]. Erfanmanesh, M. and Afuni, M. (2000).*Environmental Pollution Water, Soil and Air*.Ardakannashr, p.155. (in Persian)

[5]. FAO, and WHO, (2014).Working document for information and USE IN.

[6]. Filistowicz, A., Dobrza¦,,ski, Z., Przysiecki, P., Nowicki, S. and Filistowicz, A. (2011).Concentration of heavy metals in hair and skin of silver and red foxes (Vulpesvulpes).*Environmental Monitoring and Assessment*, 182(1-4), pp.477-484.

[7]. Franson, M. (1994).*Standard methods for the examination of water and wastewater 18th edition supplement*. Washington, D.C.: Published jointly by American Public Health Association, American Water Works Association and Water Environment Federation.

[8]. Ghomi, M., hajati, A., khodadadi, A. and hasanmojtahedzadeh, S. (2008). Under the influence of different soil horizons and zinc processing plant tailings dam Lacan prevent lead contamination in groundwater dissolved. *Fifth Iranian Geology engineering and environment*. [online] Available at: http://www.civilica.com/Paper-ICEGE05-ICEGE05_164.htm [Accessed 22 Feb. 2012].

[9]. Gueu, S., Yao, B., Adouby, K. and Ado, G. (2007). Kinetics and thermodynamics study of lead adsorption on to activated carbons from coconut and seed hull of the palm tree. *International Journal of Environmental Science & Technology*, 4(1), pp.11-17.

[10]. Hajati, A. (2008). Assessment of surface and groundwater pollutions rout adjacent to Lakan work area using GIS.In: *second professional environmental engineering*. Tehran.(in Persian)

[11]. Hāshimī, ‘., Tartar, G. and Kindī, (1982).*Dialogue islamo-chrétien sous le califeAl-Ma’mûn (813-834)*. Combs la Ville/france: Centre Evangélique de Temoignageet de Dialogue.

[12]. Hillenbrand, T., Toussiant, D. and Bohm, E. (2005).discharges of copper, zink and lead to the water and soil. *natural conservation and nuclear safety*, 202(242), p.29.

[13]. Jorhem, L., Sundstrí¶m, B., Engman, J., í…strandâ€ˆYates, C. and Olsson, I. (1996). Levels of certain trace elements in beef and pork imported to Sweden. *Food Additives and Contaminants*, 13(7), pp.737-745.

[14]. Karbassi, A., Monavari, S., NabiBidhendi, G., Nouri, J. and Nematpour, K. (2007). Metal pollution assessment of sediment and water in the Shur River. *Environmental Monitoring and Assessment*, 147(1-3), pp.107-116.

[15]. Karrari, P., Mehrpour, O. and Abdollahi, M. (2012).A systematic review on status of lead pollution and toxicity in Iran; Guidance for preventive measures.*DARU*, 20(1), p.2.

[16]. Liao, V., Chien, M., Tseng, Y. and Ou, K. (2006).Assessment of heavy metal bioavailability in contaminated sediments and soils using green fluorescent protein-based bacterial biosensors. *Environmental Pollution*, 142(1), pp.17-23.

[17]. Malakootian, M., Nouri, J. and Hossaini, H. (2009).Removal of heavy metals from paint industry â€™s wastewater using Leca as an available adsorbent. *International Journal of Environmental Science & Technology*, 6(2), pp.183-190.

[18]. Mosavi, E., A, S., N, M. and L, K. (2011). Assessment of local heavy metal distribution in Hamadan soil25(4),. *Iranian journal of soil research*, 25(4), pp.323-337. (in Persian)

[19]. Mulchandani, A. and Bassi, A. (1995). Principles and Applications of Biosensors for Bioprocess Monitoring and Control. *Critical Reviews in Biotechnology*, 15(2), pp.105-124.

[20]. Nicholson, F., Chambers, B., Williams, J. and Unwin, R. (1999). Heavy metal contents of livestock feeds and animal manures in England Wales. *Bioresource Technology*, 70(1), pp.23-31.

[21]. Pengping, S. and SukjitKungwankunakorn, S. (2013). Determination of Some Heavy Metals in Human

Hair by Ultrasonic Acid Digestion and Atomic Absorption Spectrophotometry. *Chiang Mai*, [online] 41(1), pp.148-155.Available at: http://epg.science.cmu.ac.th/ejournal/ [Accessed 14 Apr. 2013].

[22]. Pourjafar, M., Rahnama, R. and Shakhse-Niaie, M. (2008). Lead Profile in Blood and Hair from Cattle, Environmentally Exposed to Lead Around Isfahan Oil Industry, Iran. *Asian Journal of Animal and Veterinary Advances*, 3(1), pp.36-41.

[23]. Puls, R. (1999).*Puls, R., (1988).Mineral Levels in Animal Health. 1st Edn., ,*. British Columbia: Sherpa International, pp.98-99.

[24]. ROUSSEL, A. (2015). New aspects on trace element metabolism.*2000, 151, 7,*,Revue Méd.(637-642), p.6.

[25]. Samarghandi, M., Nouri, J., Mesdaghinia, A., Mahvi, A., Nasseri, S. and Vaezi, F. (2007).Efficiency removal of phenol, lead and cadmium by means of UV/TiO2/H2O2 processes. *International Journal of Environmental Science & Technology*, 4(1), pp.19-25.

[26]. Samiee, A., Sedaghat, A. and khodakarami, B. (2006).environmental assessment of Lakan mine and factory. Tehran: Fifth Iranian Geology engineering and environment, p.11. (in Persian)

[27]. Sharam, S. (2004). measuringzink, lead and arsenic in hair and blood of animals around angooran mine. *ijorlu*, 2(1), pp.43-51.(in Persian)

[28]. Skalicka, M., Korenekova, B. and Nad, P. (2012). Concentrations of selected trace elements in organs and tissues of livestock from a polluted area. *Journal of Environmental Science and Health, Part A*, 47(9), pp.1207-1211.

[29]. Souza, M., Fontes, M. and Fernandes, R. (2014).Heavy metals in equine biological components. *Revista Brasileira de Zootecnia*, 43(2), pp.60-66.

[30]. Sterner, W. (1972).Hair analysis: A method particularly suitable for epidemiological investigations to. *Veterinary Medicine: Lead Preliminary*, 23(10), pp.209-212.

[31]. Tahvonen, R. and Kumpulainen, J. (1994).Lead and cadmium contents in Finnish breads. *Food Additives & Contaminants*, 11(5), pp.621-631.

[32]. Townsend, A., Miller, K., McLean, S. and Aldous, S. (1998). The determination of copper, zinc, cadmium and lead in urine by high resolution ICP-MS. *J. Anal. At. Spectrom.*, 13(11), pp.1213-1219.

[33]. ttp://ftp://ftp.fao.org, (2011). *WORKING DOCUMENT FOR INFORMATION AND USE IN*. [online] Available at: http://ftp://ftp.fao.org/codex/meetings/CCCF/cccf5/cf05_INF.pdf [Accessed 8 Jan. 2013].

[34]. Zeng, H. and Wu, J. (2013). Heavy Metal Pollution of Lakes along the Mid-Lower Reaches of the Yangtze River in China: Intensity, Sources and Spatial Patterns. *IJERPH*, 10(3), pp.793-807.

[35]. ZUO, Z., CHEN, G., LUO, X., PUAH, C., ZHU, W., CHEN, K. and JIANG, H. (2007). Pharmacophore-directed Homology Modeling and Molecular Dynamics Simulation of G Protein-coupled Receptor: Study of Possible Binding Modes of 5-HT 2C Receptor Agonists. *Acta Biochimicaet Biophysica Sinica*, 39(6), pp.413-422.