Survey of Arsenic concentration in the goat's blood, wool and liver at Kurdistan Province, Iran

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Received: November 2021 Accepted: January 2022

Abstract

In Ghorveh area, city of Kurdistan provinces in Iran, there are channels of arsenic and other geogenic toxic chemical compounds. The aim of this study is to determine the level of arsenic in goat`s blood, wool and liver at Ghorveh and other villages. 55 goats including both sexes in the age groups less than 1 year, 1-3 years and above 3 years were randomly chosen, and their blood and wool were collected as samples of the study, in addition to these samples 10 goat's liver also were taken from the slaughterhouse of the mentioned area to be examined. The results indicated that arsenic concentration in the sample's blood was significant higher than normal levels (Mean values are more than 12.038±5.025 ppb comparing to the normal amount that is 2.92 ppb), which shown significant difference statistically ($p \leq 0.05$). The mean concentration of arsenic in the wool and liver of goats are 18.566±10.026 ppb and 9.823±3.245 ppb respectively, which in comparison to the normal concentrations do not show significant difference statistically ($p \geq 0.05$). Also there is no significant correlation between arsenic concentration existing in the goat's blood, wool and liver and variables of age and sex ($p \geq 0.05$).However, being high level of arsenic concentration in the blood of goats reveals the high level of arsenic in the environment and food of Ghorveh area which can be a serious threat to public health and other creatures. So, it is advised to do further and comprehensive studies in large scale.

Keywords: Arsenic, Blood, Wool, Liver, Kurdistan , Iran

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Introduction

Arsenic can be found approximately everywhere on the earth (Mandal and Susuki, 2002, Banejad and Olyaie 2011). This heavy metal is being as organic and inorganic forms and each of these forms can be found as trivalent and pentavalent metal which the former type is more toxic than the latter. Poisoning caused by arsenic was reported as one of the main causes of poisoning domestic animals and birds (Bazargani *et al*., 2007, Ashrafihelan et al. 2013). Drinking water and eating grass containing high concentration of arsenic are the main ways of entering arsenic into animal bodies and then entering into food chain of human beings which result in poisoning human beings and animals. Arsenic has been known as one of the main carcinogenic and diabetic agents in human beings (Biswas *et al*., 2000; Mukherjee *et al*., 2004; Rana *et al*., 2010). Poising with arsenic may be occurred in the clinical forms of per acute, acute, sub acute, and chronic, while sudden death may be happened in above acute forms without clinical symptoms. Being this metal reported in water of such countries as America, Canada, Mexico, Argentina, Chile, the Netherlands, Japan, China, Taiwan, Nepal, Vietnam, Bangladesh, India and Iran (Mandel and Suzuki 2002; Wang *et al*., 2002; Ng *et al*., 2003; Mosaferi *et al*., 2006; Hosseinpourfeizi, 2007). There are several reports of chronic poisoning caused by arsenic in Iran (Hosseinpourfeizi, 2007; Mosaferi, 2006). One of the important requirements of poisoning with arsenic compounds is the presence of arsenic in some ores and gases released from volcanic lava, so that licking stones by the animals or gases released from volcanic lava can contaminate soil, pastures or nearby water sources then feed by animals. Volcanic and hydrothermal activities within the Ghorveh area have been caused significantly increase of arsenic concentrations and this area contains the main channels for exiting arsenic compounds (Dadsetan and Mehrzad, 2011). Some villages of the Ghorveh city are located near the springs which their soil contains large amounts of heavy metals such as arsenic. This study aimed to examine and measure the presence of arsenic in the blood and goat’s tissues of Ghrveh area which can be samples of ecosystem and environment population of the area.

Materials and methods

This study was done in three villages of Kurdistan provinces in Iran which were introduced by the researchers in geological studies in the past as risky areas with severe pollution in terms of arsenic presence. The samples of blood and wool were randomly taken from 55 goats including both sexes in the age groups less than 1 year, 1-3 years, and above 3 years from three villages (Dashkasan, Ghaslan and Baharloo).In addition to these samples 10 goat’s liver also chosen from the slaughterhouse of the mentioned area to be examined. Samples of the blood, wool, and liver sent to laboratory to measure arsenic

concentration in each of them according to atomic absorption instruction at the wavelength 193.7 nm. (Phoenix 980-Biotech England in 193.7 wave length).The blood samples were taken from jugular vein by Venoject tube (vaccute, EDTAK3, Greiner Bio-one, Austria) and transferred to 1.5 ml micro tubes and stored at -20 ºC until subsequent analysis. Wool samples were collected from both costal sites of each animal with the stainless steel shear (Rezazadeh *et al*., 2014).Then the samples were kept individually in clean sealed plastic bags until analysis. Approximately 20 gr of wool per animal was used as representative sample for the measurement of arsenic concentration. In order to get ash from the wool samples, they were kept in 550ºC furnace for 24 h. Two gram of ash was digested by adding 20 mL nitric acid (25%) and then prepared for arsenic measurement. (Rezazadeh *et al*., 2014). 10 gram of liver were kept in oven for 24 h. 1 gram of ash was digested by adding 20 ml nitric acid (25%) and then prepared for arsenic measurement. Initially data were entered in Microsoft Excel and then imported to GraphPad prism (GraphPad Software Inc., USA) version 3.0 where descriptive statistics (Mean, standard deviation of the mean) of the blood, wool and liver analytical variables were determined. The SPSS (version 14) statistical tool was used for one way analysis of variance (ANOVA) computation to compare the groups and $P \leq 0.05$ was considered significant.

Results

In this research the levels of arsenic concentration in the blood, and wool of goats at Ghorveh area have been studied and obtained results shown in Table 1.

Table 1: The amount of arsenic (ppb) and number of samples with maximum, minimum and mean±SD.

Sample	Num.	Min.	Max.	Mean±SD	Normal value
Blood	55	8.035	18.755	12.038±5.025[a]	≤ 2,92[b]
Hair	55	4.603	37.09	18.566±10.026[a]	≤ 100[a]
Liver	10	5.218	13.280	9.823±3.245[a]	3-15[a]

Mean with different superscript on the same row are significantly different ($p \leq 0.5$).

The mean of arsenic concentration in 55 goat's blood was 12.038±5.025 ppb. Considering the studies done by(Lopez Alonso *et al*., 2000 ; Shariati, 2009) in which maximum level of arsenic in the blood of animals has been specified 2.92, results of the present study indicate significant differences of arsenic concentration in goat's blood under study compared with normal levels ($p \leq 0.05$). The mean of arsenic concentration in 55 goat's wool under study was 18.566±10.026 ppb. But based on the studies done by(Lopez Alonso *et al*., 2000 , Shariati, 2009) in which maximum level of arsenic in the wool has been specified 100 ppb, there is no significant difference of arsenic

concentration in goat's wool under study compared with normal levels($p \geq 0.05$). The mean of arsenic concentration in the liver was 9.823±3.245 ppb. According to levels of toxic arsenic in liver in the forms of acute, sub acute and chronic poisoning (Radostits et al, 2007) which can be 3-15 ppb, it can at least be confirmed the absence of toxic amounts in livers under study. The results show no significant difference between age and concentration of arsenic in blood and wool. Similarly, no significant difference has shown between concentration of arsenic and sex. (Tables 2 and 3).

Table 2: The amount of arsenic in blood and hair in age groups (ppb).

	Num.	Min.	Blood Max.	Mean±SD	Min.	Hair Max.	Mean±SD
≤1years	15	8.240	16.120	12.345±2.18	7.9	35.650	21.450±5.35[a]
1-3years	25	6.245	18.655	12.211±5.32	5.06	30.230	15.205±8.04[a]
≥3years	15	5.568	18.659	14.288±5.3	6.603	37.09	22.230±10.20[a]

[a] There is no significant difference ($p \geq 0.05$) in the level of arsenic in age groups.

Table 3: The level of arsenic in blood & hair in male and female (ppb).

	Num.	Min.	Blood Max.	Mean±SD	Min.	Hair Max.	Mean±SD
Male	21	8.60	16.24	12.450±2.01	12.06	38.09	20.68±7.25[a]
Female	24	7.540	16.935	12.455±5.4	7.08	36.240	18.497±95[a]

[a] There is no significant difference ($p \geq 0.05$) in the level of arsenic in both sexes.

Discussion

As results show, the level of arsenic concentration in goat's blood of the area under study was noticeably higher than normal range. Comparing with normal level of 2.92 ppb, it indicates significant difference. With regard to the studies have been done on drinking water and underground water of Kurdestan province and Ghorveh area, and their results that showed high arsenic contamination, it can be said that one of the main reasons for this high level is using ground water which is contaminated with arsenic in different ways. Using grasses and pastures irrigated with this water and exposing to gases released from springs and mineral can be other possible causes. In the study done on ground water of Kurdestan specially water of 18 villages of Ghorveh, in some cases the concentration of arsenic was up to 1000 ppb, the mean of arsenic concentration in that study was 290 ppb, means 6 times the national standard for arsenic levels in drinking water (Mosaferi *et al*., 2006).

Obtained results of arsenic concentration existing in goat's wool of the area under study comparing with normal level which is 100 ppb show no significant difference (Lopez Alenso et al, 2000; Shariati, 2009). In the study done on chronic arsenic poisoning in sheep at villages of Bijar city (Kurdistan Province) from the standpoint of medical geology, the

amounts of arsenic in sheep's wool of the contaminated areas had significant difference comparing with the amounts existing in control group's wool (non-infected) (Seraj *et al*., 2013). In the study done on arsenic concentration in sheep and some blood parameters on Tekab's Sheep around gold mines, the level of arsenic concentration in all sheep's wool under study was higher than normal range (Rezazadeh *et al*., 2014). Generally, hair contains metabolic dead substances which are around the hair, between the hair, and in the active substances which are in the hair root. Active root hair cells are able to concentrate or accumulate different elements; this accumulation depends on the type and concentration of elements in the environment, nutrition, exposure duration, weather conditions, individual characteristics and breed. Therefore, while the results of the present study about arsenic concentration in goat's wool are similar to the results of other studies, but it differs from other studies for several reasons which can be argued as below:

Firstly, different standards for levels of arsenic in the hair or wool are introduced: (Lopez Alenso et al, 2000; 100ppb, Radostits et al, 2007; 0.5 ppm).

Secondly, with regard to the source of exogenous and endogenous in arsenic concentration in the hair and its significant reduction after washing, the testing process at this stage which is washing with acetone can be effective. Thirdly as already discussed, several factors such as environmental pollution, Individual characteristics, and the health of organs which are responsible for detoxification can change this amount. So to overcome this ambiguity, studying, and sampling should be done as made in the study at both the infected and control areas (Seraj *et al*., 2013) in order to obtain a reference value for goat's wool of the area under study. Perhaps due to the significant difference and noticeable increase of arsenic concentration in the blood of all animals in the present study, values obtained in their wool are proximately toxic or abnormal also. The results of this study are matched with similar studies' results considering the effect of sex and age variables on arsenic concentration which shows no significant difference (Lopezalenso et al, 2000; Rezazadeh et al, 2014). Based on normal values (Radostits et al, 2007), regarding the concentration of arsenic in the livers under study none of the livers shows the level to which any sign of poisoning was observed. But it is important to bear in mind that the value of 3-15 ppb which was introduced by (Radostits et al, 2007) indicates the risk of arsenic poisoning in animals. It can never represent the authorized or non-authorized concentration of arsenic in the liver as a substance in the human food chain. According to the results of the present study especially the levels of arsenic concentration in the blood of animals under study, public health risk followed by direct or indirect use of arsenic in many different ways such as drinking water, eating vegetables, feeding on domestic animals and their products is quite serious danger which

its consequences show itself proportional to the exposure to toxins duration, poison's concentration and its chemical nature, in the clinical forms of poisoning, types of cancers, diabetic diseases, neurological disorders, etc.. More comprehensive studies with a wider range and by studying more parameters are recommended.

Acknowledgement

The authors gratefully acknowledge the financial support by branch Sanandaj Islamic Azad University.

References

Ashrafihelan, J., Salaramoli J., Alamdari, M. and Bahati, A.A., 2013. Arsenic toxicosis in sheep: The first report from Iran. *Interdisipilinary Toxicology*, 6, 93-98. Doi: 10.2478/intox-2013-0016.

Banejad, H. and Olyaie, E., 2011. Arsenic toxicity in the irrigation water-soil-plant system: A significant environmental problem. *Journal American Sciences*, 7, 125–131.

Bazargani, T.T., Afsharianhelan, J.A. and Salar–Amoli, J., 2007. Arsenic poisoning in dairy herd in Isfahan. *Iranian Veterinary Journal*, 3, 177 – 83. Doi: 10.1080/00480169.1987.35431

Biswas, U., Sarkar, S., Bhowmik, M.K., Samanta, A.K. and Biswas, S., 2000. Chronic toxicity of arsenic in goats: Clinicobiochemical changes, pathomorphology and tissue residues. *Small Ruminant Research*, 38, 229–235. Doi: 10.1016/s0921-4488(00)00162-0.

Dadsetan, A. and Mehrzad, J., 2011. Determination of source and indices metal pollution in water and soil and their effects on animal and human immune system, Bijar, Kurdistan, Iran. Proceeding of the 30th conference of earth sciences held at the jeology organization of Iran 1-3th march 2011.

Hosseinpourfeizi, M.A., Mosaferi, M., Dastgir, S., Zolali, S.H., Pulady, N. and Azarfam, P., 2007. Contamination of drinking water with arsenic and its various health effects in the village of Ghopuz. *Iranian Journal Epidemiology*, 3, 19- 24.

Rogowska, K.A., Monkiewicz, J. and Grosicki, A., 2009. Lead,cademium, arsenic, copper and zink contents in the hair of cattle living in the area contaminated by a copper in 2006-2008. *Bulletines of Veterinary Institute in Pulawy*, 53, 703-706.

Lopez Alonso, M., Benedito, J.L., Miranda, M., Castilo, C., Hernandez, J. and Shore, R.F., 2000. Arsenic,cademium,lead, copper and zink in cattle from Galicia,NW Spain. *Sciences Total Environmental*, 10, 237-46. Doi: 10.1016/s0048-9697(99)00461-1.

Mandal, B.K. and Suzuki, K.T., 2002. Arsenic round the world: A review. *Talanta*, 58, 201–235. Doi: 10.1016/S0039-9140(02)00268-0

Mosaferi, M., Yonesian, M., Mesdaghinia, A., nadim, A., Naseri, S. and Mahvi, H., 2006.

Arsenic occurrence in drinking water of Iran : The case of Kurdistan Province. *Iranian health Environmental Journal*, 1, 19-28.

Mukherjee, S., Das, D., Darbar, S., Mukherjee, M., Das, A.S. and Mitra, C., 2004. Arsenic trioxide generates oxidative stress and islet cell toxicity in rabbit. *Current Sciences*, 86, 854–857.

Ng, J.C., Wang, J. and Shraim, A., 2003. A global health problem caused by arsenic from natural sources. *Chemosphere*, 52(**9**),1353–1359. Doi: 10.1016/S0045-6535(03)00470-3.

Radostits, O.M., Gay, C.C., Hinchcliff, K.W. and Constable, P.D., 2007. *Veterinary Medicine*. 10th ed. Saundrs London; pp. 1808–1811.

Rana, T., Bera, A.K., Das, S., Bhattacharya, D., Bandyopadhyay, S., Pan, D. and Kumar Das S., 2010. Effect of chronic intake of arsenic-contaminated water on blood oxidative stress indices in cattle in an arsenic-affected zone. *Ecotoxicology and Environmental Safety*, 73,1327–1332. Doi: 10.1016/j.ecoenv.2010.06.002

Rezazadeh, F., Jafari, R., Sheikhzadeh, F. and Paktinat, S., 2014. A study on wool arsenic concentration and some blood parameters in sheep flocks grazing around tailing dams of gold mines in Takab, Iran. *Research Opinion Animal Veterinary Sciences*, 4, 233-236.

Seraj, A., Keshavarzi, B., Mar, F. and akbari, Z., 2013. Arsenic chronic poisoning in sheep in Bijar area. Proceeding of the 16th conference of environment health held at the University of Shiraz 2013.

Shariaty, S.H., 2009. Determination of concentration lead, zinc and arsenic in blood and hair of animal around the lead factory in Anguran area. *Journal Earth Resources*, 2, 43-54.

Wang, J.P., Qi, L., Moore, M.R. and Ng, J.C., 2002. A review of animal models for the study of arsenic carcinogenesis. *Toxicology Letter*, 133, 17–31. Doi: 10.1016/s0378-4274(02)00086-3.