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RESEARCH OPINIONS IN ANIMAL & VETERINARY SCIENCES

Wool arsenic in grazing sheep of a copper mine (Songoun) in North-West of Iran

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Abstract

Arsenic (As) is widespread environmental toxicant that causes neuropathy, skin and vascular lesions and cancer upon prolonged exposure. The aim of this study was to determine the amount of As in wool in sheep grazing around a mining centre (Soungun) in North-West of Iran. The samples of hair were taken randomly from 83 sheep of 4 flocks. Significantly higher concentration of as was found in sheep in Pesian area. Significantly high As concentration in young animals were found compared to old animals. Wool As concentration was also significantly higher in under three years sheep. Our finding showed the arsenic amount in wool of sheep grazing around Sogoun mines is higher.

Keywords: Sheep, arsenic; wool; Iran

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Introduction

Arsenic (As) is a solid, brittle metalloid. Thus, it has both metallic and nonmetallic properties. Arsenic is the 20th most common element in the Earth's crust with an average natural abundance of about 1.2-3 mg/kg (Mandal et al., 2002). Since its isolation in 1250 A.D., it has been used in various fields such as medicine, electronics, agriculture, and metallurgy (Sharma and Sohn, 2009). Arsenic exposure may not only affect and disable organs of the body, especially the skin, but may also interfere with the proper functioning of the immune system (Duker et al., 2005). Because of its ability to reabsorb and accumulate heavy metals, the kidney is the first organ of arsenic toxicity (Birri et al., 2010). Fish, fruits and vegetables primarily contain organic arsenic, less than 10% of the arsenic in these foods exists in the inorganic form, although the arsenic content of many foods (i.e. milk and dairy products, beef and pork, poultry and cereals) is mainly inorganic, typically 65-75% (Mandal et al., 2002). Arsenic, being a normal component of human body is transported by the blood to different organs in the body, mainly in the form monomethyilarsonic acid after ingestion (Mandal et al., 2002; Duker et al., 2005). Arsenic is excreted rapidly after absorption, chiefly in the urine, and after the ingestion of non-toxic amounts by the cows, there is no detectable excretion in the milk. When much large doses are taken, arsenic may be excreted in the milk, as well as in urine and faeces, but the concentration is still low. The biological half-life of arsenic taken orally in the form of arsenialate is 4.2 days in liver, 5.7 day in kidney, and 15 days in muscle (Radostits et al., 2007).

Deposition of arsenic in wool occurs and persists there until their shedding (Radostits et al., 2007). The wool of animals not exposed to arsenic should contain less than 0.5 mg/kg, but that of normal exposed animals may contain as much as 5-10 mg/kg (Radostits et al., 2007).

The presence of trace elements in farm animals is of interest from both the animal health and human health perspectives. Exposure of livestock to either high

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levels of toxic metals or less than normal optimal levels of the essential microelements can cause adverse effects such as reproductive impairment, physiological abnormalities, behavioural modifications and death (Nriagu et al., 2009).

The aim of the present study was to measure arsenic in wool in sheep grazing in suburb of a copper mine (Songoun) in North-West of Iran.

Materials and Methods

The samples were taken from 83 apparently healthy sheep in both sexes and two age categories (above 3 and below years). The area for sampling was located around a river that originated and passed through a copper mine (Songoun) in North-West of Iran. Based on earlier study, water and plants were reported to have high amount of arsenic in this region (Hashtjine et al., 2011). The samples of wool were collected from 59 female and 24 male sheep from 4 flocks. The wool was taken from both flank sites with a shear (Ramirez-perez et al., 2000). Approximately 10g of wool per animal was used as a representative sample for the determination of arsenic. Arsenic was measured by a method of Raab et al. (2002). An analytical instrument (analytical Jena, Vario 2- Germany) with a graphite furnace was used for determination of As concentration.

The results were analyzed by SPSS (version 16). Comparison of wool As consent between different areas was analyzed with one-way ANOVA. Age and sex wise significant difference was analyzed by Student t-test. P value less than 0.05 was considered as significant.

Results

The mean Arsenic concentration in wool of sheep in different areas is given in Table 1. Significantly high concentration was found in Pesian. Male had significantly higher arsenic concentration compared to female sheep (Table 2). Similarly, sheep under three years of age had significantly lower concentration of wool arsenic as shown in Table 3.

Table 1: Concentration of arsenic in wool of sheep in different localities of the mine

Name of villages	Maximum (mg/kg)	Minimum (mg/kg)	Mean ± SE (mg/kg)
Pesian	2592.9	31.38	1104±17.13[a]
Alajoja	3264.2	30.18	822± 35.54[c]
Ebrahim Sami	2528.0	27.33	778±33.51[c]
Ozan	2696.1	27.87	1078±20.76[b]

[a-c] Means in a column having different superscripts differ significantly (P>0.05)

Table 2: The concentration (mg/kg) of arsenic in wool of male and female sheep

Sex	Maximum	Minimum	Mean ±SE
Female	3264.2	27.33	965.1 ±11.87[b]
Male	2592.9	320.3	1671.2±48.55[a]

Mean values in column bearing different superscripts differ significantly P<0.05

Table 3: Mean arsenic (mg/kg) concentration in wool of sheep of two age groups

Age groups	Maximum	Minimum	Mean ± SE
Under 3 years old (N= 21)	2969.1	34.14	1438.6±19.40[a]
Over 3 years old (N= 42)	2079.5	27.33	785.2±13.11[b]
Significantly			

Mean values in column bearing different superscripts differ significantly P<0.05

Discussion

Arsenic is widespread environmental toxicants that cause neuropathy, skin lesion, vascular lesions and cancer upon prolonged exposure (Modi et al., 2006). In addition, it is a cumulative poison and its chronic exposure through contaminated drinking water has become an increasing global problem of public health concern (Jin et al., 2004). Natural soil concentrations of arsenic typically range from 0.1 to 40 mg/kg with an average of 5 to 6 mg/kg (Girourad et al., 2009). High arsenic concentrations, typically caused by anthropogenic sources, and ranging from 10 to >1000 mg/kg have been observed worldwide (Girourad et al., 2009). Furthermore, industrial and agricultural activity has also resulted in increased environmental concentration of trace metals, such as copper and zinc in certain areas (Lopez Alonso et al., 2000). The skin localizes and stores arsenic because of its high keratin content and may be the reason for its high sensitivity to arsenic (Duker et al., 2005).

Based on study in cattle, the amount of arsenic in blood of calves and cattle was 2.92µg/l in blood (Lopez Alonso et al., 2000). In present study, the sex had not significant effect on the amount of arsenic or other elements in the wool. Age did influence accumulation; cadmium and lead (but not arsenic) in most tissue were significantly grater in cows that females calves (Lopez Alonso et al., 2000), but our finding refers that the amount of arsenic in sheep under 3 years are higher than over 3 years old. This problem may be due to shearing of sheep over 3 years is regular but in a young sheep is irregular. Contamination of the soil with arsenic based herbicides, pesticides, timber preservatives as well as through mining and smelting increases its range up to 15000 mg /kg soil (Juhasz et al., 2007). This study showed the Mean± SE arsenic in 4 regions is approximately 1000 mg/kg. The hair of animals not exposed to arsenic should contain less than

0.5 mg/kg, but that of normal exposed animals may contain as much as 5-10 mg/kg (Radostits et al., 2007). Both arsenic deprivation and toxicity are influenced or affected by factors that change labile methyl metabolism. Generally, factors that reduce the availability of labile methyl groups exacerbate arsenic deprivation and toxicity. For example, methionine or choline deficiency, excessive dietary arginine, and dietary guanidoacetic acid supplementation enhanced the response to arsenic deprivation in chicks and rats (Mineral Tolerance of animals, 2005). Other nutrient deficiencies that can affect arsenic toxicity or deficiency through affecting labile methyl or oxidative metabolism includes cysteine, folic acid, pyridoxine, and zinc (Mineral Tolerance of animals, 2005).

Conclusions

Based on our findings, it was concluded that As amount in wool of sheep, grazing around of Sogoun, is higher. We suggested that veterinarian and sanitary personnel should take care while working with the wool of these sheep to avoid possible As toxicity. Further study suggested confirming of arsenic toxicities in sheep and in other domestic animals at around of Songun mining center.

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