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CLINICAL AND HAEMATOLOGICAL STUDY OF LACTATING CATTLE, REARED AROUND A THERMAL POWER PLANT, SHOWING HORN AND HOOF ABNORMALITIES

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ABSTRACT

The present study was aimed to assess clinic-haematological changes in cows showing hoof and horn abnormalities, reared around Koradi Thermal Power Plant, Nagpur, Maharashtra (India). Hoof and horn abnormalities are usually attributed to selenium toxicity. Twenty cows were randomly selected within a radius of 5 km of thermal power plant. Blood, urine and milk samples were analyzed for haemato-biochemical changes. Also, the selenium level was estimated and compared with control samples taken from Deolapar Cattle Farm and Agriculture College Dairy Farm (located within the same agro-climatic conditions but away from the impact area of fly ash). Mean selenium value in blood of exposed animals was insignificantly higher than unexposed animals while selenium in urine and milk of exposed cows was significantly higher than control though within the permissible range. The haemato-biochemical parameters *viz.*, haemoglobin, AST, ALT, serum creatinine and BUN of exposed cows were insignificantly less than control cows. Air, water, soil and fodder samples, collected from the study area, showed the selenium level of 3 ng m^{-3}, 0.001±0.002 ppm, -0.593 ppm and 1.25±0.20 ppm, respectively. It appears that the selenium level in impact area has not reached to the level that may develop selenium toxicity like sloughing of horns, weakness and hoof deformity; and the symptoms observed are due to the factor other than selenium toxicity.

Key words: Cow, flyash, haemato-biochemical parameters, lactation, selenium, thermal power plant

INTRODUCTION

Coal power production releases waste mostly comprising of fly ash which accounts about 88% of total ash produced from coal burning (Sandelin and Backman, 2001). Potential toxic trace elements in coal include arsenic, beryllium, cadmium, barium, chromium, copper, lead, mercury, molybdenum, nickel, radium, selenium, thorium, uranium, vanadium and zinc. Selenium is an essential trace element but can be toxic at higher concentrations. The fly ash contaminates the environment and eventually poses a health hazard to both human and animal population in the vicinity. The present study was undertaken on the animals reared in the vicinity of a thermal power plant showing the symptoms of hoof and horn abnormalities. These symptoms are usually attributed to selenium toxicity (Radositis *et al*., 1934). The normal levels of selenium in air, water, soil and fodder are 0.1 to 10 ng m^{-3} (Zoller and Reamer, 1976), 0.06 to 400 µg L^{-1} (Lindberg, 1968), 0.01 ppm (Radositis *et al*., 1934) and 5 mg kg^{-1} dry matter (Radositis *et al*., 1934), respectively. It is believed that selenium enters the animal diet through feedstuff of plant origin, including grains and grasses. The amount of selenium in a plant shows direct relation with the amount of selenium in soil (Allen *et al.,* 1955). Selenium in excess interfere with sulphur-containing amino acids such as methionine, cystine and cysteine, weakens keratin and causes disruption of hair, hoof and horn (Nuttal, 2006). Selenium in toxic concentrations leads to the alteration in haematological and biochemical parameters (Kaur *et al.,* 2005). The present study was aimed to assess the clinical and haematological changes in cattle showing hoof and horn abnormalities and reared around Koradi Thermal Power Plant, Nagpur, Maharashtra (India) and to establish whether there is any role of selenium in hoof and horn abnormalities in cattle.

MATERIALS AND METHODS

Twenty cows of 5-15 years were randomly selected in year 2012 from villages Surradevi and Khapri which lie within a radius of 5 km of Koradi Thermal Power Plant, Nagpur, Maharashtra (India). Only the cows born in the area and which attained lactation status in this area as well as showed symptoms of hair loss and horn deformities were selected. The cows selected were free from metabolic and infectious diseases. The cows were reared on free range system grazing on the pastures exposed to fly ash. Also, 20 lactating cows were selected as control at Agriculture Dairy Farm, Deolapar Cattle Farm and Cattle Breeding Farm, Nagpur Veterinary College. The fly ash-exposed animals were maintained by livestock keepers while control cows were maintained on balanced ration in organized farms. Within the villages, soil, air, water and fodder samples were taken from six different locations within the radius of 5 km around Koradi thermal power plant taking in to consideration the deposition of fly ash. Respirable dust sampler was used for air sampling. Water samplings were collected from six water bodies located around the thermal plant in 500 mL bottles. Soil sampling was done with the help of wooden plank in polythene bags. Fodder samples were immediately oven-dried. Selenium estimation in above samples, after acid digestion of samples in conc. HNO_3 (Yadav *et al.,* 2004), was done at NEERI, Nagpur using inductively coupled plasma optical emission spectrometer (ICP-OES).

Blood samples (10 mL) was collected from each lactating cow (n = 40), of which 2.5 mL was collected in sterile EDTA vial for haematological study, 5 mL kept in sodium citrate vials for selenium estimation and rest used for serum separation for biochemical study. Haemoglobin content was estimated by acid haematin method using Sahli's haemoglobinometer (Jain, 1986). Blood urea nitrogen was estimated by modified Bertholet method (Mahajan *et al.,* 2012) using auto-analyzer slim (SEAC). Serum creatinine was estimated by alkaline picrate method (Toro and Ackermann, 1975) using auto analyzer slim (SEAC). Serum aspartate aminotransferase and serum alanine aminotransferase were estimated by using auto analyzer slim (SEAC) by standard method (Thefeld *et al.,* 1974).The data was statistically analyzed by standard method (Snedecor and Cochran, 1994).

RESULTS AND DISCUSSION

Cattle reared within 5 km radius of Koradi Thermal Power Plant are exposed to fly ash emitted from the plant which contains heavy metals including Se. As the fly ash is suspended in air it gets

Fig. 1: Sloughing of horn

deposited on soil and hence dissolved in water. All the exposed animals were born and attained lactation status in the same area and the rearing of livestock on free range system by sending animals for grazing the common pasture was a common practice in the area. Sharma and Tripathi (2008) have reported that soil surrounding thermal power plant contain higher concentration of toxic metals. Mozhaiskii *et al.* (2000) registered increased the concentration of toxic element in plants near thermal power plant which act as a source of pollution and produce toxicity in grazing animals.

In present study distinct clinical symptoms observed in the cattle exposed to fly ash were inappetance, weight loss, loss of hair and horn deformities. Such symptoms are generally observed in cattle exposed to selenium toxicity.

In present study the selenium level in air was 3 ng m^{-3} (0.003 µg m^{-3}) which is in line with Zoller and Reamer (1976) who reported selenium content in most urban air varying from 0.1 to 10 ng m^{-3} and opined that higher levels may be found in certain areas such as in the vicinity of copper smelters. The level of selenium observed in present study is comparable with urban level thereby indicates that air is polluted like that of industrial areas. Water is normally not a major source of selenium intake. In present study the selenium level of six water bodies around Koradi Thermal Power Plant was 0.001±0.002 ppm (1 µg L^{-1}) which was lower than the value of control samples of water [0.01± 0.002 ppm]. The level of selenium around Koradi Thermal Power Plant appears to be within normal range. This revealed that water is not contaminated to the level that may cause selenium toxicosis. The soil samples of exposed area had selenium content below the detectable level (-0.593 ppm). This is in agreement with Lean *et al.* (1990) who reported that herd selenium levels were not significantly related to soil selenium. Fodder was also taken from six different locations around Koradi thermal Power Plant for selenium estimation .The mean selenium levels in fodder from exposed area was 1.25±0.20 ppm which was below the recommended toxic levels in fodder (Garg, 2002). The selenium in fodder in control group was 19.60± 18.53 ppm.

In present study the level of selenium in blood of exposed cattle was1.37±0.33 ppm which was insignificantly higher than those of control animals (0.39±0.04 ppm). Deore *et al.* (2002) reported that in experimentally induced selenosis in male buffalo calves, the signs of selenium toxicity appeared when selenium in blood were about 2 ppm and signs were prominent above 2.5 to 2.6 ppm. The selenium content in urine of exposed cattle was 1.113±0.278 ppm, whereas the mean selenium content in control cattle was 0.067±0.008 ppm. The level of selenium in exposed cattle was significantly higher than control cattle. As the level of selenium in blood is elevated, the concentration of selenium in glomerulus increases thereby creating hyperosmolar state inducing excretion of selenium in urine which is nothing but a renal clearance (Radositis *et al.*, 1934). The mean selenium level in milk of exposed cattle was 0.60±0.20 ppm as compared to 0.05±0.003 ppm

Table 1: The selenium content (ppm) in blood, milk and urine

Samples		Average ± S.E.	'f' value	Significance
Blood	Exposed	1.37 ± 0.32	3.43	ns
	Control	0.39 ± 0.04		
Milk	Exposed	0.60 ± 0.20	7.72	*
	Control	0.05 ± 0.003		
Urine	Exposed	1.31 ± 0.27	20.18	**
	Control	0.07 ± 0.008		

ns = Non-significant, *,**significant at 5 and 1% level, respectively

Table 2: Haemato-biochemical contents in exposed and control group of animals

Parameters		Average ± S.E.	'f'cal	Significance
Haemoglobin (g dL^{-1})	Exposed	10.98 ± 1.03	0.003296	ns
	Control	11.04 ± 0.16		
AST (IU L^{-1})	Exposed	91.93 ± 6.28	0.496675	ns
	Control	97.58 ± 5.00		
ALT (IU L^{-1})	Exposed	25.24 ± 1.63	2.941899	ns
	Control	30.52 ± 2.60		
Creatinine (mg dL^{-1})	Exposed	1.43 ± 0.08	3.924481	ns
	Control	1.68 ± 0.08		
BUN (mg dL^{-1})	Exposed	11.14 ± 0.74	2.258618	ns
	Control	12.84 ± 3.82		

ns = Non-significant

in control group. Higher levels of selenium in milk samples of cows from exposed area could be due to persistent nature of this metal thereby gradually gets accumulated in body and is excreted through milk (Radositis *et al.*, 1934).

The mean haemoglobin level in lactating cows from exposed area was 10.98±1.03 g% compared to 11.04±0.16 g% in control group (Table 2). The variation in the two groups was insignificant. Haemoglobin level gets reduced in selenium toxicity (Kumar *et al* 1989). Among the exposed cows, mean serum aspartate aminotransferase (AST) level was 91.93±6.28 IU which is well within normal range. However, this value is insignificantly lower than 97.59±5.00 IU L^{-1} observed in control cows. The mean alanine aminotransferase (ALT) level in exposed cows was 25.24±1.63 IU L^{-1} which falls within normal range. However, it was insignificantly lower than control group (30.52±2.60 IU L^{-1}). These findings are in consonance with those of Raisbeck *et al. (*1996) who found non-significant difference in ALT level between treatment groups of captive antelope upon feeding alfalfa grass hay containing >15 ppm total dietary selenium for 164 days. Mean serum creatinine value in exposed cows was 1.43±0.08 mg dL^{-1} which is within the normal range but is comparable with the value of 1.68±0.08 mg dL^{-1} in unexposed cattle and is insignificantly low. The mean blood urea nitrogen (BUN) level in lactating cattle from exposed area was 11.14±1.03 mg dL^{-1}. This was close to the estimated value of 12.84±0.16 mg dL^{-1} in control cows, though non-significantly on lower side. The haematological and biochemical parameters were within normal range and insignificantly lower than those of control cows. These findings are contradictory to Kumar *et al.* (2005) who reported increased biochemical parameters in chronic selenium toxicity in calves. The study indicates that the clinical signs observed in cows in the vicinity of thermal power plant is not related to toxic levels of selenium but may be attributed to some other factor which needs further thorough investigation.

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