

GEOMEDICAL STUDIES ON SELENIUM TOXICITY IN BOVINES

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INTRODUCTION

Selenium (Se) in small amounts is essential to animal health (8), but is toxic in larger amounts. Although, Se is a nonessential element for plants, yet its concentration in plants is critical to animal health. Invariably, feeding of selenium rich fodders ends in chronic selenium toxicity in animals. Typical selenium toxicity symptoms in animals and plants were observed in seleniferous regions of Punjab, India (5). Hoof and horn abnormalities in buffaloes, cattle and goats were associated with selenium toxicity (5,6). The present study was, therefore, planned to establish the linkage between the selenium content of soils and fodders and that in blood, hair and hooves of animals. The effect of toxic levels of Se on clinical status and haematological indices was also investigated.

MATERIALS AND METHODS

Collection of Samples

Soil and fodder samples were collected from two sites in seleniferous region and one site in the nonseleniferous (control) region. From the sites in seleniferous region, nine animals (5 cattle and 4 buffaloes) manifesting cracks in hooves and horns were selected for investigation. The animals were thriving on fodders raised on seleniferous soils for more than a year. Six healthy animals were selected from nonseleniferous region to establish controls. Blood samples were collected in heparinised vials by jugular venipuncture. Hoof and hair samples were also collected from the same animals.

Clinical Observations

History was recorded with regard to duration and progression of illness and reproductive status of animals. All the animals were examined and clinical manifestations were recorded.

Analytical Procedures

The samples were digested in nitric and perchloric acid mixture and analysed for Se (3). Haemoglobin (Hb), packed cell volume (PCV), total erythrocyte count (TEC), total leucocyte count (TLC) and differential leucocyte count (DLC) were determined as per standard procedure (7). Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were also computed.

RESULTS AND DISCUSSION

The most consistent clinical manifestations of selenium toxicity were overgrowth and cracks followed by detachment of the hoof at the level of crack (Fig. 3,4), abnormalities in the horn (Fig. 2) and shedding of horn corium. All the affected animals reported to be losing body condition (Fig. 1), progressively showing reluctance to

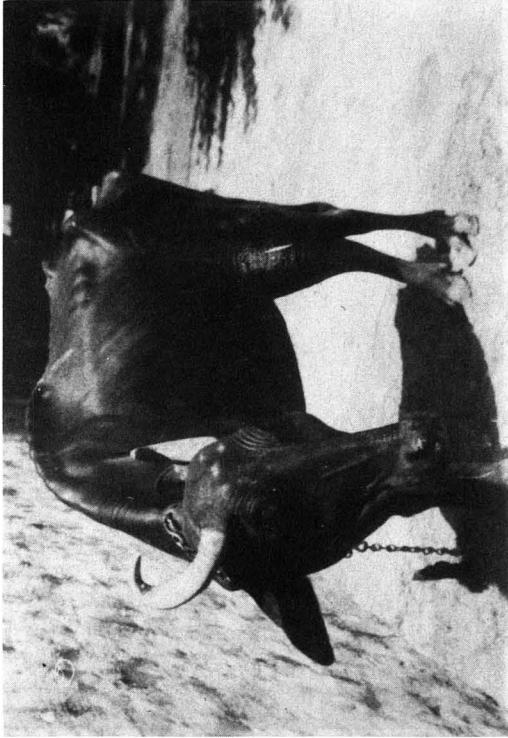


Fig. 1. Emaciation in a buffalo



Fig. 2. Horn abnormalities in a buffalo



Fig. 3. Deep cracks in hooves of forelimbs in a cow heifer



Fig. 4. Overgrown medial digit and sloughed of lateral digit in a buffalo

move and had a stiff gait. Two animals had loss of hair from the switch of the tail and necrosis of the tip of tail. Bilateral cataract was observed in one buffalo. Complaints of delayed onset of oestrus, anoestrus and premature abortion were also recorded.

The average Se content of soil samples from seleniferous sites was four to five times higher than that of nonseleniferous areas (Table 1). Fodder from these areas contained Se in toxic range since it was considerably higher (Table 1) than the upper safe limit of 5 mg Se/kg of animal feed (1). Fodders grown on soils containing more than 0.5 mg Se/kg accumulate Se in levels toxic for animals (4).

Table 1. Selenium content ($\mu\text{g/g}$) of fodders and soils

Fodder/soil	Seleniferous site		Nonseleniferous site
	Barwa	Jainpur	
Fodders			
Wheat straw	14.3 \pm 3.3	8.5 \pm 3.2	0.33 \pm 0.15
Sugarcane leaves	22.7 \pm 2.9	42.8 \pm 20.6	2.67 \pm 0.82
Berseem	6.2	15.3	-
Millet	-	12.0 \pm 1.9	-
Soil	1.41 \pm 0.15	1.84 \pm 0.56	0.37 \pm 0.09

Table 2. Selenium content ($\mu\text{g/g}$) of blood, hair and hooves of animals

Animals	Blood	Hair	Hooves
Healthy	0.080 \pm 0.023	0.137 \pm 0.028	0.796 \pm 0.150
Diseased	3.78 \pm 2.45	37.09 \pm 18.50	38.15 \pm 1.43

The average Se content of blood, hair and hooves of animals from seleniferous sites was 47, 271 and 47 times higher than healthy animals raised on fodders grown in nonseleniferous areas (Table 2). The selenium content of blood and hair from the affected animals was significantly higher than the critical levels reported by Blood and Radostitis (2) in cattle, thus confirming selenium toxicity. The well evident higher level of Se in blood, hair and hooves of the affected animals could be attributed to toxic levels of Se in feeds and fodder being fed to these animals. The average Hb, PCV and TEC values were considerably lower in affected animals (Table 3). An increase in MCV and a decline in MCHC was also observed. These results reflected macrocytic and hypochromic anaemia. Occurrence of anaemia has also been reported in advanced cases of chronic selenium toxicity in cattle (9). The values of TLC and DLC were within normal range (Table 3) and, therefore, cannot be used in diagnosis and assessment of prognosis of chronic selenosis. The results of this study revealed that animals feeding on fodders grown on soils containing more than 1 mg Se/kg suffer from chronic selenosis, establishing inter-relationship between soil-plant-animal system.

Table 3. Haematological alterations due to chronic selenosis in bovines

Animals	Hb (g%)	TEC ($\times 10^6 \text{ mm}^{-3}$)	PCV (%)	MCV (μ^3)	MCH (pg)	MCHC (%)
Healthy	11.76 ± 0.26	7.92 ± 0.21	34.01 ± 0.73	50.22 ± 0.61	14.70 ± 0.62	31.29 ± 0.72
Diseased	7.60 ± 0.42	5.75 ± 0.68	29.72 ± 1.88	57.05 ± 5.18	14.25 ± 1.15	25.46 ± 1.28
	TLC ($\times 10^3 \text{ mm}^{-3}$)	DLC				
		N (%)	L (%)	M (%)	E (%)	B (%)
Healthy	6.33 ± 0.19	32.5	54.3	5.7	5.2	0.6
Diseased	5.48 ± 0.71	35.37 ± 3.43	62.87 ± 3.56	2.16 ± 0.30	0.12 ± 0.25	-

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SUMMARY

The study was conducted to estimate the Se content of soils and fodders and its relationship with Se status of animals in seleniferous areas of Punjab, India. The effect of toxic level of Se on clinical status and haematological indices was also investigated. Selenium content of soils from seleniferous sites ranged from 1.41 ± 0.15 to $1.84 \pm 0.56 \mu\text{g/kg}$, which was 4-5 times higher than that from nonseleniferous areas. Fodders raised on seleniferous soils contained Se in the toxic range of $6.2-42.8 \mu\text{g/g}$. The average Se content of blood, hair and hooves of animals suffering from chronic selenosis was 47, 271 and 47 times, respectively, higher than that of healthy animals. The most

consistent clinical manifestations were overgrowth and deep cracks in hooves and horns, progressive emaciation, stiff gait, delayed onset of oestrus, anoestrus and premature abortion. Haematological alterations were macrocytic and hypochromic anaemia. The inter-relationships of soil-plant-animal system in terms of the development of chronic selenosis are discussed.

RESUMÉ

Le étude était conduite pour évaluer la quantité de Se dans le sol et dans le fourrage et sa relation avec la position de Se de animaux qui vien de region de Punjab, Inde. Le effect toxique de Se à la position generale et biochemique haemato a aussi recherché. La quantité de Se de le region qui a plus de Se range entre 1.41 ± 0.15 et 1.84 ± 0.56 $\mu\text{g/g}$ qui était 4-5 fois plus de quantité on trouve dan le region qui a moin Se. Le fourrage levé sur le sol de region seleniferous contenir Se a la range toxique 6.2-42.8 $\mu\text{g/g}$. Le quantité moyenne de Se dans le sang, et cheven et pieds était 47, 271 et 47 fois plus par raport les animaux normale de region non-seleniferous. Les animaux effectue pousse plus que animaux normale, profonde lacher dans les pieds et les corner, les animaux marche avec la difficulte. Ilya délai oestrus et anoestrus. Le changement de Haemato-biochemique était macrocytique, hypochromique anaemia et alterer de hepaticque et les fonctions renal. Nous avons aussi discuté de relation entre le système de sol-plantes-animaux dans la developement de selenosis chronique.