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Clinical Article

INDUSTRIAL FLUORIDE POLLUTION: CLINICAL INVESTIGATION ON CHRONIC FLUORIDE POISONING IN CATTLE

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Abstract: A field investigation was carried in cattle in the vicinity of Aluminium industry and Fertilizers unit situated in the Eloor industrial belt of Ernakulam district, Kerala. Clinical surveys were conducted in randomly selected 119 cattle aged three years and above. Blood and urine samples were collected from the randomly selected thirty cattle, aged three years and above and the fluorine content was estimated. Dry, fat free bones were collected from the local slaughter house to estimate the fluorine content. Fifty five (46.22%) cattle showed clinical signs of lameness, dental lesions, bony exostosis, reproductive problems and gastro-intestinal disorders suggesting fluorosis. The fluoride levels (ppm) in plasma, urine and bone were 1.247±0.123, 35.477±5.35 and 3523.057±591.885, respectively. It can be concluded from the present study that aluminium smelter and fertilizers units involved fluorine contamination in the Eloor industrial area and caused incidence of fluorosis in cattle.
Keywords: Cattle, Fluorine, Industrial fluorosis.

Introduction

Industrial process has been directly or indirectly responsible for release of toxic pollutants in the environment. According to Clarke *et al.* (1981) at least 28 industrial occupations has been identified with fluorine hazards and therefore, amount of fluorine emitted by industry is enormous. The major industries, which cause fluorine contamination are aluminium, steel, phosphate fertilizers, ceramic industries and combustion of coal and welding operations. Eloor industrial area of coastal Kerala is highly polluted with fluoride effluents (Kumar *et al*., 2001). The present case study was conducted to assess the industrial fluorine contamination and its effect on cattle.

Materials and Methods

The study was conducted in the vicinity of Aluminium industry and Fertilizers unit situated in the Eloor industrial belt of Ernakulam district, Kerala. Clinical surveys were conducted in randomly selected 119 cattle aged three years and above to investigate the health status of cattle in this area. The prevalence and pattern of clinical lesions suggestive of

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fluorosis were noted in detail. The lameness was assessed based on the observation of cattle standing and walking, with special emphasis on their back posture. The mobility scoring system was followed depending upon the severity of the lameness (0-Normal, 1- Mild-stand with flat back, but arches when walk, 2-Moderate-stands and walks with an arched back and short strides, 3- Severe-pronounced arching of back, reluctant to move).

Blood and urine samples were collected from the randomly selected thirty cattle aged three years and above for fluorine analysis using ion selective electrode. Bone sample were collected from the local slaughter house estimate the fluorine content. Dry, fat free bones were ashed at 550^0C and fluorine concentration was estimated using microprocessor ionalyser/901 as per the methods described by Singer and Armstrond, 1968. Ten healthy cattle aged three years and above were selected randomly from University Livestock Farm, Mannuthy as control. Blood and urine samples were collected from the control animals to estimate the fluorine level. Bone samples were collected from the slaughtered animals at Meat Technology Unit, College of Veterinary and Animal Sciences, Mannuthy and the fluorine level was analysed. The data obtained were statistically analysed by the completely randomized design (CRD) using SPSS computer software 17.00.

Results and Discussion

The major clinical signs observed in the cattle of Eloor industrial area are presented in Table 1. The cases of lameness, dental abnormalities, reproductive disorders, debility and reduced milk yield were recorded in the vicinity of aluminium smelter and phosphate fertilizer unit. Excessive periosteal bone formation and hyperostosis was observed in the cattle of study area and the affected bones were visibly enlarged. The joints became thickened and ankylosed, due to calcification of tendons at their points of attachment to the bone. Stiffness and lameness became apparent in the affected cattle. Hence, the affected animals were unable to feed and drink, which markedly affected the performance of animals. Shupe *et al.* (1963) described that fluorides had high affinity and biological activity to the calcified tissues of body such as bone and teeth.

Table 1. Distribution of major clinical signs observed in the cattle of Eloor industrial area (n=119)

Disorders	Number of animals showing clinical signs	Percentage
Lameness	20	16.81%
Bony exostosis	9	7.56%
Dental lesions	37	31.10

Debility	11	9.24%
Reproductive disorders	32	26.89%
Gastro-intestinal problems	13	10.92%

In the present study, majority of animals showed characteristic lesions notably mottling, discoloration, hypoplasia, hypocalcification and excessive erosion (Fig. 1 and 2) which are in agreement with the earlier observations of Choubisa *et al.* (2012)

Fig 1. Permanent incisor teeth showing discoloration and hypoplastic pits in the cattle affected with fluorosis

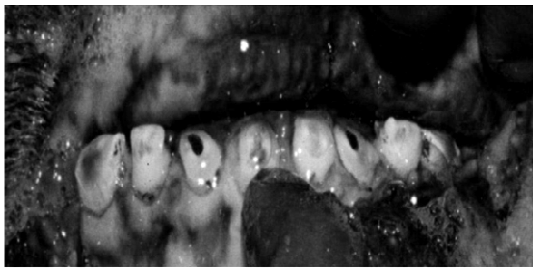

Fig 2. Permanent incisor teeth showing uneven erosion in the cattle affected with fluorosis

The fluoride levels in plasma, urine and bone are presented in Table 2. The plasma fluoride content of cattle in the Eloor industrial area was significantly higher ($P \leq 0.01$) compared to control value and it is in agreement with findings of Singh and Swarup (1999). The most reliable monitoring method to find out recent fluoride exposure was assessing fluoride levels in urine (WHO, 1994). In the present investigation, urinary fluoride content of cattle in the Eloor industrial area indicated recent and continuous exposure of cattle to industrial fluorine contamination. Bone fluoride concentrations were better indicators of long-term fluoride exposure (WHO, 1994). Significantly higher ($P<0.01$) levels (ppm) of fluoride in the bone were recorded in this study and this indicates cattle reared in this area having long-term exposure to the fluorine contamination.

Table 2. Flouride content (mean±SE) of biological samples in the cattle of Eloor industrial area

Samples	Control (n=10)	Study animals (n=30)
Plasma	0.108±0.016[c]	1.247±0.123 [a]
Urine	5.031±0.576 [c]	35.477±5.35 [a]
Bone	420.393±62.225 [c]	3523.057±591.885 [a]

*a,b,c- means with different superscriptions within the same row differs significantly (P≤0.01)

From the present study, it can be concluded that aluminium smelter and fertilizers units involved in the environmental pollution with fluorine in the Eloor industrial area and caused incidence of fluorosis in cattle.

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