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Fluoride Toxicity in Livestock

Pushpendra Koli[1]*, Sunita Yadav[2], Dinesh Kumar Yadav[2] and Saroj Devi[3]

[1]ICAR-Indian Grassland and Fodder Research Institute, Jhansi, U.P.-284003

[2]ICAR-Indian Agricultural Research Institute, New Delhi -110012

[3]Institute of Home Economics, University of Delhi, New Delhi-110016

***Email of the corresponding author: kolipushpendra@gmail.com**

Sources of fluoride into the environments are water, food, air, cosmetics, drugs, industrial exposure and organo-fluoro pesticides. The principal sources of fluoride to animals are drinking water, vegetation grew on fluorotic soils and water, certain edible marine animals, fluoride rich phosphate feed supplements, mineral mixture, medicines, cosmetics, dust in the air, and certain industrial processes Fluoride is having both beneficial and detrimental effects on human and livestock health but the problems associated with the excess fluoride in drinking water are highly endemic and widespread in countries like India. Mostly affected states with fluoride contamination are Raiasthan. Guiarat and Andhra Pradesh.

Introduction

Fluorine (F) is most electronegative, highly reactive element in the list of the periodic table. It is found abundantly in the earth's crust in the form of fluorides and fluoride-containing minerals are Fluorspar, Cryolite, Sellaite and Fluorapatite. Fluorine is having infinite routes of entry in livestock. Unfortunately, there is an enormous lack of precautions regarding livestock health; animals get contaminated through water, air and feed. Water is one of the major elements essential for sustenance of all forms of life and is available in abundance in nature covering approximately three-fourths of the surface of the earth. The chemical nature of water is one of the most important criteria that determine its usefulness for a specific need and as such not all the waters are fit for drinking; hence the problems of scarcity of drinking water. The presence of fluoride, in quantities in excess of limits, is a serious matter of concern from a public health point of view. Like any other pollutant, the fluoride pollution can also occur due to both natural and manmade reasons. Leaching of Fluoride from the earth crust is the chief source of fluoride content in ground water; however, the other sources like food items also add to increase the overall ingestion of fluoride into the human body. Today, every single house is equipped with an aqua guard or water purifier to get purified drinking water but in the case of animal drinking water no concern at all. In rural areas, milk is directly consumed after getting from animals; they don't follow even pasteurisation of milk. All animal products are consumed by a human being and ultimate we are the sufferer. Therefore, it is the need for livestock health concern.

The Major Sources of Excess F in Animal Diets

The principal sources of fluoride to animals are drinking water; vegetation grew on fluorotic soils and water, certain edible marine animals, fluoride rich phosphate feed supplements, mineral mixture, medicines, cosmetics, dust in the air, and certain industrial processes (Ranjan et al. 2015). According to National Academy of Sciences, the major sources are:

- Forages subjected to air- borne contamination from nearby industrial operations.
- Feed supplements and mineral mixtures containing excess F
- Water that is excessively high in F
- Forages contaminated with soils high in F
- The supplementation of rock phosphate and fertilizer grade phosphorous supplement (mono ammonium and di ammonium phosphate) may cause chronic fluoride toxicity in animals (Jubb et al. 1993).

Incidence of Fluorides in River Waters and Ground Waters in India

Traces of fluorides are present in many glasses of water; like in underground sources, higher concentrations are found. Total fluoride concentration of 1.3 mg/lit has been reported in sea water by Slooff et al., (1988). In fluoride minerals containing rich areas, water may contain fluoride up to about 10 mg per litre. Fluorides may also enter a river as a result of industrial discharges. Many rivers flowing through more than half a dozen states in India reported having fluoride contents varying from 0.1 to 12.0 ppm. In groundwater, fluoride concentrations vary with the type of rock the water flows through but do not usually exceed 10 mg/lit (WHO, 1996).

Fluorine-containing Pesticides

Fluorinated pesticides, including the inorganic compounds Cryolite and Sulfuryl Fluoride, as well as hundreds of organo-fluorine compounds that may well prove to be as toxic, or more toxic, than the chlorinated pesticides they are replacing. Fluoridated pesticides are being used in agriculture among them most widely used are herbicides: Trifluralin, Fluometuron and Benefits (EPA, Aug 97). Sodium fluoride is used as a rodenticide and insecticide.

Many of these pesticides are extremely toxic-most particularly the ones that contain both bromine and fluorine because this combination has shown severe effects on the brain. These particular pesticides are Amidoflumet, Bromethalin, Chlorfenapyr, Fluazolate, Fluorosalan, Halfenprox, Tralopyril, and Thifluzamide. It could turn out that the fluorinated pesticides are equally dangerous, or even more so.

Effect of Fluoride ingestion in Livestock

Chronic ingestion of fluoride rich fodder and water in endemic areas leads to the development of fluorosis in animals (Radostitis et al., 1994). Consumption of fluorinated drinking water for long term results in its accumulation predominantly in hard tissues such as teeth and bones causing diverse adverse changes that appear in the form of dental mottling (dental fluorosis) and bone deformities (skeletal fluorosis) in man Dental fluorosis is common to buffalo compare to cattle. Besides these maladies, non-skeletal fluorosis or toxic effects of chronic fluoride exposure in soft tissues or organs viz., gastrointestinal discomforts, neurological disorders, impaired endocrine and reproductive functions, teratogenic effects, renal effects, genotoxic effects, apoptosis, excitotoxicity, etc., have also been reported in man as well as in domestic and laboratory animals (Choubisa SL, 2012).

The effects of industrial fluorosis have been seen on cattle's serum biochemistry and haemogram. The elevated serum, urinary and bone fluoride concentration were associated with

decreased serum calcium, albumin and total protein, and increased serum phosphorus and alkaline phosphatase activity in the cattle affected with F toxicity (Kumar et al., 2015).

Other problems are associated with fluorine toxicity are:

- Signs of dental discoloration
- Difficulty in mastication
- Bony lesions
- Lameness
- Debility and
- Mortality in domesticated animals (Patra et al. 2000).

Fig. 1 Dental fluorosis in mature Sheep

Fig. 2 Dental fluorosis in mature Goat

Fig. 3 Dental fluorosis in mature Cow

Fig. 4 Dental fluorosis in mature Buffalo

Fig. 5 Dental fluorosis in Camel

Fig. 6 Skeletal fluorosis in Cattle calf

Fluoride removal

There are so many physical and chemical methods are there to remove fluoride from water sources. Fluoride from water or wastewater can be removed by ion exchange/adsorption process or by coagulation, precipitation process. The ion exchange/adsorption can be applied to either

concentrate or diluted solutions and they are capable of achieving complete removal under proper conditions. A list of methods has been given below.

- Precipitation methods
- Activated alumina
- Bone Char:
- Degreased and alkali treated bones:
- Synthetic tricalcium phosphate
- Florex
- Activated Carbon
- Ion Exchange Resins
- Serpentine: This is a mineral name and it has good defluoridation capacity.
- Fly Ash
- Electro coagulation/Electrochemical methods
- Rare earth based materials

Conclusion

Depending upon the amount and period of ingestion, illness of varying degree like dental fluorosis, skeletal fluorosis and non-skeletal fluorosis would occur. Calcification of certain ligaments, rendering movement of joints difficult, is usually associated with at least 10 mg/L of fluoride in drinking water. The detrimental effects of excessive fluoride can be controlled by defluoridation of natural waters. A number of methods of defluoridation are available; however not all the methods are suitable for all circumstances and hence proper justification is required for selecting an appropriate method for a given situation. Certain under-exploited but abundantly available materials like rare earth materials have indicated excellent potential for fluoride uptake. Attempts may be made to develop cost effective, simple to use technologies based on this material.

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