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Mini Review

Is it Safe for Domesticated Animals to Drink Fresh Water in the Context of Fluoride Poisoning?

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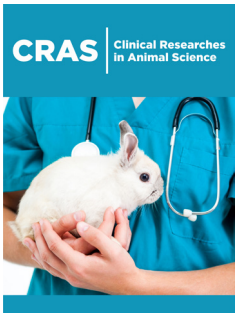

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Abstract

In most rural areas or villages, the sources of drinking water for domesticated animals are perennial rivers, canals, lakes, streams, reservoirs, ponds, etc. However, the most common sources are perennial ponds. Seasonal ponds dry up after a few months while perennial ponds retain water for a long time. That is why most of the animals in the villages drink water again and again from these perennial fresh water sources whenever they go out for grazing. According to the World Health Organization, fluoride in these drinking water sources (habitats) is found in trace amounts or in the range of 0.01-0.3ppm. Drinking such fluoridated water is generally harmless to animals. But recent survey studies have shown that many fresh water sources in different geographic regions have fluoride content much higher than the standard or acceptable value for humans of 1.0ppm or 1.5ppm. If such water is frequently consumed by domesticated animals, such as cattle (*Bos taurus*), water buffalo (*Bubalus bubalis*), sheep (*Ovis aris*), goats (*Capra hircus*), horses (*Equus caballus*), donkeys (*E. asinus*), and dromedary camel (*Camelus dromedarius*) over a long period of time then it becomes harmful to their health and causes chronic fluoride poisoning or intoxication in the form of dangerous fluorosis (hydrofluorosis) disease. Due to this disease, the teeth of animals get damaged, brownish stained, become weak, and fall at an early age (dental fluorosis) and most of the animals become victims of lameness (skeletal fluorosis). Many health complaints such as gastrointestinal discomforts, anaemia, repeated abortions, infertility, etc. (non-skeletal fluorosis) are also found in animals afflicted with fluoride poisoning or fluorosis. But most of the cattle rearers are not aware of the side or toxic effects of drinking fluoridated fresh water or fluorosis in their animals. Chronic fluoride poisoning not only harms the health of animals but is also responsible for economic losses to livestock farmers, which is also focused on in the present communication.

Keywords: Chronic fluoride poisoning; Dental fluorosis; Domestic animals; Fresh water; Fluorosis; Health; Livestock farmers; Non-skeletal fluorosis; Skeletal fluorosis

Introduction

Animal husbandry is an important source of income in most of the rural areas of the world. This not only strengthens the rural economy, but also provides employment opportunities to the local youth. This also helps in controlling the problem of unemployment to a great extent. By getting milk, meat, leather, wool, cow dung etc. from animal husbandry, the daily needs of the people are also fulfilled. For these reasons, the rural people still have attachment to animal husbandry and mainly rear animals like cow (*Bos taurus*), water buffaloes (*Bubalus bubalis*), sheep (*Ovis aries*), goats (*Capra hircus*), horses (*Equus caballus*), donkeys (*E. asinus*), dromedary camels (*Camelus dromedarius*), etc.

In most rural areas, sources of drinking water for domesticated animals can be rivers, canals, streams, ponds, lakes, dams, reservoirs, etc., but perennial ponds and rivers are the main sources of drinking water for these animals (Figure 1). Nevertheless, perennial fresh water sources retain water for longer periods. That is why most of the animals in the villages drink water again and again from these perennial water sources whenever they go out for grazing. But it is not necessary that the water from these sources is free from fluoride contamination. According to the World Health Organization, the fluoride content in various surface water sources has been estimated to range from 0.01 to 0.3ppm [1]. But recent research studies have found fluoride content of more than 1.0ppm or even 1.5ppm [2-9] in

various freshwater bodies of many countries including India. In India, the fluoride content in various perennial fresh water sources has been reported to range from 0.1-3.05ppm, especially in the Scheduled Tribal Areas of Rajasthan State [10-15].

Figure 1: Domesticated animals in rural areas drink water from different perennial fresh water sources (a-d) during grazing in field.

Most fresh water sources are naturally or geologically contaminated with fluoride. But in some rural areas these water sources may also be contaminated by industrial fluoride emissions or pollution. It is well known that there are many industries, such as coal-burning power stations and brick kilns and manufacturing or production plants for steel, iron, aluminum, zinc, phosphorus, chemical fertilizers, glass, plastics, cement, oil refineries, etc. are the most common source of fluoride emissions or pollution [16-18]. In fact, fluoride from these industries or factories is released into the surrounding environment in both gaseous and particulate/dust form and pollutes/contaminates not only air, soil, diverse biological communities, vegetation and agricultural crops but also various freshwater ecosystems on which domestic animals generally depend for food and water [19-21].

Is Fluoridated Fresh Water Safe for Animal Health?

According to the World Health Organization, the Indian Council of Medical Research and the Bureau of Indian Standards, the maximum permissible limit of fluoride in drinking water should be 1.0ppm or 1.5ppm [1,22,23]. Consumption of fresh surface water with fluoride below this maximum allowable limit is harmless to human and animal health. But when fluoridated water above this limit is consumed over a long period of time, it becomes toxic and deteriorates the health and eventually causes a serious disease called fluorosis (hydrofluorosis) which occurs not only in humans [24-34] but also in different species of domestic animals such as bovine, flocks equines, camel, etc. [35-54]. Wild animals also develop fluorosis if exposed to fluoridated fresh water that contains fluoride above the standard value (1.0ppm or 1.5ppm) [55-57]. However, it has become abundantly clear that long-term drinking of fresh water from rivers, ponds, lakes, etc. with high fluoride content is not safe for the health of all types of domestic animals [35-54].

Indeed, fluoride ingested through drinking water gradually accumulates in maximum amounts in the teeth and bones. The accumulation of fluoride adversely affects and interferes with their various biological activities. Due to chronic fluoride poisoning or toxicosis, animal teeth become light to dark brown, weak, fractured, and fall out at an early age (Figure 2) [58]. These adverse changes in the teeth are collectively known as dental fluorosis which is irreversible or not curable. This entity can be easily identified with the naked eye. In fact, dental fluorosis is a biomarker and early sign of chronic fluoride poisoning not only in animals but also in humans [59]. Loss of teeth at an early age in animals due to dental fluorosis can also lead to their death. Because of loss of teeth, animals cannot masticate food properly, due to which animals become weak and die due to hunger [60]. Livestock mortality also results in considerable economic loss to the livestock owners [50,54].

Figure 2: Appearance of severe dental fluorosis in adult cattle exposed to fluoridated water.

Animals drinking fluoridated fresh water develop various changes or deformities in their bones (also called skeletal fluorosis) that are more painful and reduce their mobility at an early age. In various bones, the most common pathologies are found as periosteal exostosis, osteosclerosis, osteoporosis, and osteophytosis [61-64]. These changes manifest clinically as vague aches and pains in the body and joints that are associated with stiffness or rigidity in animals [44-47,58]. Excessive accumulation of fluoride in muscles also reduces or restricts the movement of bones, causing lameness in animals. Enlarged joints, emaciation, hoof deformities, body muscle wasting, and exostosis of bones or lesions in the jaw, ribs, metacarpus, and metatarsus regions are also consequences of severe skeletal fluorosis in animals (Figure 3).

Figure 3: Adult cattle afflicted with moderate skeletal fluorosis due to exposed to fluoridated water. This animal had also dental fluorosis as shown in Figure 2.

In addition to dental and skeletal fluorosis, fluoride toxicity has also been found in the soft organs of animals, causing a variety of health complaints (non-skeletal fluorosis) in animals. The most common fluoride-induced health complaints, such as gastrointestinal discomforts, often frequent urination (polyuria), frequent water intake (polydipsia), muscle/body weakness, allergic reactions, irregular reproductive cycles, abortions, stillbirths, etc. have been observed and reported in diverse animal species [35-54,58]. It is not necessary that all these health problems occur in the same animal. But these can be reversed after withdrawal of fluoride exposure [58].

The severity or magnitude of chronic fluoride poisoning or fluorosis is much more depend on the fluoride concentration in drinking fresh water and its duration and frequency of intake or exposure. However, the magnitude of fluoride poisoning is also influenced by several factors or determinants, such as chemical constituents in drinking water, age, sex, species, food constituents, environmental factors, individual susceptibility, and biological response or tolerance, health, and genetics of an individual [65-72].

Interestingly, most cattle ranchers or villagers are generally innocent and unaware of fluoride poisoning in their pets. But this fluoride poisoning in pet animals can be easily prevented if the animal health department provides complete information to the cattle rearers about the drinking water sources located around the villages, which water source contains fluoride or not. These water sources can be easily identified by fluoride estimation. Animal rearers should also be advised from time to time that they should give only fluoride free water to their animals from ponds and rivers. Nalgonda techniques can also be employed for defluoridation of water to obtain fluoride free water for rural livestock [73]. Animal parents can use this water for drinking and cooking, so that there will be no risk of fluorosis in them. It is clear that fresh water with fluoride above 1.0ppm or 1.5ppm is unsafe for the health of animals and is likely to develop the dreaded fluorosis disease. If this water is used for agricultural irrigation, then it is also harmful for agricultural crops and due to its contaminated effect, agricultural production also decreases, which causes huge economic loss to the farmers [74].

Conclusion

It is not necessary that only groundwater is naturally found to be contaminated with fluoride, but fresh water is also found to be contaminated with fluoride in many geographical areas in the world. Generally, most fresh water sources (rivers, canals, ponds, dams, lakes, etc.) are contaminated with fluoride naturally and through geologic processes. But the water from these sources is also more likely to be contaminated with fluoride by industrial fluoride emissions or pollution. Fluoride is found in the range of 0.1-0.3ppm in most fresh water sources. But in many rural areas these water sources have more than 1.0ppm or 1.5ppm fluoride which is not safe for the health of domestic animals and their owners as well. Pets are more likely to develop the dreaded fluorosis disease if they repeatedly drink water from these sources over a long period of time. But most of the cattle rearers are ignorant and unaware of this disease occurring in their animals as well as its side effects. If the animal parents take a little vigilance and caution, then this disease can be prevented in their animals. Apart from this, using this fluoridated water for irrigation also causes heavy damage to the crops and their yield also declines. Farmers are not even aware of this. However, more research studies are still needed on chronic fluoride toxicity in different species of domestic animals exposed to fluoridated water from various freshwater bodies.

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