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Short Communication

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Is Drinking Groundwater in India Safe for the Health of Domestic Animals with Respect to Fluoride?

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Abstract

In rural India, most livestock keepers feed their livestock with water from hand-pumps and bore-wells as these sources of drinking water are abundant and easily accessible. But most of these water sources have been found to have fluoride content much higher than the prescribed standards of 1.0 or 1.5 ppm. Drinking such water again and again for a long time not only worsens the health of animals but also leads to a dangerous disease called fluorosis (hydrofluorosis). Due to this disease, the teeth of the animals become weak and discoloured (dental fluorosis) and also fall out soon, while the animals start walking with a limp (skeletal fluorosis). In chronic fluoride exposure, many health problems such as gastro-intestinal discomforts, body weakness, polydipsia, polyuria, frequent abortions etc. also develop in domestic animals. At 1.5-4.4 ppm of fluoride in drinking groundwater, 28.3-70.2% and 25.7-64.1% of different species of domestic animals including cattle (*Bos taurus*), water buffaloes (*Bubalus bubalis*), sheep (*Ovis aries*), and goats (*Capra hircus*) are found to be afflicted with dental and skeletal fluorosis, respectively. In rural India, > 90% of drinking groundwater sources is naturally contaminated with fluoride. Fluoride is present in groundwater in 23 of the country's 37 states and union territories. Among these states, 70–100% districts in the states of Andhra Pradesh, Gujarat, Rajasthan, and Telangana and 40–70% districts in the rest of the states have fluoride-contaminated groundwater with maximum allowable levels >1.0 ppm or 1.5 ppm. Based on published reports on endemic hydrofluorosis in various species of domestic animals, such water is not safe for the health of the animals. In the present communication, attention has been drawn to the concerned people whether the groundwater of rural areas of India is safe for the health of animals in terms of fluoride or not. Along with this, in this article, attention has also been given to how domesticated animals can be saved from hydro fluorosis.

Keywords: Domestic animals; Fluoride toxicosis; Groundwater; hydrofluorosis; Rural India

Introduction

80 decades ago, in rural India, cattle herders used to feed water to their domesticated animals from nearby fresh water sources, such as open-wells, ponds, rivers, etc. But ever since hand-pumps and bore- wells became available in rural areas, villagers started feeding their animals their water. In fact, hand-pumps are not only sources of drinking water for animals (Figures 1-6) but humans also use water from these sources for drinking, cooking and various domestic purposes (Figure 7). In fact, "Dracunculus Eradication Programme" has been the reason behind the high number of these groundwater sources in the country [1]. Because the drcunculiasis disease, caused by infection of human nematode or dracunculus worm (*Dracunculus medinensis*), was endemic or more prevalent especially in the rural areas, hand-pumps and bore wells were dug at various places to break the life cycle of this dreaded worm [2-4]. But at that time people did not know that there is fluoride

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chemical in the water of these manmade drinking water sources. In the present communication, attention has been drawn to the concerned people whether the groundwater of rural areas of India is safe for the health of animals in terms of fluoride or not. Along with this, in this article, attention has also been given to how domesticated animals can be saved from the ill effects of fluoride containing groundwater.

Figures 1-6: Different species of domesticated animals drink water from hand-pumps as these sources are easily available and highly approachable in most of the rural areas in India.

Figure 7: Not only have domesticated animals' drunk water from hand-pumps but also their owners use this water for drinking, cooking, and other domestic purposes.

Is groundwater Safe for Animal Health?

In rural India, > 90% of drinking groundwater of different sources, mainly hand-pumps and bore-wells, is naturally contaminated with fluoride [5]. Fluoride is present in groundwater in 23 of the country's 37 states and union territories in varying amounts (Figure 8). Among these states, 70–100% districts in the states of Andhra Pradesh, Gujarat, Rajasthan, and Telangana and 40–70% districts in the rest of the states have fluoride-contaminated groundwater with maximum allowable levels >1.0 ppm or 1.5 ppm [6-8]. In general, drinking of groundwater having fluoride below this standard value is beneficial and helpful in the mineralization of teeth and bones. But, long-term drinking of water containing fluoride above 1.0 ppm or 1.5 ppm is harmful and worsens the health of both humans and animals. In fact, such fluoridated water mainly has the potential to damage teeth and bones to varying degrees. Eventually, prolonged exposure to fluoride through drinking water leads to the development of a dangerous disease called fluorosis, not only in humans [9-20] but also in various species of wild [21-23] and domestic animals [24-41]. Fluorosis developed by drinking of fluoridated water is also termed as "hydrofluorosis". Depending on the organs affected, fluorosis is classified or categorized into dental fluorosis, skeletal fluorosis, and non-skeletal fluorosis in both humans and animals.

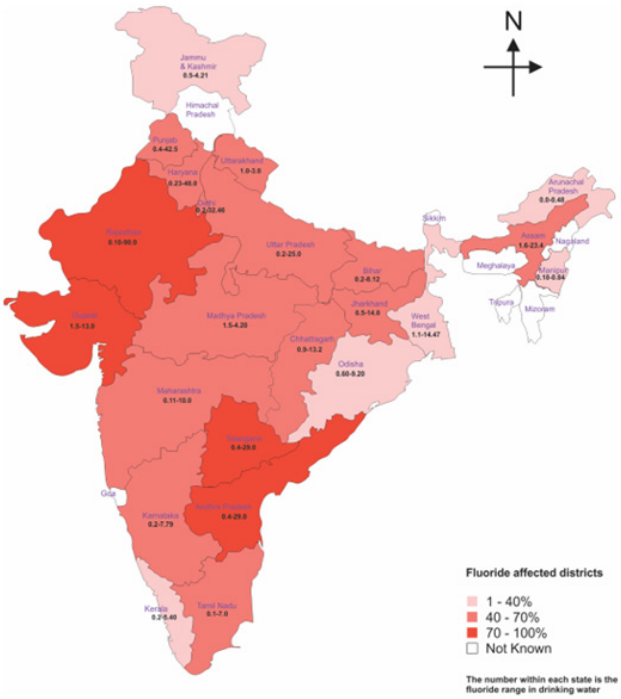

Figure 8: Map of India showing fluoride (in ppm) contamination of drinking groundwater in different states and union territories [20].

Dental Fluorosis

The earliest visible pathognomonic sign of hydrofluorosis in diverse species of domestic animals, such as cattle (*Bos taurus*), water buffaloes (*Bubalus bubalis*), sheep (*Ovis aries*), goats (*Capra hircus*), horses (*Equus caballus*), donkeys (*Equus asinus*), and dromedary camels (*Camelus dromedarius*), is the dental mottling [42]. This is the most recognizable, irreversible, sensitive, and indexive sign of fluorosis. In rural India, dental fluorosis is rampant in these animals and is characterized with bilateral, striated, and light to deep brownish staining on teeth surface (Figures 9 & 10). In some cases, unusual dental staining is also possible in the form of light to deep brownish spots, patches, and fine dots or granules on the surface of teeth. In severe dental fluorosis, pronounced loss of teeth supporting alveolar bone with recession and swelling of gingival and excessive wearing of teeth giving a wavy appearance have also been observed in most of the old animals. In the country, at 1.5-4.4 ppm of fluoride in drinking groundwater, 28.3-70.2% of different species of domestic animals are found to be afflicted with dental fluorosis [31]. However, immature animals are more susceptible and have low tolerance to fluoride exposure [35]. Therefore, calves have been considered as ideal bio-indicators for endemic of fluorosis [35,43,44]. Whatsoever, in severe state of dental fluorosis teeth become weak and fall out in early age. This is enough to cause difficulty in grazing and chewing, animals die of hunger and cachexia at an early age [6,45]. Nevertheless, the death of animals at a young age has economic consequences for herders. But most of the cattle herders are unaware of this.

Figures 9 & 10: Dental fluorosis in bovine calves < 2 months of age due to drinking of groundwater in rural areas of India characterised with stratified brownish yellow staining [28].

Skeletal Fluorosis

Figures 11 & 12: Domestic animals suffering with chronic skeletal fluorosis due to drinking of fluoridated groundwater in rural areas of India characterised with lameness in hind legs, enlarged joints, debility, invalidism, wasting of body muscles, and bony lesions in ribs, metacarpus and metatarsus regions [25,33].

Long-term drinking of fluoridated groundwater also affects or causes bone changes or anomalies that are more painful and reduce the mobility of animals at a young age. The most common bone changes are found as periosteal exostosis, osteosclerosis, osteoporosis, and osteophytosis [46-49]. These changes manifest clinically as vague aches and pains in the body and joints that are associated with stiffness or rigidity and lameness, stunted growth, obvious bone lesions, and a cracking or snapping sound in the legs when walking in animals [24-41]. In addition, these progressive and irreversible bone changes become more severe as the amount of fluoride in drinking water increases and the advancement of animals age. Excess accumulation of fluoride in muscles also reduces or restricts the movement of bones, causing lameness in animals. Although intermittent lameness, enlarged joints, emaciation, mortality, hoof deformities, body muscle wasting, and exostosis of bones or lesions in the jaw, ribs, metacarpus, and metatarsus regions are well recognized in animals afflicted with severe skeletal fluorosis (Figures 11 & 12). In the country, at 1.5-4.4 ppm of fluoride in drinking groundwater, 25.7-64.1% of different species of domestic animals are found to be afflicted with mild to severe skeletal fluorosis [31].

Non-Skeletal Fluorosis

Fluoride in drinking water can also affect the soft organs of the body and cause various health complaints in animals. Fluoride-induced diverse changes in different organs or health complaints are referred to as non-skeletal fluorosis. Among various species of animals, the most common and prevalent health complications or complaints such as gastrointestinal discomforts, frequent tendency to urinate (polyuria) / itching in the region, frequently intake of water (polydipsia), muscles/body weakness, allergic reactions, irregular reproductive cycles, abortion, still birth etc. are found due to resultant of chronic hydrofluorosis [24-41]. It is not necessary that all these health problems occur in the same animal and they are all reversible after withdrawal of fluoride exposure [42].

Interestingly, the prevalence and severity of hydrofluorosis in domestic animals are not found to be the same, but vary greatly, at nearly identical fluoride concentrations in drinking water from different geographic regions. This indicates that certain factors are involved and responsible for controlling fluoride toxicosis. These have been well studied in both animals and humans. The most important and common determinants are: fluoride concentration in drinking water and its duration and frequency of exposure, density or rate of bio-accumulation of fluoride, chemical constituents in drinking water, age, sex, habits, food constituents, environmental factors, individual susceptibility and biological response or tolerance, health, and genetics of an individual [50-57].

Prevention and Control of hydrofluorosis

Hydrofluorosis disease can be prevented and controlled in domestic animals with a little efforts and precautions. But once this disease occurs in animals, there is no cure for it. In fact, this disease is irreversible. Therefore, prevention is the only option to cure or treatment for this disease. In order that this disease does not occur in these animals, it is necessary that these animals should be fed only fluoride-free water or very little fluoride-rich water (< 1.0 ppm fluoride in drinking water). To obtain fluoride free water, defluoridation of fluoridated water can be done by adopting Nalgonda defluoridation technology which is ideal and not very costly in terms of cost. Another option, rainwater harvesting and conservation is the most suitable and easiest way to get regular fluoride - free drinking water for animals. One more effective option is to provide fresh surface waters (ponds, reservoirs, dams, etc.) instead of groundwater (hand- pump and bore-well water) to domestic animals which contain fluoride in the range of 0.01-0.3 ppm [6,58]. To prevent this disease, it is more important to give healthy food to the animal and bring awareness among the villagers or animal keepers.

Conclusion

In rural India, based on available scientific reports, it is clear that feeding groundwater to animals is not safe for their health. Because, groundwater of most of the hand-pumps and bore-wells have been found to be contaminated with fluoride (> 1.0 or 1.5 ppm). Feeding this type of water to animals causes great harm to their health and causes a disease called fluorosis (hydrofluorosis). Drinking of such fluoridated groundwater is also harmful to villager's health [59]. Due to this disease, the teeth of the animals become weak at an early age and fall quickly (dental fluorosis), the same animals also become victims of lameness (skeletal fluorosis). Thousands of domestic animals in rural areas of the country are found to be afflicted with hydrofluorosis. Therefore, there is a need to run a campaign at the national level to prevent this disease in animals in India. Because these animals are not only an economic source for the villagers, but also play an important role in strengthening the rural economy in the country.

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Conflict of Interest

No conflict of interest.

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