

OSTEO-DENTAL FLUOROSIS IN DOMESTIC HORSES AND DONKEYS IN RAJASTHAN, INDIA

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SUMMARY: Chronic fluoride (F) intoxication in the form of osteo-dental fluorosis was observed in 23 domestic equus animals, 9 to 23 years old, including 14 horses (*Equus caballus*), and 9 donkeys (*E. asinus*) living in F endemic areas of Dungarpur district, Rajasthan, India. The mean F concentration in the drinking water in these areas ranged from 1.4 to 3.3 ppm. Eleven (78.7%) of these horses and all nine donkeys were afflicted with mild to severe dental fluorosis. Their incisor teeth were brown to black-yellowish in color. Also present as indications of more severe chronic F intoxication were irregular wearing and excessive abrasions of the teeth, deep dark-yellowish discoloration of exposed cementum and/or remaining enamel surface, and pronounced loss of tooth-supporting alveolar bone with recession of gingiva. Excessive hypoplasia and light brown-yellowish pigmentation on the enamel surface of incisors were also observed in 2 foals below the age of 2 months.

Among the mature animals, the following manifestations of skeletal fluorosis were present: periosteal exostoses in mandibular regions, ribs, metacarpus, and metatarsus, intermittent lameness, hoof deformities, and hardness of tendons in the legs. Other signs of F intoxication included colic, diarrhoea, retention of urine, repeated abortions, and sterility were noted. This evidence of osteo-dental fluorosis in domestic horses and donkeys is reported for the first time in India, and this condition in donkeys is reported for the first time anywhere.

Keywords: Domestic horses; Donkeys; Equus species; Fluoride toxicity; Osteo-dental fluorosis; Rajasthan; India.

INTRODUCTION

Varying degrees of chronic fluoride (F) intoxication have been found in humans and domestic animals in fluoride endemic areas.¹⁻³ Recently, F poisoning has been reported in horses (*Equus caballus*) consuming artificially fluoridated drinking water in the USA containing 0.9 to 1.3 ppm F.⁴⁻⁶ In India, although many states are endemic for fluorosis, F intoxication in horses does not appear ever to have been reported. Moreover, as far as we are aware, studies on F toxicity in other domestic equus species, e.g., *E. asinus* (donkeys) have not been conducted. Since the state of Rajasthan is hyperendemic for fluorosis in cattle, buffalo, sheep, and goats,⁷⁻¹¹ we considered it of interest to investigate F intoxication in horses and donkeys, especially in the southern part of that state.

MATERIALS AND METHODS

During a cross-sectional survey in 2009 of osteo-dental fluorosis in various domestic animals in F endemic areas of the Dungarpur district of southern Rajasthan, India, 14 horses (*E. caballus*) and 9 donkeys (*E. asinus*), 9 to 23 years old, were also examined. Besides these mature animals, 2 foals (< 2 months old) were examined. The mean F concentration in drinking water sources of these areas

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ranged from 1.4 to 3.3 ppm.¹² These equus animals were caught from pastures with the help of cow-herds and passers-by. Later their owners were traced, and relevant information about the animals such as age, medical history, and sources of F intake or exposure other than drinking water sources. In the absence of urinary and blood analyses, identification of F effects in these animals was based on clinical examination only.

Background: The horses living for the last six to eight years in the F endemic areas of Dungarpur district were purchased from elsewhere, but the donkeys lived from birth in these areas. These animals are generally used for domestic labor, and their main drinking water sources are hand pumps and dug-wells. However, during grazing in grassy fields they may also drink seasonal pond waters. No other sources of fluoride intake or exposure were found.

Medical history: In these F-affected horses and donkeys, colic, diarrhoea, and retention of urine were commonly found. However, a history of repeated abortions and sterility were also reported for some of these equuses.

Interestingly, neither owners nor local veterinarians knew about these F effects, not only in these animals, but also in other local domesticated animals living in this fluoride endemic area of southern Rajasthan.

OBSERVATIONS AND DISCUSSION

Dental fluorosis: Of the 14 mature horses, and 9 mature donkeys of either sex, 11 (78.7%) of the horses and all 9 donkeys, respectively, were afflicted with varying degrees of dental fluorosis. Enamel of mandibular and maxillary incisor teeth was bilaterally and vertically stained brown to black-yellowish in color. In severe form the incisors had deep dark-yellowish discoloration on their exposed cementum and/or remaining enamel surface, pronounced loss of tooth supporting alveolar bone with recession of gingiva, and excessive abrasions or irregular wearing of the teeth (Figures 1 and 2). Similar observations have also been reported in horses consuming artificially fluoridated drinking water containing 0.9 to 1.3 ppm F.^{4,6} Enamel of incisor teeth of one of these F-affected horses showed scattered deposition of fine blackish and/or yellowish spots on their surfaces. None of these equuses showed a well-defined condensed, horizontal, stratified brown to yellowish lines on their incisor teeth. Such an appearance of dental fluorosis has been observed and reported mostly in cattle and buffaloes as well as in human beings.^{10,13} The reason for this difference is not clear.

Initial stages of dental mottling were also observed in 2 sickly foals (Figure 3) below the age of 2 months, characterized by excessive hypoplasia, and light yellowish pigmentation on erupted incisors of both jaws (Figures 4 and 5). The appearance of dental mottling in these immature animals may indicate they may be more sensitive and less tolerant to F.



Figure 1. Teeth of a 20-year-old horse showing severe dental fluorosis characterised by deep dark-yellowish discoloration of exposed cementum and remaining enamel of all incisors along with very severe bulging of gingiva and pronounced recession of the alveolar bone of maxillary teeth with corresponding exposure of roots. Dentin next to the pulp cavity also shows deep yellowish discoloration in the lower incisor teeth.



Figure 2. Teeth of an 18-year-old female donkey (jinny) showing severe dental mottling characterised by deep yellowish vertical discoloration of enamel surface of all incisors and recession of tooth supporting bone with recession and bulging of gingiva.



Figure 3. Emaciated under 2-month-old foal affected with dental fluorosis shown in Figure 4.



Figure 4. Teeth of under 2-month-old foal in Figure 3 showing initiation of dental fluorosis characterised by enamel hypoplasia, light yellowish discoloration of erupted incisors of both jaws, and bulging gingiva. (Figure is slightly out of focus.)



Figure 5. Teeth of another under 2-month-old foal showing initiation of dental fluorosis characterised by enamel hypoplasia, light brownish discoloration, slight resorption of the alveolar bone with exposure of the root, and bulging of the gingiva with slightly irregular wearing of the upper incisors.

Skeletal fluorosis: Careful palpation of mandibular regions, ribs, metatarsus, and metacarpus bones revealed diffused to well marked periosteal exostoses (bony lesions) in the horses and donkeys afflicted by dental fluorosis (Figure 6). In these animals slight to severe intermittent lameness or restricted movements in their hind legs, stiffness of tendons in the legs, wasting of main mass of hind quarter and shoulder muscles, deformed hooves (Figure 7), snapping sounds, and lowering of neck and head during walking were also observed. Other signs of chronic F intoxication including colic, intermittent diarrhoea, and repeated abortions were noted. In general, these animals were bodily weak, indolent, and more reluctant to stand.



Figure 6. Emaciated 18-year-old donkey with dental fluorosis shown in Figure 2. Note wasted thigh muscles and bulging lesions on mandibular, metacarpal, and metacarpus regions.



Figure 7. Deformed hooves of 17-year-old horse characterized by stratified brownish discoloration (right leg) and irregular wearing and cracking (left leg).

Besides these clinical signs of F effects, most of the male animals (stallions and jocks) appeared reluctant to engage in copulation or mounting. Some females (mares and jinnys) had not conceived many times after several attempts at copulation or artificial insemination, and their estrus cycles were also irregular. F toxicosis is known to impair reproductive function. High prevalence of sterility, repeat estrus cycles, still births and births of weak offsprings have also been observed and reported in other domesticated animals.^{2,14-17}

These pathognomonic signs indicate these animals are suffering from two-fold chronic F intoxication, which is further supported by the presence of osteo-dental fluorosis in other domestic animals living in the same F endemic areas.¹¹ Earlier official reports stated that toxic F effects appear in horses only at relatively high levels of F intake and that horses are relatively more tolerant to F than other species of domestic animals.^{18,19} But recent studies and the present findings indicate that F intoxication in horses and donkeys can occur at relatively low or moderate concentrations of F in drinking water,⁶⁻⁸ as found in other species of domestic animals, e.g., *Bos taurus* (cattle), *Bubalus bubalis* (buffalo), *Ovis aries* (sheep), and *Capra hirus* (goat).⁹⁻¹¹

The prevalence and severity of F toxicity in animals and humans varies from place to place, even in areas having similar F concentrations in drinking waters. Besides the amount of F in the water and the duration of exposure and frequency of F intake, age, nutrition, health, stress factors, and differences in the biological response of individuals, other factors such as the local environment (temperature and humidity), other dissolved salts in the drinking water, and the involvement of fluoridated food chains may increase the prevalence and severity of F toxicity.^{3,20-23} In the present areas of study, most of the owners, farmers, and local veterinarians are unaware of the adverse effects of F in horses and donkeys as well as in other domesticated animals. In this connection, the appropriate comments and suggestions given by Burgstahler²⁴ are useful for the recognition and prevention of F intoxication in animals. The significance of the present study is that *it reports for the first time in India, evidence of chronic F intoxication in horses and donkeys, and this condition in donkeys is reported for the first time anywhere.* These findings can also be seen as contributing significantly to our knowledge of F toxicosis in animals.

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REFERENCES

- 1 World Health Organization. Fluorides and human health. Monograph series No. 59. Geneva: World Health Organization;1970.
- 2 Udall DH. The practice of veterinary medicine. Ithaca, New York: Udall DH;1954.
- 3 Shupe JL. Clinical and pathological effects of fluoride toxicity in animals. In: Elliott K, Birch J, editors. Novartis Foundation Symposia. Ciba Foundation symposium 2: Carbon-fluorine

- compounds: chemistry, biochemistry and biological activities. A Ciba Foundation symposium. Amsterdam: CIBA Foundation and Association of Scientific Publishers;1972. p. 357-88.
- 4 Krook LP, Justus C. Fluoride poisoning of horses from artificially fluoridated drinking water. *Fluoride* 2006;39:3-10.
 - 5 Justus C, Krook LP. Allergy in horses from artificially fluoridated water. *Fluoride* 2006;39:89-94.
 - 6 Macicek P, Krook LP. Fluorosis in horses drinking artificially fluoridated water. *Fluoride* 2008; 41:177-3.
 - 7 Choubisa SL. Chronic fluoride intoxication (fluorosis) in tribes and their domestic animals. *Int J Environ Stud* 1999;56:703-16.
 - 8 Choubisa SL. Some observations on endemic fluorosis in domestic animals in southern Rajasthan. *Vet Res Comm* 1999;23:457- 65.
 - 9 Choubisa SL. Fluoridated ground water and its toxic effects on domesticated animals residing in rural tribal areas of Rajasthan (India). *Int J Environ Stud* 2007;64:151-9.
 - 10 Choubisa SL. Dental fluorosis in domestic animals. *Curr Sci* 2008;95: 1674-5.
 - 11 Choubisa SL, Mali P. Fluoride toxicity in domestic animals. In: Dadhich L, Sultana F, editors. *Proceedings of the National Conference on Environmental Health Hazards*; 2009 Dec17-18; Kota, Rajasthan, India. 2009. p.103.
 - 12 Choubisa SL, Sompura K, Choubisa D, Pandya H, Bhatt SK, Sharma OP, et al. Fluoride content in domestic water sources of Dungarpur district of Rajasthan. *Indian J Environ Hlth* 1995;37:154-60.
 - 13 Choubisa SL. An epidemiological study on endemic fluorosis in tribal areas of southern Rajasthan [a technical report]. New Delhi: Ministry of Environment and Forests. Government of India;1996.
 - 14 Swarup D, Dwivedi SK. *Environmental pollution and effects of lead and fluoride on animal health*. New Delhi: Indian Council of Agricultural Research; 2002.
 - 15 Burgstahler AW, Freeman R, Jacobs PN. Toxic effects of silicofluoridated water in chinchillas, caimans, alligators, and rats held in captivity. *Fluoride* 2008;41:83-8.
 - 16 Spittle B. Fluoride and fertility [editorial]. *Fluoride* 2008;41:98-100.
 - 17 Long H, Jin Y, Lin M, Sun Y, Zhang L, Clinch C. Fluoride toxicity in the male reproductive system. *Fluoride* 2009;42:260-76.
 - 18 Shupe JL, Olson AE. Clinical aspects of fluorosis in horses. *J Am Vet Med Assoc* 1971;15:167-74.
 - 19 Subcommittee on Fluorosis, National Research Council Committee on Animal Nutrition. *Effects of fluoride on animals*. Washington, DC: National Academy of Sciences;1974.
 - 20 Choubisa SL. Endemic fluorosis in southern Rajasthan. *Fluoride* 2001;34:61-70.
 - 21 Choubisa SL. Osteo-dental fluorosis in relation to nutritional status, living habits, and occupation in rural areas of Rajasthan, India. *Fluoride* 2009;42:210-15.
 - 22 Choubisa SL, Choubisa L, Choubisa D. Osteo-dental fluorosis in relation to age and sex in tribal districts of Rajasthan, India. *J Environ Sci Eng*. In press 2009.
 - 23 Choubisa SL. Osteo-dental fluorosis in relation to chemical constituents of drinking water. *J Environ Sci Eng*. In press 2010.
 - 24 Burgstahler AW. Failure to diagnose fluoride poisoning in horses caused by water fluoridation [editorial]. *Fluoride* 2006;37:1-2.