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Fluoride in dog food

Fluorine is an elemental gas that occurs rarely in nature, but in ionic form as fluoride-containing compounds, it is widely distributed in the earth's crust and soil. Hydrogen fluoride is released to the air from volcanic eruptions and industrial high-temperature processing of mined resources. Various fluorides end up in land or water and may be taken up by plants. Animals eating those plants can accumulate fluoride in their bones.

Fluoride is not intentionally added to petfood, but comes with bone residues in animal ingredients. Perhaps, fluoride is an essential nutrient for dogs in minute amounts, but high intakes are toxic, depending on the chemical form. European legislation has set a maximum for fluoride: 170 mg total fluoride per kg complete canned or kibbled dog food when completely dried (1, 2). Public, fluoridated drinking water, to help prevent human dental decay, has about 1 mg fluoride/kg.

Excessive intake of absorbable fluoride during dental development causes chalk-like patches in tooth enamel. Such dental mottling was seen in puppies fed a diet with added sodium fluoride, but not with other fluoride sources; the diets contained 167 mg fluoride per kg dietary dry weight. It is likely that long-term feeding of a diet high in absorbable fluoride induces skeletal fluorosis in dogs, which is typified by bone outgrowth and stiffness. Fluoride is also called a bone-seeking element.

Canine dental and skeletal fluorosis may still occur in areas with groundwater high in dissolved fluoride. The scant research data suggest that commercial dog food normally does not cause fluorosis. Food fluoride measured in 2009 (3) was much lower than the European maximum, while bone-derived fluoride is limitedly absorbed. There is no evidence that fluoride in dog foods imposes risk of diseases, including fluorosis.

Dietary fluoride

The analysed concentrations of total fluoride (F) in dry and wet dog foods (3-8) were generally lower than 170 mg/kg dietary dry matter (ddm). One brand of dry dog food contained 460 mg/kg ddm, which was due to rock phosphate added as mineral source (6). Two foods (presumably canned) had 326 and 550 mg F/kg ddm (7). The three excessive levels were reported in 1984 (6) and 1985 (7).

Mammalian bone meal may contain 200 to 600 mg total F/kg (4, 7). When its ash content is put at 40%, then animal meal with 20% ash has up to 300 mg F. Fish meal may hold 100 to 400 mg F/kg (7) and feed phosphates can bring along 70 to 3860 mg/kg (9). There is only about 1 mg F/kg in grains (10). Besides the ingredients, the water added during production also is a source of F in petfood.

Dental and skeletal fluorosis

Dogs living in areas endemic for fluorosis may display conditions featuring dental and/or skeletal fluorosis. Such dogs, from locations in China (11), India (12) and Turkey (13), were subjected to clinical studies. The occurrence of mottled teeth and bony exostoses in dogs at three kennels has been attributed to the feeding of a commercial dry food containing 460 mg total F/kg ddm (6, 14).

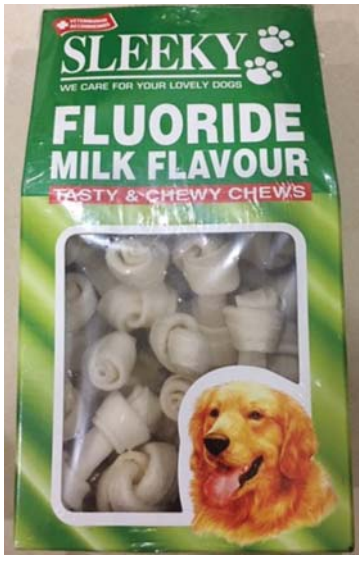
Puppies and their mothers were fed one of four diets with similar calcium and phosphate levels (4). The control diet contained pure calcium phosphate. Test diets had either calcium phosphate plus NaF, bone meal or feed phosphate. Control and test diets provided 15 and 193 mg F/kg ddm. Only the permanent teeth of puppies fed NaF (n = 4) developed dental fluorosis.

Dogs aged 7-14 weeks were fed a basal ration without (n = 2) or with (n = 6) 0.1-0.2 g NaF per day (15), equivalent to about 500 mg F/kg ddm. Eruption of permanent teeth was considerably delayed in all dogs fed F. Discolored hypoplasias of the premolars and molars were seen. Ten to 14 weeks after F administration, bones were markedly thickened, due to periosteal bone formation, while the original cortex was thin.

Absorption and metabolism

The concentration of soluble F in the intestinal content determines quantitative F absorption. The hydroxyl group in hydroxyapatite can be replaced by F, so forming fluorapatite. The two premises explain that young dogs fed iso-fluorous diets accumulated drastically more F in their femurs when NaF was the F source instead of bone meal or feed phosphate (4).

Dog chow with F-rich rock phosphate markedly raised plasma F (14). Femur F increased over time in growing dogs (3) and was directly related with NaF intake in weanling (16) and adult dogs (5). NaF feeding enhanced bone remodeling in adult dogs (17).



In young dogs dosed orally with NaF (18), equivalent to 45 mg F/kg ddm, the increase in urinary F excretion corresponded with 48% of the dose. Net intestinal F absorption was higher than 48%, as there was F body retention (18) and biliary excretion (19).

Osteosarcoma

Fluoridated drinking water and high-fluoride food are considered potential causes of canine osteosarcoma (8, 20, 21). A case-control study (22) found that dogs with osteosarcoma (n = 161) were not exposed to community fluoridation more frequently than dogs with other types of cancer.

Rodenticides

Fluoroacetate was, and sodium fluoroacetamide is used as rodenticide. In 1979 it was reported that one or both organofluorides were present in marketed frozen, minced poultry meat, causing mass poisoning in dogs (23).

List of references is available on request from the author (beynen@freeler.nl)

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