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Diet and canine coprophagy

Coprophagy, or stool eating, is a common behavior among dogs. For several weeks after puppies are born, bitches ingest their feces, likely for hygienic purpose. Quite a few dogs eat feces of hoofed animals, their own feces and/or that of other adult dogs. Coprophagic behavior is clinical when caused by digestive disease (1) or chronic stress (2, Note 1). Otherwise, it might be considered normal canine behavior. But dogs' risk of contracting certain parasites is increased by ingesting feces of conspecifics (Note 2). In addition, the habit of dogs eating feces disgusts many owners.

A web-page survey completed by 1475 dog owners found that 16% of pet dogs engaged in frequent eating of their own or other dogs' feces (3, Note 3). The conspecific coprophagy was mainly directed at feces no more than two days old (3). The web-page survey (3) and two other questionnaire-based studies (4, 5) did not ascertain an association between type of diet and coprophagy. The paper on the large-scale study states explicitly that the vast majority of the dogs was fed on dry food (3). Thus, an association between diet and coprophagy, if there is any, was undetectable beforehand due to limited variation of diet type.

Unsubstantiated theories have advanced that diet affects canine coprophagy. More specifically, high carbohydrate (starch) intake, insufficient supply of vitamin B1 (thiamine), diets with below-average digestibility and low-fiber diets have all been suggested to promote coprophagic behavior (Notes 4, 5). None of the diet factors proposed to initiate or intensify canine coprophagy is backed by available research data. As to dietary behavior, the recent web-page survey (3) shows that greedy eating is associated with coprophagy.

Various dietary supplements, in the form of chewable tablets or powders, are marketed as coprophagy deterrents for dogs eating their own feces (Note 6). Presumably in response to the unsubstantiated theories on diet and canine coprophagy, several supplements contain thiamin and digestive enzymes, including alpha-amylase which breaks down starch. Most products enclose substances that allegedly make stool less appealing to dogs.

A commonly used substance in coprophagy deterrents is an extract from the desert plant Yucca schidigera, but there is no convincing experimental evidence for its efficacy. Three questionnaire-based studies indicate that coprophagy-treatment products are not very successful and that preventing access to feces is the most commonly used and most effective way to stop canine coprophagy (3, 5, 6).

In conclusion, there is no demonstrable evidence, in the form of outcomes of controlled studies, that even one of the proposed diet changes significantly diminishes canine coprophagy. The same holds for the coprophagy deterrents on the market. In itself, the principle of making feces repellant by a safe dietary constituent or supplement seems achievable. Clearly, its application would be primarily autocoprophagy-directed.

Carbohydrate intake

In 1973, Kronfeld published his diet-intervention study in a group of 16 racing sled dogs that performed poorly (7). The article states that all dogs practiced coprophagy and that it was said to be a general problem. Type of coprophagy (allo- and/or autocoprophagy) and housing (individually or in groups) were not mentioned. Each evening, the dogs received a single meal, consisting of commercial dry food (68.4%), horse meat (26.3%) and corn oil (5.3%). By percentages of metabolisable energy, the dietary protein:fat:carbohydrate ratio was 29:32:39. The carbohydrate content was lowered from 39 to 28, through replacing part of the dry food by an isoenergetic amount of horse meat. The coprophagy was found to cease in a few days.

The observation that coprophagy was corrected by lowering of carbohydrate intake (7) corroborates earlier and later statements that high carbohydrate intake promotes coprophagy (Note 4). However, the evidential value of the study is rather limited: there was no control group, the intervention involved multiple dietary variables and reproducibility is unknown.

Kronfeld and others have further reported on sled dogs fed high- or low-carbohydrate diets, but coprophagy was either not mentioned in relation to the study at issue (8) or not at all (9, 10). This is surprising, not only in the light of the initial study (7), but also because group-kept, Antarctic sled dogs have been typified by their “almost invariable coprophagy“ (11) and “voracious coprophagic habits of hungry dogs” (12).

Vitamin B1 deficiency

It has been asserted that canine coprophagy is triggered by a deficiency of B vitamins (13). As evidence, the following statement was presented as a fact: adding brewers yeast (which is rich in B vitamins) to the diet stopped coprophagy within a few days (13, Note 7). That statement is not substantiated or accompanied by cited literature, but at the time there was a supportive study in dogs with experimentally-induced vitamin B1 deficiency (14). Furthermore, it is well known that feces is an abundant source of microbial-synthesized B vitamins. However, for the following three reasons it is improbable that deficiency of B vitamins plays a role in canine coprophagy.

Deficiency of B vitamins is highly unlikely in coprophagic dogs fed on a commercial, complete diet. A vitamin deficiency prompting coprophagy requires that a low bodily status of the vitamin directs selection of feces as an edible item being rich in the vitamin concerned. However, dietary self-selection instructed by micronutrient-status has not been demonstrated in dogs. Furthermore, as explained below, the observation that deficiency of vitamin B1 led to coprophagy in dogs (14) probably is irreproducible.

The 1981 paper (14) describes that young dogs fed a thiamin-deficient, semipurified diet (Note 8) developed progressive inappetance, lack of growth and coprophagy, followed by neurological abnormalities. The control dogs remained healthy; they were fed the same diet, but received a weekly intramuscular dose of thiamin hydrochloride. The authors (14) mentioned that other workers (15) also noted coprophagy in dogs fed a thiamin-deficient diet. In fact, those other workers suspected coprophagy in two dogs, but never directly observed it (15). A literature-based list with common signs of thiamine deficiency in dogs does not include coprophagia (16).

Exocrine pancreatic insufficiency

In 1966, McCuistion wrote that coprophagy in dogs may be an expression of an insufficiency of digestive enzymes, particularly amylase (17, Note 4). Exocrine pancreatic insufficiency (EPI) is a well-known maldigestion disease due to lack of pancreatic digestive enzymes (1). The clinical signs are weight loss, polyphagia and output of voluminous, semi-formed feces. EPI also is considered a clinical cause of coprophagia. Primary treatment consists of supplementing each meal with pancreatic enzyme extracts.

A questionnaire-based study has addressed the efficacy of long-term enzyme replacement in dogs with EPI (18). The study involved German Shepherd Dogs and Rough-Coated Collies, breeds with a high risk of EPI. The dogs were either clinically normal or had EPI and were given dietary enzyme supplements for at least four months. According to the owners, "coprophagy (sometimes)" occurred in 8% of the healthy (n =72) and in 18% of the affected (n =45) German Shepherds. For the Collies these frequencies were 0% (n = 73) and 26% (n =31). It is clear that coprophagia was (still) increased in the enzyme-treated dogs with EPI.

Hungriness and coprophagy

Perhaps, hungriness instigates coprophagy in dogs with EPI (1) and in Antartic, working sled dogs (12). Coprophagic pet dogs were more frequently typified by their owners as greedy eaters than were non-coprophagic dogs (3). It could be suggested that food restriction, which plausibly strengthens hungriness and gobbling, enhances coprophagic behavior. However, there is no evidence for that suggestion. In group-housed dogs of various breeds, the transition from ad libitum feeding to caloric restriction and vice versa did not affect camera-monitored coprophagy (19, 20). During regular feeding, coprophagy was uncommon in the dogs (Note 9). Possibly, they were unreceptive to engaging in coprophagy.

Yucca schidigera

For making a claim on waste-odor control, petfoods are typically supplemented with a Yucca schidigera preparation. There is experimental evidence that yucca substances generally reduce group-mean odor offensiveness of dog and cat feces (21). Ten out of 13 brands of coprophagy deterrents contain Yucca schidigera as active ingredient (Note 6). One brand states that Yucca schidigera makes stool less appealing to a dog.

Autocoprophagic behavior in dogs can be quantified as delay in fecal excretion of orally administered radio-opaque markers (22, Note 10). Autocoprophagic dogs (n =15) were fed a dry diet without or with 125 mg Yucca schidigera/kg in a cross-over trial (23). After 20 days on the diets, radio-opaque markers were given and feces collected for another 10 days. The percentages marker recovery were 71 and 93% for the control and yucca-containing diet. The outcome, albeit statistically non-significant (P =0.15), suggests that dietary yucca reduced coprophagy. Unfortunately, the degree of stool eating was not visually observed so that practical meaningfulness of the yucca effect cannot be assessed.

Note 1

Boredom has been suggested as a motivating factor for canine coprophagy (cf. 6). However, availability of toys such as rawhide or rope were not associated with less coprophagic behavior (6). Claw horn from calves is a valued chewing object in group-housed laboratory dogs, but its administration increased coprophagy, possibly because feces with claw residue is more attractive to dogs (24).

Note 2

Coprophagy can increase the risk of infection with *Toxocara canis* in dogs (25), but certain parasites may produce eggs that pass through the gastrointestinal tract without being affected. The presence of those eggs in feces of a dog, due to eating another dog's stool, can lead to false positive outcomes in the diagnosis of parasitic infections by fecal examination (26).

Note 3

Other studies have also quantified the occurrence canine coprophagy. In a questionnaire-based study, 177 out of 623 owners (28%) indicated that their dogs showed coprophagic behavior (6, 27). Dogs that consumed all feces types, only dogs' feces or only herbivores' feces were similar in number (6). Interviews with owners of 70 dogs revealed that 30 dogs (43%) were coprophagic (4).

A web-page survey that was focused on coprophagic dogs comprised 802 owners with 1157 dogs of which 862 (75%) were coprophagic (5). Within the framework of a study on helminth infections in dogs, 561 owners of 896 dogs reported that 391 animals (44%) ate feces of unspecified origin (26). The owners of dogs that were purchased from an animal rescue shelter, reported that 49 (9%) out of 556 dogs displayed coprophagy (28).

Note 4

Chronological order of quotes, taken from veterinary journals and books, about a causative role of the amount of dietary carbohydrates with regard to canine coprophagy. Three authors' statements (13, 17, 29) are not accompanied by a literature reference. Kronfeld (7) has cited McCuistion's article (17).

1966 (17): "Feeding these dogs a diet high in carbohydrates, which they frequently may not be able to digest, results in the coprophagy syndrome". In the quote, "these dogs" refers to German Shepherds.

1973 (7): "The appearance of tying up, the coprophagy, and the hypoglycemia of the dogs all suggested excessive carbohydrate intake. The immediate correction of the coprophagy, the restoration of normal blood glucose concentrations, and the progressive increase in stamina on lowering of the carbohydrate intake supported the diagnosis". In the quote, "the dogs" refers to Siberian or Alaskan Huskies with some infusion of German Shepherd breeding.

1988 (29): "Diets high in carbohydrate tend to enhance the drive to eat stool"

1991 (13): "In the dog, the consuming of faeces (its own or the faeces of others) is observed mainly with rations containing a high level of carbohydrates: cereal starch, and more especially when this starch is not digestible enough due to inadequate cooking".

Note 5

Chronological order of quotes, taken from veterinary journals and books, about a causative role of food digestibility with regard to canine coprophagy.

1993 (30): "A highly-digestible low-residue diet which has a high energy density should be fed. Occasionally, a high-fibre diet may be more effective although the reason is not clear"

1994 (31): "If the dog is eating its own faeces, feed it a highly digestible, predominantly meat diet ..."

2000 (32): "Factors associated with coprophagy. Food. Poorly digestible food. Overfeeding"

2010 (33): "Using foods with increased fiber levels has been reported to help"

Interestingly, the last quote is at odds with second to last quote, whereas both quotes are taken from the same authors. Foods with increased fiber levels, be it insoluble or soluble fiber, generally lower net total-tract digestion of dietary dry matter in dogs (34, 35). Thus, high-fiber foods, as advised in the last quote, tend to be less digestible foods, which should be avoided, as implied by the second to last quote.

Note 6

Commercially available coprophagia deterrents for dogs: product name, form, listed active ingredients and, if provided, explanatory information about the mechanism of action and/or efficacy.

a. FOR-BID™, powder; wheat gluten and monosodium glutamate. A highly purified crystalline edible protein fraction that produces a bad taste to the stool, deterring them from further consumption.

b. Zesty Paws Chew No Poo Bites™, soft chews; vegetable blend, breath blend, glutamic acid, digestive enzyme blend, Yucca schidigera extract, Bacillus coagulans, capsicum extract. The enzyme blend and probiotic support healthy digestion; the capsicum extract gives stool an unpleasant taste.

c. Vetrinex Labs Probiotics. Advanced Probiotic Formula for Dogs & Cats, powder; various Lactobacillus species, Enteroccocus faecium, Bifidobacterium. The probiotics strengthen the digestive tract.

d. NaturVet® Coprophagia, chewable tablets; Yucca schidigera, parsley leaf, enzyme blend, chamomile. Thiamine monohydrate is listed as inactive ingredient. The product helps deter dogs from consuming their own stool

e. Healthy Solutions for Pets. No Stool Eating, soft chews; Yucca schidigera, parsley leaf, enzyme blend, Bacillius coagulans, chamomile. The product makes poop taste foul. Products d and e have identical lists of active ingredients.

f. ThomasLabs®, Stop Stool Eating, tablets; proprietary blend including Yucca schidigera extract, Lactobacillus acidophilus fermentation product. By changing the taste and texture of the stool, the product helps deter dogs from eating their own waste

g. NUTRI-VET Nasty Habit®, chewable tablets; Yucca schidigera, cayenne pepper, alpha-amylase, parsley leaf, glutamic acid, chamomile, thiamine. Yucca schidigera helps reduce odors arising from stool and urine to make them less appealing to a dog. Cayenne pepper imparts an “offensive” taste to stop dogs from eating poop. Alpha-amylase is a digestive enzyme that helps alter the taste and odor of stool. Glutamic acid makes stool taste very bitter to the dog when mixed with stomach acids.

h. PetNC™, Stool eating deterrent, chewables; Yucca schidigera extract, cayenne pepper, alpha amylase, parsley leaf, glutamic acid, chamomile, thiamine monohydrate. The product creates a bitter taste to feces to discourage dogs from consuming their own feces Products g and h have identical lists of active ingredients.

i. PROSENSE® Poop Eater Solutions, chewable tablets; monosodium glutamate, Yucca schidigera, thiamine hydrochloride, oleoresin capsicum. The product may help deter dogs from consuming own feces while reducing feces odor.

j. GNC PETS MEGA STOOL – NO, chewable tablets; Yucca schidigera, parsley, chamomile, proprietary enzyme blend. Brewer’s yeast is listed as inactive ingredient. The product is formulated to facilitate deterrence of stool eating

k. VETIQ STOOL REPEL, tablets; brewers dried yeast, alpha amylase, capsicum oleoresin. The product makes stool less palatable and contains alpha-amylase which breaks down starches, helping to improve digestion.

l. Well&Good™, Coprophagia, chewable tablets; Yucca schidigera extract, parsley leaf, fructooligosaccharide, chamomile flower, glutamic acid, cayenne pepper, sodium copper chlorphyllin, thiamine monohydrate, digestive enzymes, probiotics. The product helps prevent dogs from consuming feces.

m. ONLY NATURAL PET Stool Eating Deterrent, chewable tablets; Mojave yucca (root) extract, brewers yeast, parsley (leaf), chlorella, niacinamide, thiamin mononitrate, riboflavin, vitamin B6 (from pyridoxine HCl), enzyme blend (fungal amylase, fungal protease, lipase, cellulose), cayenne (fruit). The product features natural digestive enzymes; it has been suggested that stool eating may be induced by the presence of undigested material in the stool. The product has a powerful blend of ingredients to alter the taste and aroma of stool, making it less appealing.

a. https://www.for-bid.com/about-forbid/ and https://www.drugs.com/vet/for-bid.html and https://www.entirelypets.com/forbidsingle.html

b. https://zestypaws.com/products/chew-no-poo-bites

c. https://vetrinexlabs.com/collections/all/products/probiotics-for-dogs-and-cats

d. https://naturvet.com/product/coprophagia-stool-eating-deterrent-chewable-tablets/

e. https://healthysolutionsforpets.com/shop/dog-supplements/stool-health-dog-supplements/stool-eating-deterrent-soft-chew-supplement-for-dogs

f. https://www.entirelypets.com/thomas-labs-stop-stool-eating-100-tablets

g. https://www.nutri-vet.com/dog-health/dog-digestion-and-bladder-control/nasty-habit-chewables

h. https://www.amazon.com/PetNC-Natural-Care-Deterrent-Chewables/dp/B00IW1LRN8

i. http://www.prosensepet.com/solutions/poop-eater-solutions.aspx https://www.chewy.com/pro-sense-plus-poop-eater-solutions/dp/170614

j. https://www.gnc.com/on/demandware.static/-/Sites-GNC2-Library/default/v1593251835095/pdf/678832_lbl.pdf

k. https://markandchappell.com/vetiq/behavioural-aids/stool-repel

l. https://www.amazon.com/Well-Good-Coprophagia-Tablets-count/dp/B01MU0LG51

m. https://www.amazon.com/Only-Natural-Pet-Deterrent-Puppies/dp/B0030ZVWZE

Note 7

Apparently, the idea that thiamine deficiency causes coprophagy and that dietary brewers yeast stops it (13) has in some way reached several manufacturers of coprophagy deterrents. Out of the 13 coprophagia deterrents (Note 6), six and two products, respectively, contain thiamin (vitamin B1) and brewers yeast as (active) ingredients.

Note 8

The thiamin-deficient, pelleted diet consisted of 68% sucrose, 18% vitamin-free casein, 10% vegetable oil, 4% salt mixture and supplemental vitamins, except for vitamin B1. The casein contained 15 µg thiamin/100 g so that the diet contained 27 µg/kg (14). The adequate and recommended amounts of thiamin for puppies after weaning are 1.08 and 1.38 mg/kg dietary dry matter (= 4000 kcal = 16.736 MJ) (36).

Note 9

During 72 hours of camera observation, three out of 39 dogs exhibited eight incidents of coprophagy. The dogs were housed in groups of three or four and fed a low-calorie diet at maintenance supply or ad libitum (20).

Note 10

Autocoprophagic behavior in dogs was quantified by measuring fecal excretion of orally administered radio-opaque markers (22). In non-coprophagic dogs, all markers were excreted within three days, but in their coprophagic counterparts recovery amounted to about 40%.

Note 11

A manufacturer of pressed dog food had added an emulsifier (presumably glycerol polyethyleneglycol ricinoleate) to one of its products. The inclusion percentage was not disclosed. According to the proprietors of two different kennels, their dogs stopped practicing coprophagy after consuming the emulsifier-containing food. To verify the observations, a controlled trial was carried out (37).

Two complete, pressed foods either unsupplemented or supplemented with the emulsifier, but otherwise identical, were provided by the manufacturer. Within a double-blinded, cross-over trial with 8-week periods, the two foods were fed to 24 privately-owned, coprophagic dogs. The 16 dog owners recorded daily whether or not their dog had eaten its own feces or that of another dog. The percentage of days that individual dogs were observed eating feces ranged from 0 to 100%. The mean percentages were 40 and 42% for the control and test food, indicating that the emulsifier did not diminish coprophagy. Likewise, perceived feces consistency was not affected by the emulsifier.

Note 12

A coprophagic dog contracted thyrotoxicosis as a result of consuming the feces from a thyroxine-treated housemate (38).

Note 13

Dogs eating their own feces were treated with citronella-spray collar or sound therapy (39). The severity of coprophagy as reported by the dog owners was reduced most effectively by the spray collar.

Note 14

Four out of the 13 coprophagic deterrents contain probiotics (Note 6). A study showed that administration of *Bacillus subtilis* C-3102 did not affect coprophagy in dogs with chronic diarrhea (40).

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