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Research

Canine coprophagic behavior is influenced by coprophagic cohabitant

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ABSTRACT

Coprophagia is a common canine habit, although it is aversive for human beings. Despite absence of clinical risk to animals and their owners, this behavior may lead the owners to get rid of their dogs. The lack of information and effective corrective methods make it difficult for veterinary clinicians to contribute to eradication of this problem. The objective of this study was to evaluate nutritional, behavioral, and hereditary aspects involved in the manifestation of coprophagia in dogs, the effectiveness of the most common corrective methods, and the perception of owners about the subject through a questionnaire designed for coprophagic and non–coprophagic dogs' owners. Owners of 70 adult animals were interviewed, of which 42.8% (n = 30/70) were coprophagic and 57.1% (n = 40/70) were non-coprophagic. There was no difference between sex, habits, lifestyle, habitat, number of meals, nutritional background, commercial diet, and reproductive status. However, development of coprophagia appears to be influenced by the presence of a coprophagic cohabitant.

Introduction

Coprophagia is a common habit observed by dog owners; however, little is known about its causes or prevalence. It is estimated that almost half of domestic dogs exhibit such behavior at some point in their lives (Boze, 2008).

Coprophagia can be classified into three categories: cecotrophy, attributed to lagomorphs and rodents, which ingest specific types of feces; autocoprophagia, when there is ingestion of self-produced feces; and alocoprophagia, when ingestion of feces from other animals is observed (Galef, 1979). There are periods in the life of dogs in which coprophagia is considered normal, for example, by females during lactation to keep the nest clean (Boze, 2010; Houpt, 1982).

Some studies that aim to understand the reasons for coprophagy have cited potential predisposing causes such as factors related to housing, such as overcrowding and lack of hygiene; food-related factors such as extreme hunger, provision of a single daily meal, and nutritional deficiencies; and stress factors such as lack of social interaction (Boze, 2010; Hart et al., 2018; Meyer et al., 2014). Nutritional deficiencies are often attributed as a cause of coprophagia, although there has been no scientific confirmation.

A study conducted by Wells and Hepper (2000) on shelter dogs showed that coprophagy was observed in 12.9% of the animals, of which, half of them were returned after adoption for this reason.

This study aimed to investigate nutritional, behavioral, and hereditary aspects involved in the manifestation of coprophagia in dogs, evaluate owners' perception about possible causes, and seek information about the most effective corrective method to reduce the occurrence of this behavior.

Materials and methods

Owners of 70 dogs were interviewed in person and answered a questionnaire composed of objective questions about their dogs. If the owner had more than one dog, he/she was asked to choose one of them. Questions followed according to the inclusion criteria: healthy adult dogs of either sex living with the family since at least 3 months of age. Owners were approached in a private practice located in Pirassununga, Sao Paulo, Brazil.

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Initially, the animal's history was assessed, including breed, age, reproductive status, diet (name and brand), listing of which nonnutritive substances were ingested (rock, plants, sand, dirt, or clay), number of daily meals (two or fewer meals a day or ad libitum), and whether they were coprophagic.

In the absence of a standard classification based on incidence of coprphagic events, we considered that dogs were coprophagic if feces were ingested at least once a year (because it would be easier to remember rather than giving a frequency of ingestion) and non–coprophagic dog were those who had not ingested feces for a year.

Commercial diets were classified as super premium, premium, or economy according to manufacturer's information on label. In the case of a homemade diet, the owners were asked if it was prescribed by a veterinary nutritionist.

To assess crowding, owners were asked about the number of feline or canine cohabitants, and for those with canine cohabitants, they were asked if cohabitants were coprophagic.

Regarding the dog's behavior, owners were asked to assign a score from 0 to 10 for their animals' anxiety, with 0 being "insignificant" and 10 being "manifestation of anxiety at every possible opportunity during the day". During the conversation, signs of anxiety were noted as: ears back, panting, shaking, excessive vigilance, yawning, lip licking, aimless activity, stereotypic circling, digging, and climbing (Gruen et al., 2015). Dogs with scores equal to or less than five were not considered anxious. Dogs with scores higher than five were considered anxious.

Regarding lifestyle and environment, owners were asked about where the dog spent most of their time (inside the house or in the backyard), where they eliminate (inside the house, in the backyard, or street for those living in apartments), how much time they spent without human interaction, presence of toys for entertainment, and frequency of outdoor and indoor physical activity.

Owners were also asked about their dog's background regarding time of weaning and separation from the mother, apparent nutritional status of the mother during the gestation and lactation period, whether at least one of the parents were coprophagic and what their dogs ate during growth.

For coprophagic dogs' owners only, corrective methods used to control coprophagy were assessed and effectiveness was graded according to the methodology applied by Boze (2008) and products for coprophagia management were adapted to Brazilian context. To make it easier to answer, zero was considered as "not effective", 10 was "effective when applied" (which may not have been a definitive resolution of the problem).

All owners were asked to give their opinion about the general causes of feces ingestion among the options: "nutritional deficiency", "hunger", "behavior disorder", "lack of social interaction", or "inheritance, breed predisposition", allowing them to check more than one option and, when the last option was checked, they were asked about what breed they had in mind.

Answers about coprophagic dogs (G1) were compared to those of non–coprophagic dogs (G2) and evaluated using descriptive statistics, expressed in percentage and absolute values. Variables were categorized in maximum of two categories and analyzed with GraphPad Prism 6.0 software (GraphPad Software Inc., San Diego, California, USA) using the chi-square test and Fisher's exact test for qualitative variables and Tukey's test for quantitative variables. Values of $P < 0.05$ were considered significant.

Results

The group of coprophagic dogs (G1) was composed of 30 dogs with mean age of 5.6 ± 3.4 years. The non–coprophagic dog group (G2) was composed of 40 dogs with mean age 5.9 ± 4.2 years.

Of G1 dogs, 66.7% (n = 20/30) received super premium commercial diet; 13.3% (4/30) received premium commercial diet; 13.3% (n = 4/30) received economy commercial diet; and 6.7% (2/30) received homemade food prescribed by a veterinary nutritionist. In G2, 67.5% (n = 27/40) were given commercial super premium diet; 22.5% (n = 9/40) were given premium commercial diet; and 10.0% (n = 4/40) were given economic commercial diet. There was no difference between commercial food segment (super premium/premium × economic) between groups ($P = 0.59$).

Characteristics of dogs regarding their breed, sex, and reproductive status are presented in Table 1.

Regarding sex, there was no difference between frequency of coprophagia between males (70%; n = 21/30) and females (33.3%; n = 10/30) ($P = 0.06$). There was no difference between neutered and intact dogs of either sex ($P = 0.89$).

Among those with canine or feline cohabitants, coprophagic and non–coprophagic dogs had an average of 2.5 ± 1.4 and 1.2 ± 1.1 individuals, respectively, with no difference between groups ($P = 0.40$).

Regarding the age of weaning, for the owners who had information on age of weaning, 66.7% (n = 20/30) of G1 animals were weaned at 54.6 ± 18.3 days and G2 at 58.1 ± 32.8 days ($P = 0.74$). Furthermore, 96.7% (n = 29/30) of G1 dogs were separated from their mothers at 106.8 ± 70.7 days and 87.5% (n = 35/40) of G2 dogs at 64.9 ± 25.9 days ($P = 0.18$). Two owners (one from each group) did not remember and four owners from G2 also owned the animal's mother, so their dogs were never separated.

The owners were questioned about nutritional status of their dog's mother during gestational and lactational period. However, due to the high frequency of owners who did not have the information, this question was excluded from this study. Likewise, only 13.3% (n = 4/30) of the interviewed G1 owners knew if at least one of the parents were also coprophagic. Of these four owners, 75% (n = 3/4) reported that the parents were and 25% (n = 1/4) reported that the parents were not.

Table 1
Distribution of canine breeds, sex and reproductive status in coprophagic (G1) and non-coprophagic (G2) groups

Characteristics	G1		G2		Total
	n	%	n	%	
Breed					
Beagle	1	3.3	0	0.0	1
Boxer	0	0.0	1	2.5	1
Brazilian terrier	1	3.3	0	0.0	1
Chow chow	0	0.0	1	2.5	1
Dogue de Bordeaux	1	3.3	0	0.0	1
French bulldog	0	0.0	1	2.5	1
German spitz	1	3.3	0	0.0	1
Golden retriever	2	6.7	0	0.0	2
Great Dane	2	6.7	0	0.0	2
Labrador retriever	0	0.0	1	2.5	1
Lhasa apso	0	0.0	2	5.0	2
Maltese	0	0.0	1	2.5	1
Miniature pinscher	2	6.7	4	10.0	6
Mixed breed	6	20.0	14	35.0	20
Pekingese	1	3.3	0	0.0	1
Poodle	1	3.3	1	2.5	2
Pug	0	0.0	1	2.5	1
Samoyed	1	3.3	0	0.0	1
Shih Tzu	9	30.0	9	22.5	18
Wire Fox Terrier	1	3.3	0	0.0	1
Yorkshire Terrier	1	3.3	4	10.0	5
Gender and reproductive status					
Intact female	4	13.3	10	25.0	14
Spayed female	6	20.0	13	32.5	19
Intact male	9	30.0	8	20.0	17
Neutered male	11	36.7	9	22.5	20

G1, coprophagic dog group; G2, non–coprophagic dog group.

Regarding the growth period, 86.7% (n = 26/30) of the G1 animals were fed a commercial diet for puppies and 13.3% (n = 4/30) a commercial diet for adult dogs. In G2, similar results were found, in which, 95.0% (n = 38/40) consumed appropriate food for their life stage and 5.0% (n = 2/40) food for adult dogs. There was no difference between groups for this variable ($P = 0.21$).

The current condition of animals was assessed considering variables regarding habits, environment, and lifestyle and are described in Table 2.

The most applied treatments, in descending order, were to: warn (yelling and chasing the dog away) (80.0%, n = 24/30); prevent access to feces (63.3%, n = 19/30); deworming (53.3%, n = 16/30); distract after defecation (36.7%, n = 11/30); improve environmental enrichment (30.0%, n = 9/30) and ignore the animal's behavior (30.0%, n = 9/30); change the diet (26.7%; n = 8/30); increase physical exercise (26.7%; n = 8/30); give Coprovet (thiamine chloride and capsicum oleoresin extract [Coveli Commerce and Industry Ltda., Duque de Caxias, Rio de Janeiro, BR]) (26.7%; n = 8/30), a Brazilian drug designed to promote taste aversion and thiamine supply to reward good behavior; use alternative medicine (20.0%; n = 6/30) preparations; put pepper on the feces (10.0%; n = 3/30); supply vitamin/mineral (6.7%, n = 2/30); adopt another dog (3.3%, n = 1/30); supply brewer's yeast (3.3%, n = 1/30) and use of Acoprofagia (pancreatin, trypsin, chymotrypsin, and monosodium glutamate [Progado Laboratory, Passo Fundo, Rio Grande do Sul, BR]) (3.3%, n = 1/30), a Brazilian drug designed to promote taste aversion improve digestion process. For this part of the questionnaire, the owner was allowed to answer with multiple answers. Grades attributed for each treatment are illustrated in Figure 1.

For those who switched diet (six owners), two did not remember which diet brand they provided before, two exchanged the brand of the conventional super premium diet and gave a mean efficacy score of 0.5 ± 0.5, and two changed from super premium commercial food to homemade food and received an average efficacy score equal to 7.7 ± 0.7.

Owners' opinions about the reasons related to coprophagic behavior are illustrated in Figure 2. As for the owners who indicated the option "inheritance/breed predisposition" (30%, n = 21/70), all of them mentioned the Shih Tzu breed.

Discussion

Veterinarians and animal scientists are frequently asked about the causes of coprophagia. In this study, a questionnaire was used in an interview with owners of coprophagic dogs and answers were compared to responses from owners of non–coprohagic dogs. One third (32.9%) of interviewed owners attributed some type of nutritional deficiency as causal factor of coprophagy. The only evidence of nutritional deficiency that supports this hypothesis was reported by Read and Harrington (1981), who observed coprophagia in dogs with thiamine deficiency. Those authors argued that the development of such behavior was due to presence of thiamine in dog's feces because thiamine is a product derived from intestinal bacteria. This evidence supports the thought process of supplying thiamine by Coprovet (Coveli Commerce and Industry Ltda., Duque de Caxias, Rio de Janeiro, BR). Only some owners thought that this product worked.

Table 2
Habits, environment, and lifestyle of coprophagic (G1) and non–coprophagic dogs (G2)

Characteristics	G1		G2		*P* value
	n	%	n	%	
Eating behavior					
Ingestion of nonnutritive substances	19	63.3	22	55.0	0.4873
Do not ingest nonnutritive substances	11	36.7	18	45.0	
Number of meals					
Two or fewer meals a day	20	66.7	18	45.0	0.0717
More than two meals a day or ad libitum	10	33.3	22	55.0	
Housing conditions/habits					
Most of the time inside the house	24	80.0	27	67.5	0.2445
Only in the backyard	6	20.0	13	32.5	
Lives with up to two people in the house	11	36.7	17	42.5	0.6220
Lives with more than two people in the house	19	63.3	23	57.5	
Physical activity					
High home physical activity	24	80.0	26	65.0	0.1692
Low home physical activity	6	20.0	14	35.0	
Performs regular outdoor physical activity	13	43.3	18	45.0	0.8895
Does not perform regular outdoor physical activity	17	56.7	22	55.0	
Place destined for evacuation					
Inside the house	9	30.0	12	30.0	1.0000
In the backyard	21	70.0	28	70.0	
Behavior					
Anxious (Score >5)	18	60.0	22	55.0	0.6757
Not anxious (Score ≤5)	12	40.0	18	45.0	
Presence of feline or canine cohabitants					
Has cohabitants	24	80.0	26	65.0	0.1692
Does not have cohabitants	6	20.0	14	35.0	
Cohabitant is coprophagic[a]	11	45.8	13	15.8	0.0302
Cohabitant is not coprophagic[a]	4	54.7	22	84.6	
Time for social interaction and environmental enrichment	11	36.7	22	55.0	0.1284
Spends at least 3 hours a day without human interaction	19	63.3	18	45.0	
Rarely stays without human interaction	23	76.7	34	85.0	0.3749
Has toys	7	23.3	6	15.0	
Does not have toys					

G1, coprophagic dog group; G2, non–coprophagic dog group.
[a] Only assessed among those with dogs as cohabitants.

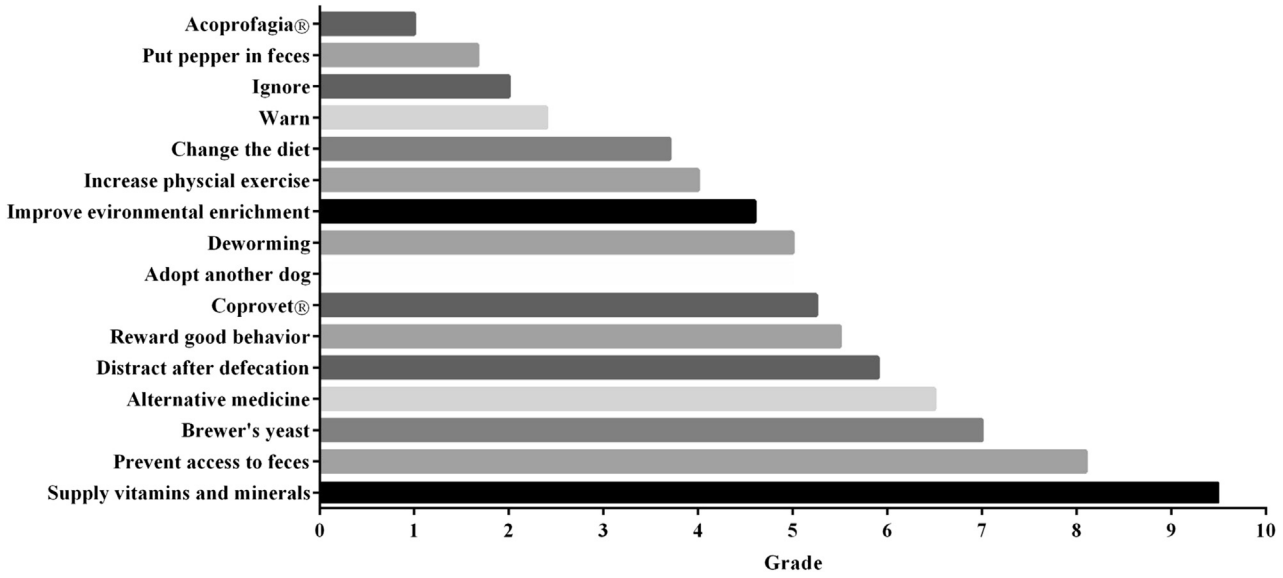

Figure 1. Score of effectiveness of the treatment and/or corrective method applied for coprophagic dogs (G1) according to the owners' perception. 0 = completely ineffective and 10 = completely effective.

Given the availability of complete and balanced commercial diets, such deficiencies have become unlikely for dogs that were fed a commercial diet (Deng and Swanson, 2015).

Thiamine deficiency can be caused by continuous ingestion of raw fish, which has thiaminase, an antinutritional factor capable of degrading thiamine (Deolalkar and Sohonie, 1957). None of the dogs had their thiamine levels assayed and owners were not questioned about ingestion of raw fish, but they did not reported ingestion of any raw food during the conversation. None of the dogs had been diagnosed with any chronic condition that may have lead to nutrient deficiency such as endocrine pancreatic insufficiency or intestinal malabsorption, so this possibility remains unlikely.

The majority of dogs in this study received complete, balanced, and super premium commercial foods. Furthermore, most of the coprophagic animals were fed adequate food for each stage of life, which makes nutritional deficiencies unlikely. Information about the fetal and neonatal period could not be obtained because the majority of the owners (98%; n = 69/70) did not know the nutritional conditions of the dams during pregnancy and lactation.

An online questionnaire applied by Hart et al. (2018), indicated that the variable most related to coprophagy was the food habit because 51.1% of the animals considered greedy eaters were coprophagic compared to 28.2% of non–coprophagic dogs with the same behavior. This topic has not been addressed in the present study, although this association could justify the fact that the exchange of dry food for home-prepared diet was interpreted by owners as an effective method to minimize coprophagic behavior

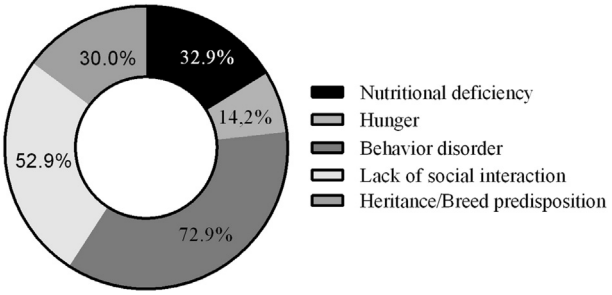

Figure 2. Interviewees' opinion about the reasons related to the eating-feces behavior.

since the latter, due to its high moisture content (60%-80%), consists of larger amounts of food with same energy intake, which may favor a greater gastric filling and increase satiety. However, studies have demonstrated that dogs can compensate for energy consumption when diets' energy density is diluted, so gastric filling does not seem to be of major importance for satiety promotion (Alexander et al., 2017; Janowitz and Grossman, 1949). In this study, the number of animals eating home-prepared diets was small.

Animals receiving vitamin/mineral supplementation and brewer's yeast were the same individuals as those that received home-prepared diets, as these supplements were part of the homemade diet composition to meet dietary recommendations. There was no additional supply of vitamins and minerals when compared to dry food.

Thirty percent of owners believed that coprophagia may be a common behavior attributed to breed and all mentioned Shih Tzu; however, the needed genetic studies are lacking. Studies with chimpanzees have shown that those raised by their own mothers had more coprophagic and self-depilation behavior than those raised by humans (Nash et al., 1999).

Unfortunately, during the interviews, the majority of the owners did not know if at least one of the parents of the G1 were coprophagic. Although, G1 had more coprophagic cohabitants than G2 dogs so this supports a hypothesis that coprophagy may be learned with animals sharing facilities. Thus, we cannot separate genetic effects from those of the social environment on the development of coprophagy.

Studies in a number of species have raised the possibility of heritability of eating habits, and preferences for early fetal exposure flavors derived from the maternal diet (Bilko et al., 1994; Galton, 2016; Nicolaïdis, 2008; Oostindjer et al., 2009; Pedersen & Blass, 1982; Schaal et al., 1998). Therefore, the possibility that puppies of coprophagic mothers have preference for these flavors is plausible, but the reasons that lead them to perpetuate this behavior are still unknown.

Another aspect for consideration is breed-associated risk for behavior problems, as it may be associated with the breed prevalence and popularity in the area (Reisner et al., 2005; Svartberg, 2006). Statistics from the Brazilian Cynophilia Confederation (CBKC) reveals that Shih Tzu ranks third in number of dogs registered in 2017, so it is a popular breed in Brazil and could lead to

popular sire effects (CBKC, 2017). In addition, this also creates the possibility of selecting for undesirable behaviors and popular sire effects (Overall et al., 2014), and future studies focused on any breed predisposition for coprophagia must take these factors into consideration.

Beyond inheritance and learning, other aspects may also play a role in development of coprophagic behavior, like sex. Col et al. (2016) described, in an Australian epidemiologic study, that male dogs were in greater risk than females for a number of behavior problems, including coprophagia. Our sample size was small, so unless there was a large effect it would not have been detected.

Behavioral disturbances are also more frequent in cases where puppies are weaned earlier (Latham and Mason, 2008), but we did not find differences in time of weaning in the groups.

Some authors note that boredom could be a predisposing cause of coprophagia (Hart et al., 1985; Loveridge, 1998). Nevertheless, if we define boredom as a lack of ability to play or exercise, in this study there were no differences between the groups regarding the availability of toys, indoor or outdoor physical exercise, and anxiety.

One of the objectives of this study was to evaluate owners' perceptions about methods to extinguish or decrease coprophagy. The method applied most often was "to warn" (80% of the cases) and it was also considered as one of the least effective, with a mean effectiveness score of 2.4 $\pm$ 2.8. In addition to being inefficient, excessive punishment for undesirable behavior involving feces (inadequate place or coprophagy) may induce the coprophagic habit to avoid punishment (Meyer et al., 2014). According to Boze (2008), preventing access to feces and distracting animals after defecation appeared to be effective methods. Rewarding good behavior was also considered efficient as well, as was the use of alternative medicine and Coprovet (Coveli Commerce and Industry Ltda., Duque de Caxias, Rio de Janeiro, BR).

Evaluation of objective variables such as presence of coprophagic behavior, number of meals, and presence of cohabitant revealed differences between G1 and G2. However, variables that required owner's perception and interpretation such as anxiety, indoor exercise, and grade of effectiveness were not found to differ between groups. From the author's point of view, the absence of differences may reflect the subjective nature of the questions and, therefore, a limitation of this study. Future studies should rely on acquiring more objective answers and not rely on owners' perceptions.

Conclusion

Coprophagy does not appear to be related to environment, lifestyle, physical activity, anxiety, type of food, nutritional status, or reproductive status. Coprophagic behavior may be influenced by the presence of a coprophagic cohabitant.

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Authors' contributions: The idea for the article was conceived by Marcio Antonio Brunetto. The study was designed by Andressa Rodrigues Amaral and performed by Andressa Rodrigues Amaral, Priscila Oliveira Martins, and Henrique Tobaro Macedo. The data were analyzed by Andressa Rodrigues Amaral. The article was written by Andressa Rodrigues Amaral, with guidance from Mariana Yukari Hayasaki Porsani, Fabio Alves Teixeira, Henrique Tobaro Macedo, Thiago Henrique Annibale Vendramini, Vivian Pedrinelli, and Marcio Antonio Brunetto.

Ethical considerations

This study was approved by the Human Research Ethics Committee (protocol number 2.547.833) of the College of Animal Science and Food Engineering, University of São Paulo.

Conflict of interest

The authors declare no conflict of interest.

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