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Clinical Signs of Hairballs in Cats Fed a Diet Enriched with Cellulose

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Abstract: Problem statement: The intake of cellulose may delay gastric emptying and raise the intestinal transit rate. These effects could antagonize hairball formation. Thus, it was hypothesized that a diet enriched with a cellulose preparation (Arbocel BWW40®), forming a completely insoluble fiber network, would diminish the severity of clinical symptoms of hairballs in cats. **Approach:** In a double-blind, placebo-controlled trial with parallel design, 24 privately owned cats were used and the clinical signs were evaluated by the owners. For a period of four weeks, the cats (n = 12 per treatment group) consumed a complete dry food without or with 4% (w/w) cellulose. During the test period, the control or test diet was the only source of nutrition. The trial questionnaire was in the form of a booklet in which each day the occurrence of hairball symptoms (vomiting, retching and coughing) were recorded by the owners. **Results:** When compared with the control diet, the feeding of the diet with added cellulose lowered the total incidence of vomiting, retching and coughing by 79, 91 and 70%, respectively. The cellulose-induced decrease in vomiting was statistically significant. It is suggested that cellulose ingestion had caused delayed gastric emptying, leading to binding of single strands of hair to food particles so that more hair is transferred into the duodenum. The cellulose-mediated increase in transit rate of digesta may subsequently promote the excretion of hairs with the feces. **Conclusion:** This study shows that a diet fortified with cellulose reduced the severity of clinical signs in cats with existing hairballs, but the diet may also be effective in the prevention of hairball development.

Key words: Hairballs in cats, treatment group, cellulose ingestion, clinical signs, double-blind, gastric emptying, transit rate, hairball development, abdominal pain, health problems, nutrient absorption, dry food

INTRODUCTION

The normal grooming activity in cats leads to hair ingestion. Together with the digesta, the swallowed hair can be moved by peristalsis and subsequently be voided with the feces (Malik, 2003). Frequently, the hair may conglomerate into solid masses in the stomach or intestine, thus causing the formation of hairballs (trichobezoars). The risk of hairball development in cats is increased by longer, thicker coats and by fastidious grooming behavior (Ryan and Wolfer, 1978; Barrs *et al*., 1999).

Cats get rid of gastric hairballs through retching until vomiting from the stomach or by passing them into the intestinal tract followed by excretion with the feces (Malik, 2003). The clinical signs of hairballs are vomiting, retching and/or coughing (Barrs *et al*., 1999). Occasionally, the aggregates of hair cause obstruction of the intestines, which is associated with severe clinical signs such as abdominal pain and anorexia (Barrs *et al*., 1999; Agnello and Kantrowitz, 2003).

In severe cases, treatment of trichobezoars requires removal by surgery or endoscopy (MacPhail, 2002; Durocher *et al*., 2009). Hairballs generally do not induce severe health problems. Nevertheless, many cat owners wish to prevent hairball formation because they are annoyed by the signs of vomiting, retching and coughing. The treatment of the clinical signs of feline hairballs often involves the use of laxatives and lubricants (Ryan and Wolfer, 1978; Barrs *et al*., 1999; Agnello and Kantrowitz, 2003). However, such treatment may interfere with normal digestion and nutrient absorption.

It has been shown that ingestion of a chew containing psyllium husk reduced the severity of hairball symptoms in cats (Dann *et al*., 2004). Psyllium husk is a source of gel-forming, fermentable fiber. The ingestion of such type of fiber may increase the

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frequency and strength of intestinal motility, but delays gastric emptying and leaves gastric motor activity unchanged (Xu *et al*., 2005). Possibly, psyllium promotes the binding of hair to food particles and thereby increases the quantitative transfer of gastric hair into the duodenum followed by enhanced passage through the intestine.

The Arbocel BWW40® preparation of cellulose (J. Rettenmaier and Söhne GmbH + Co KG, Rosenberg, Germany) is a natural, highly purified product, forming a completely insoluble fiber network. This cellulose-based fiber is made by a special technique to achieve a very fine and defined particle structure. The so-called fibrillation technique produces fibers with high capillary effect and surface activity. We have shown earlier that a chew containing this cellulose preparation has a beneficial influence on canine periodontal disease (Beynen *et al*., 2010). We now hypothesized that the addition of fibrillated cellulose to cat food would promote the transfer of gastric hair into the duodenum and then enhance its passage through the intestine. In dogs, the intake of cellulose delays gastric emptying (Malagelada *et al*., 1980) and raises the intestinal transit rate (Burrows *et al*., 1982), both observations pointing at an analogy with the above-mentioned psyllium. This study addresses the efficacy of Arbocel BWW40® in the treatment of feline hairball symptoms. In a double-blind, placebo-controlled trial, privately owned cats were used and the clinical signs were evaluated by the owners. For a period of four weeks, the cats consumed a complete dry food without or with 4% (w/w) Arbocel BWW40®.

MATERIALS AND METHODS

Animals: Cats with clinical signs of hairballs were recruited through the websites of breed associations and newsletters of veterinarians. The (potential) participants were informed about the purpose and design of the trial and had to sign a statement on informed consent. Fifty eight cats were subjected to either the placebo or test group. Twenty cats did not finish the trial because they did not accept the control or test food or because of poor feces consistency. One cat died during the trial. For 13 cats, the data were incomplete and could not be used. Thus, the data for 24 cats (12 control and 12 test cats) were suitable for analysis.

Experimental design: Recruitment of the cats, maintaining contact with the cat owners, supplying of food, data collection and general coordination of the trial was done by JM who was blinded to treatment modality. The eligible cats were allocated to either the placebo or treatment group by DJHS, who kept the treatment code closed until statistical analysis of the data.

All cats were fed on a complete dry food, which was supplied in 15 kg, blank packaging. The control diet was based on a standard commercial cat food (Vobra Special Petfoods BV, Veghel, The Netherlands). To formulate the test diet, 4% of the corn component of the control diet was replaced by the same amount of Arbocel BWW40®. The control diet contained no added cellulose and had the following calculated composition: crude protein, 28.5%; crude fat, 12.0%; crude fiber, 1.8%; crude ash, 5.1%, moisture, 10.0%. The calculated composition of the test diet was as follows: crude protein, 28.2%; crude fat, 12.0%; crude fiber, 5.5%; crude ash, 5.0%, moisture, 10.0%. The foods were sent by courier to the cat owners. The entire trial lasted six weeks. The first two weeks served as a baseline. During the second week, the cats were gradually transferred from their habitual diet to the experimental diets. As from the third week, the control or test food was fed for another four weeks.

Trial questionnaire: The trial questionnaire was in the form of a booklet, which also provided instructions. The booklet was sent to the cat owners together with the food. The severity of hairball symptoms at baseline and during the trial were assessed in different ways. The baseline symptoms were quantified in the form of a severity score, whereas the symptoms during the trial were measured as daily frequency.

The baseline degree of the clinical signs of hairballs was scored by the owners by signing a cross on a horizontal line. The line was without any unit, but functioned as a scale in combination with the description. The line had a length of 100 mm. The owners scored the extent and/or severity of the following signs: vomiting, retching and coughing. The signs were scored on day 0 (start) and at the end of the first week during which the habitual diet was continued to be fed.

To aid in scoring the signs, the following descriptions were given. *Degree of vomiting.* "Cats vomit to get rid of the loose hairs that they swallow during their daily activity of grooming. The loose hairs may aggregate in the stomach and form a solid mass or hairball. This ball has become elongated when vomited. If a cat is vomiting, aggregated hair is bothering and has to be expelled. If your cat is vomiting, you do not necessarily have to observe a hairball." How often does your cat vomit? The scale ran, from "Often" (extreme left) to "Not" (extreme right). *Degree of retching.* "Cats that retch often are bothered by hairballs as is the case when vomiting. However, it is possible that your cat is

vomiting less often, but has to retch more frequently" How often does your cat retch? The scale ran, from "Often" (extreme left) to "Not" (extreme right). *Degree of coughing*. "Coughing occurs frequently in cats with hairball problems. There are diseases leading to quite some coughing, like asthma. If your cat is coughing and stretching its neck at the same time, this often points at a hairball." How often does your cat cough? The scale ran from "Often" (extreme left) to "Not" (extreme right).

From the beginning of the second week until the end of the trial, the cat owners recorded the number of times that they observed vomiting, retching and/or coughing on a daily basis. The frequency recording was done in predesigned columns in the booklet. There were 28 columns, the number being equivalent to the 28-days duration of the test period. Each column consisted of three lines, in which the frequencies of vomiting, retching and coughing were recorded. Prior to the trial, the owners were asked to write down the calendar dates on top of each column.

Data analysis: After scoring by the owner of the clinical signs in the booklet, the crosses on the lines were expressed as mm distance from the extreme left. Thus, the extreme left was identical to 0 mm and the extreme right to 100 mm. The values are reported here without unit. To calculate the baselines, the values for day 0 and week 1 were averaged per variable per cat. The frequencies of vomiting, retching and coughing during the test period were expressed as total number of events per treatment group per 28 days. To identify significant differences between the placebo and test group, the frequency values of individual cats were subjected to the Wilcoxon Signed-Rank test. One-tailed $p<0.05$ was preset as criterion of statistical significance.

RESULTS

Table 1 shows that the distributions of age, body weight and gender were similar for the placebo and test group. The number of cats with short, medium or long hair was also similar for the two groups. The control group consisted of one Oriental Shorthair, one Norwegian Forest cat, one Ragdoll, two Birmans and 7 Maine Coons. The test group comprised three European Shorthairs and 9 Birmans. The baseline values for the mean scores of coughing were identical for the test and placebo group, but the scores for vomiting and retching were on average lower for the control cats.

Figure 1 shows the total number of times that vomiting, retching and coughing were observed by the owners. The data represent the cumulative number of clinical signs for the two groups, i.e., the total number of signs in all cats during the whole test period.

Table 1: General characteristics of the cats

Characteristic	Control diet (n = 12)	Test diet (n = 12)
Mean age, years (range)	4.4 (0.6-10.9)	5.4 (1.5-13.0)
Mean body weight, kg (range)	4.8 (3.0-8.0)	4.2 (2.4-6.0)
Gender, female/male	9/3	7/5
Hair length, short/medium/long	2/6/4	3/7/2
Mean vomiting score (range)	71 (33-96)	86 (25-100)
Mean retching score (range)	74 (33- 97)	94 (68-100)
Mean coughing score (range)	85 (58-100)	85 (17-100)

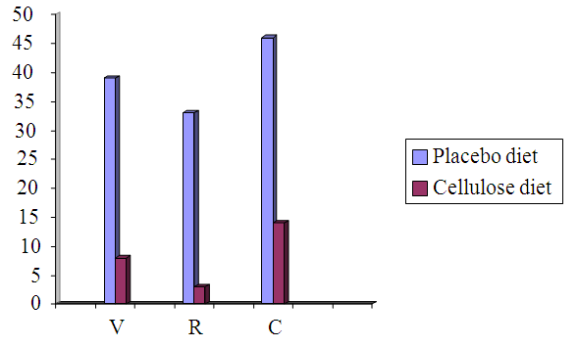

Fig. 1: Hairball symptoms during the experimental period for the cats fed either the placebo diet without (n = 12) or the test diet with cellulose (n = 12). The data are expressed as the cumulative number of times of Vomiting (V), Retching (R) or Coughing (C) for the two whole groups of cats during the entire 28 days experimental period

In the cats fed the diet with cellulose, the total number of clinical signs was markedly lower than in their counterparts fed the control diet. The one-tailed P values for the differences between the two groups were 0.027 for vomiting, 0.070 for retching and 0.486 for coughing. The cellulose diet had induced a statistically significant lowering of the incidence of vomiting.

DISCUSSION

This study shows that the feeding of a diet with added cellulose lowers the frequency of hairball symptoms in cats. The diet fortified with cellulose lowered the incidence of vomiting, retching and coughing by 79, 91 and 70%, respectively, when compared with the control diet. The cellulose-induced decrease in vomiting was statistically significant. Thus, the Arbocel BWW40® cellulose preparation may be an effective functional, dietary ingredient in the management of hairball symptoms in cats.

The mechanism by which the ingestion of cellulose depresses the clinical signs of hairballs in cats is not known. In dogs, it has been shown that the feeding of cellulose reduces gastric emptying (Malagelada *et al*.,

1980) and enhances the intestinal transit rate of digesta (Burrows *et al*., 1982). It could be suggested that delayed gastric emptying leads to binding of single strands of hair to food particles so that more hair is transferred into the duodenum and gastric hairballs are less easily formed. The cellulose-induced increase in transit rate of digesta may further promote the excretion of hairs with the feces.

Dann *et al*. (2004) reported that the intake of a chew containing psyllium husks and slippery elm, instead of a placebo chew, significantly reduced hairball symptoms in cats. The total number of vomiting, retching and coughing was lowered by 24, 35 and 28%, respectively. It would thus seem that the diet containing cellulose used in this study was more effective than the chew containing psyllium husk used by Dann *et al*. (2004). This idea is supported by the fact that the cats in this study and those in the study of Dann *et al*. (2004) had similar severity of hairball symptoms and thus may be considered comparable. The average daily occurrence of vomiting, retching and coughing in the control group of this study was 0.15, 0.13 and 0.17 events per cat. For the control cats in the study of Dann *et al*. (2004), the values were 0.15, 0.09 and 0.10.

This study has a parallel design so that similarity of the two treatment groups is crucial for non-biased comparison of the treatment effects. The characteristics of the groups, such as the distributions of age, body weight, gender and hair length, were similar. The mean baseline scores for coughing were identical for the two groups. However, the mean baseline scores for vomiting and retching were 71 and 74 for the control group and 86 and 94 for the test group. The scores are on a scale from 0-100, the score of 100 being equivalent to the absence of clinical signs. Thus, the test cats had less severe signs of vomiting and retching than did the control cats. This implies that the observed beneficial effect of the diet with cellulose is underestimated rather than overestimated. Treatment effects generally are smaller in patients with less severe symptoms.

CONCLUSION

In conclusion, this double-blind, placebo-controlled study shows that a diet fortified with 4% cellulose markedly reduced the clinical signs of hairballs in cats, the reduction in vomiting being statistically significant. The observed effect may be considered of practical relevance. In cats with a vomiting incidence of five times per five weeks, the cellulose-containing diet would lower the incidence to once every five weeks. This study involved dietary treatment of cats with existing hairball symptoms. However, it is likely that a diet with added cellulose also is effective in the prevention of hairballs, which would be beneficial for cats with increased risk of hairball development.

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