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Research Article

Effectiveness of Palatable Dental Bites Developed for Cats to Prevent Plaque and Calculus Accumulation

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Abstract

Introduction: Preventing dental plaque and calculus accumulation is as important in pets as it is in humans and can help prevent the occurrence of more serious diseases. On top of professional descaling, using dental products at home, like dental bites or chews, is an important part of the dental care program.

Objective: A new bite-shaped co-extrusion dental product containing pomegranate, sodium hexametaphosphate and fish oil was assessed for its effectiveness to prevent plaque and calculus accumulation in cats.

Methods: Fifty cats were selected, their teeth were scaled and polished (Day-7) and plaque buildup was evaluated after 7 days (pre-test). On day 0, the cats had their teeth scaled and polished again and were then allocated to two groups, randomly and evenly in terms of number and plaque score obtained during the pre-test: one group received the control diet only and the other one received the same diet plus 3 test dental bites every day for 1 month. The accumulation of dental plaque and calculus and the gingivitis were then scored on D28 in a blinded manner. Body weight, food and bites consumptions and general health of the cats were also assessed and recorded regularly. Student's t-tests were used to compare the scores between groups on Day 28. Differences in scores were considered statistically significant for a $p < 0.05$.

Results: The 3 bites were completely consumed by cats 99,9% of the time. No clinical sign in relation to product administration was reported and the body weight and food consumption were not impacted by the product. A significant decrease of the calculus score was observed in the test group as compared to the control group (24%, $p < 0.05$), with a higher decrease observed on the left side of the mouth than on the right side (29% *vs.* 18%). The mean plaque score also decreased (10%) and the difference with the control group was significant only for the left side of the mouth (12%, $p < 0.05$).

Conclusion: Results indicated that when 3 dental bites were fed per day to cats over a 28-day period, a significant reduction in calculus accumulation and to a lower extent, plaque accumulation was observed. The study also confirmed the very good acceptability and tolerance of these bites by the cat. This home dental product for cats can therefore be recommended by veterinarians and used by cat owners with confidence.

Keywords: *Dental Bites; Cats; Plaque; Calculus; Tartar; Dental Care*

Abbreviations

PD: Periodontal Disease; MGI: Modified Gingival Index; SD: Standard Deviation; SHMP: Sodium Hexametaphosphate

Introduction

The prevalence of periodontal disease (PD) in the general feline population is hard to estimate since a proper diagnosis requires a general anesthesia. The prevalence found in different studies varies according to the type of cats studied (healthy or with oral issues), methods used (like anesthesia and radiography) and levels of disease (from gingivitis to severe periodontal disease) [1]. The real prevalence is certainly underestimated but, according to specialised veterinary dentists, by two years of age, 70% of cats have some form of periodontal disease [2]. However, despite its high prevalence, this disease is still underdiagnosed.

Periodontal disease is a painful disease that can trigger more serious diseases, either locally or generally, when bacteria enter into the bloodstream, and can alter the quality of life of the animal, its behavior and general health [2,3].

Periodontal disease usually starts with the formation of plaque, a biofilm of bacteria that can mineralise to form tartar (or calculus) and be a source of halitosis. When plaque spreads and goes under the gingiva, it can lead to gingivitis and ultimately to periodontal disease, with a loss of periodontal attachment and eventually tooth loss [1,2].

The host response to bacterial byproducts plays an important part in the inflammation and tissue damages, and dictates whether the gingivitis will resolve, stabilise or evolve into chronic inflammation [1].

An abnormal inflammatory response for example, initiated by the plaque biofilm and associated with other factors (genetic and environmental, including viral infections) can lead to chronic inflammation like Feline chronic gingivitis/stomatitis [4].

Therefore, preventing plaque and calculus accumulation is key to preserve cats from more serious diseases. Combining regular visits at the veterinary clinic for descaling and follow-up, together with homecare, is ideal to prevent plaque and tartar accumulation. The gold standard for home dental care remains tooth brushing, but its performance on a daily basis remains a real challenge in cats, which considerably limits proper achievement of compliance. Other options exist to help prevent plaque or tartar accumulation at home like water additives, rinses or dental food, chews, treats or bites designed for dental care. Chewing can indeed help remove plaque and tartar through a mechanical action. Chewing also stimulates saliva production that helps to detach deposits and flush away debris [5].

However, cats can be fussy when it comes to food or treats acceptability and the calorie content or tolerance of certain treats, especially when given in the recommended quantity for effective dental activity, can be a real concern.

With these limits in mind, low fat and palatable dental bites, containing pomegranate, sodium hexametaphosphate and fish oil, were developed to help pet owners take care of their cats' teeth while keeping their animal in good health and shape. The objective for the development was to achieve significant efficacy on dental deposit accumulation giving only 3 bites per day, representing a few calories (< 8 kcal/day).

Aim of the Study

The aim of the study was to evaluate the efficacy of these dental bites to reduce plaque and calculus accumulation in cats. This study was performed in an independent facility in a randomized, blinded manner, with a control group of 25 cats receiving no bites and another even group receiving 3 bites of the test product per day for 28 days. The cats teeth were scaled and polished on Day 0, and plaque and calculus accumulation was evaluated on Day 28 and compared between the groups.

Materials and Methods

Animals

Fifty Domestic short-hair cats (25 per group), aged from 3 to 10 years, from a facility's general cat population (Summit Ridge Farms, Susquehanna, PA, USA) were used for this study. Groupings were determined by stratifying the animals according to their plaque scores obtained on Day 0 and assigning animals with similar plaque scores to each of the study groups, in order to reduce inter-group variability.

An equal number of cats were assigned to each study group. Animals were in apparent good health at the time of selection for inclusion. Before study initiation, all cats underwent an oral cavity examination to check normal occlusion and the presence of all teeth required for scoring. Cats showing any complete furcation defects in any test teeth were not included.

The protocol and amendment for this study were reviewed and approved prior to implementation by the Summit Ridge Farms' Institutional Animal Care and Use Committee and were in compliance with the Animal Welfare Act.

Design

Pre-Test: A pre-test phase of seven (7) days was conducted before the trial period. During that pre-test phase, the cats selected for inclusion were weighed and fed Purina Cat Chow, the control diet, a kibble dry feed. Each animal had its teeth scaled and polished upon initiation of the pre-test phase (Day-7). After this procedure a disclosing agent (2% Eosin) was used to ensure there was no remaining plaque or calculus buildup and a clean mouth had been established. On Day 0 of the trial, plaque and gingivitis were evaluated. The scores obtained were indicative of the plaque buildup rate for each animal being fed the control diet only. The animals were then stratified into two groups based on plaque scores.

Following the dental scoring on Day 0, each animal had a dental cleaning and polishing procedure and a disclosing agent was used again to ensure a clean mouth at the start of the study.

Test phase: From day 1 to day 27 onwards, all cats assigned to the control group were fed the control kibble dry feed only. Cats assigned to the test group were offered the same control diet and 3 pieces of the test item as recommended. The bites were offered for a minimum of one hour, 2 hours after the diet was removed. On Day 28, the cats were presented randomly to the investigators who were blinded to study groups and each animal received gingivitis, plaque and calculus evaluations.

Test product

The test product is a dental bite designed for cats (C.E.T® Intellident™ Cat Bites, Virbac) containing chicken meal, brown rice, yellow corn flour, corn gluten meal, gelatin, natural flavor, glycerin, fish meal, powdered cellulose, salmon oil, sodium hexametaphosphate, phosphoric acid, poultry fat, salt, calcium sulfate, brewers dried yeast, pomegranate, red iron oxide and vinegar. It has a low fat content (7%) and a low calory content (3075.92 kcal/kg or 2.61 kcal/bite, corresponding to 7.8 kcal per day with 3 bites).

Procedures

Examinations and measurements: A complete physical examination was performed before the start of the study and all cats had blood collected for serum chemistry and cell blood count analysis. During the study, animals were observed twice daily and the food and bites consumptions were measured daily. Body weight was measured weekly. For dental scoring and/or cleaning procedures on Days-7, 0 and 28, each animal was mask induced with the inhalation of 5% isoflurane in 100% oxygen. Once the cat was anesthetized it was intubated and anesthesia was maintained by inhalation of isoflurane (2% - 3%) in 100% oxygen.

Scoring: Gingivitis was evaluated first and then calculus accumulation was scored prior to applying the disclosing agent for plaque evaluation. Teeth examination included the buccal surfaces and both sides of the mouth. The examination was limited to seven teeth: in the upper jaw - canine (C), premolar 3 (P3), premolar 4 (P4); in the lower jaw - canine (C), premolar 3 (P3), premolar 4 (P4), molar 1 (M1). The whole teeth surface was scored for plaque and calculus except for the canine teeth (only the gingival half was scored).

Gingivitis was evaluated by a modified gingival index (MGI) as follows: 0: no inflammation; 1: mild inflammation with no bleeding on probing; 2: mild inflammation with bleeding on probing within 30 seconds; 3: moderate inflammation with immediate bleeding on probing and 4: severe inflammation with spontaneous bleeding, congestion or ulceration.

Calculus coverage was scored quantitatively on the whole buccal surface of the crown from 0: no coverage to 4: 75 - 100% coverage.

Plaque extent and thickness were determined using a disclosing agent. Each tooth was given a score for the percentage of the coronal surface covered with plaque (from 0: no coverage to 4: 75 - 100% coverage) and the thickness of plaque (from 1: light to 3: heavy). The score for each tooth was calculated by multiplying the coverage and thickness scores.

For the 3 dental parameters assessed, each tooth was assigned a numerical score and the sums of the teeth scores were averaged to obtain a whole mouth mean score as well as a mean score for the left and right sides of the mouth.

Statistical analysis

Results were compared between groups on D28 using Student's t-tests. Data were considered significantly different between the groups for a p value < 0,05. Data are expressed as mean ± SD and the percentage reduction in the test group as compared to the control group is also provided.

Results

General parameters

All cats in the test group ate the 3 bites every day during the 27 day-administration period, except for 1 cat that did not eat the bites on 1 occasion only (99,9% full consumption during the entire study).

Giving 3 bites per day to cats had no impact on food consumption (Figure 1) or weight gain (Figure 2) since the evolution of these parameters were similar between groups. Furthermore, no clinical signs associated with the bites administration were observed.

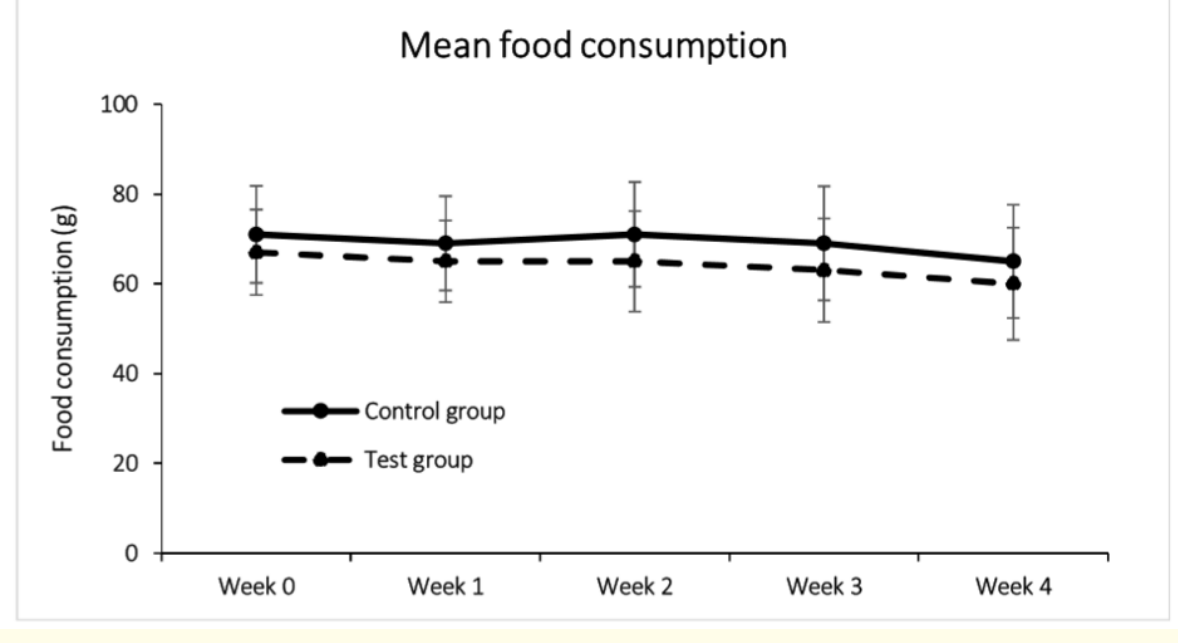

Figure 1: *Mean food consumption evolution during the study. Food consumption was recorded daily and averaged weekly for each animal. Means and standard deviations (error bars) are represented for the control group (plain line) and test group (dashed line). The evolution of food consumption was similar in both groups.*

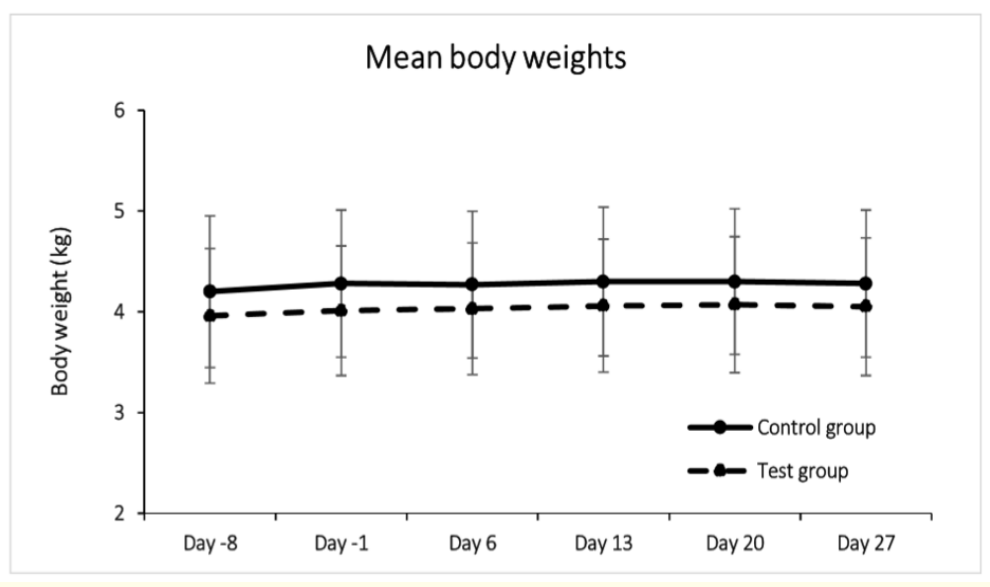

Figure 2: *Mean body weights evolution during the study. Body weights were recorded weekly for each animal. Means and standard deviations (error bars) are represented for the control group (plain line) and test group (dashed line). The evolution of body weights was similar in both groups.*

Dental scoring

There was no significant difference between the groups concerning the mean mouth gingivitis score (MGI) on D28 (0.5 ± 0.93 vs. 0.3 ± 0.37 in the test and control group, respectively).

The test group had a reduction of 10% in the mean mouth plaque score when compared to the score of control cats, but this reduction was not statistically significant. However, when comparing groups for each side of the mouth, a significant reduction was observed on the left side of the mouth of cats in the test group (12% reduction, $p < 0,05$, Table 1).

	Plaque			Calculus		
	Mean left side	**Mean right side**	**Mean mouth**	**Mean left side**	**Mean right side**	**Mean mouth**
Control group	4 ± 0.83	4 ± 0.93	4 ± 0.82	0.8 ± 0.3	0.8 ± 0.3	0.8 ± 0.3
Test group (3 bites per day)	3.5 ± 0.94	3.6 ± 0.94	3.6 ± 0.84	0.5 ± 0.3	0.6 ± 0.3	0.6 ± 0.2
% reduction	12%*	8%	10%	29%*	18%	24%*

Table 1: *Mean plaque and calculus scores calculated in each group, on each side of the mouth and for the total mouth. Data are presented as mean ± SD. The percentage of reduction in the test group compared to the control group is also given (% reduction)*

A 24% reduction in the mean mouth calculus value was also observed in the test group compared to the control group and this reduction was statistically significant ($p < 0,05$, Table 1). When comparing groups for each side of the mouth, a significant reduction was observed on the left side (29%, $p < 0.05$) but not on the right side (18%, NS).

Altogether, these data show that giving 3 test dental bites per day can significantly reduce calculus accumulation and suggest a significant effect on plaque accumulation as well, though this last parameter was only significant on the left side of the mouth.

Discussion

The aim of the study was to evaluate the efficacy of newly developed dental bites for cats (C.E.T® Intellident™ cat bites, Virbac) to reduce dental plaque and calculus accumulation. However, the study also indirectly assessed the acceptability of these bites and their general tolerance.

Helping pet owners to prevent plaque and calculus accumulation at home, in complement of a professional dental scaling, has been an area of development for years. Finding efficient products for cats especially, who do not accept tooth brushing so easily and who are particularly fussy with food and treats, have been a real challenge. For compliance and to keep a good relationship with the cat, the palatability of the treats or bites developed are therefore of great importance. In this study, all 25 cats provided with 3 bites per day accepted to eat them every day, confirming the good acceptability of the product.

This study also showed the good tolerance of the dental bites since no clinical signs associated with the product administration were observed. Furthermore, cats' weight and their food consumption in the test group remained stable throughout the study and were similar to those obtained in the control group. This could be related to the limited amount of calories provided by the 3 test bites given every day over the 28-day period. Such data can provide confidence in the use of these newly developed dental bites for cats in terms of tolerance and calorie intake when used according to manufacturer directions.

The effectiveness of the bites to help reduce plaque and tartar accumulation was assessed following a protocol recommended by veterinary dental specialists (Veterinary Oral Health Council - see http://www.vohc.org/vohc_council.html for more information). Indeed, the teeth of all cats were scaled and polished on Day 0 and the cats were then randomly allocated in two groups, one receiving the control diet only and the other one receiving the same diet plus 3 test bites per day. The accumulation of dental plaque and calculus was then scored on D28 by an evaluator blinded to the study groups. The results showed that calculus accumulation was significantly decreased (by 24%) in the test group compared to the control group. Plaque accumulation also seemed to be decreased but the difference with the control group was significant only for the left side of the mouth. These discrepancies between the right and left side of the mouth, which was also present with the calculus scoring, might suggest that the cats receiving the product ate the bites preferentially on the left side of the mouth, hence a better mechanical removal of calculus deposit on the left side compared to the right side. It is possible that with a higher number of cats per group or if tested in other cats, such discrepancies may not have existed.

The effectiveness observed on tartar accumulation may not be due only to the mechanical action but also to the presence of sodium hexametaphosphate (SHMP) in the dental bites. This compound is a calcium chelator that forms soluble complexes with cations like calcium, thus decreasing the amount available for forming calculus. SHMP has been shown to significantly decrease calculus formation in dogs when coated onto dry dog food, chows or biscuits [6]. Pomegranate may also have played a role in preventing dental deposits as seen in other species [7].

These results are reassuring in terms of acceptability, tolerance, calorie intake and efficacy of these newly developed feline dental bites. It should be kept in mind, though, that chews or bites alone may not be as efficient as regular tooth brushing (especially on rostral teeth where the chewing does not occur) and certainly not as efficient as regular professional teeth cleaning [2]. Giving bites to cats that are well accepted and tolerated is however a good way to help prevent tartar formation between visits to the veterinarian when tooth brushing at home is not possible or not as often as would be needed.

Conclusion

The test dental bites (C.E.T® Intellident™ Cat Bites, Virbac) have been developed in order to help prevent dental deposits while being palatable, safe and with a low calorie content. The study presented here confirmed the effectiveness of these bites to significantly reduce

calculus accumulation and, to a lower extent, plaque accumulation with only 3 bites per day. The study also confirmed their very good acceptability and tolerance. These cat dental bites can therefore be recommended by veterinarians and used by cat owners with confidence.

Conflict of Interest

All authors are Virbac employees and the study was financed by Virbac.

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