Soft Rawhide Reduces Calculus Formation in Dogs
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Summary:
This clinical investigation was conducted to evaluate the impact of a unique soft rawhide product on the formation of dental calculus in a housed colony of beagle dogs. The study was designed as a 2-way crossover test with 4-week test periods and a 1-week wash-out period between the test periods. All dogs were provided a dry commercial diet and tap water ad libitum. The dogs were stratified into two groups of matched pairs on the basis of their calculus and plaque formation rates. Each test period was initiated immediately following a complete supragingival scaling and crown polishing and the dogs in the test group received a soft rawhide treat about 4-hours after their normal feeding. Examinations were performed about 20 to 24-hours after the last feeding by an experienced clinical examiner using conventional indices. The data indicated that once daily feeding of the soft rawhide chew product resulted in statistically significant reductions in the formation of dental calculus (28.0 %), dental plaque (19.0 %), and gingivitis (46.0 %). J Vet Dent 26 (2); 82 - 85, 2009

Introduction
It is widely recognized that a pellicle film from saliva is deposited within seconds following the prophylactic cleaning of tooth surfaces, and that this glycoprotein coating serves as an excellent foundation for the immediate colonization of oral bacteria and the initiation of the development of the oral biofilm commonly called dental plaque. Further, it is known that the amount of dental plaque increases continuously due to continued microbial colonization and that the dental plaque begins to calcify forming dental calculus within 3-days after initial plaque formation. Continued maturation of the calculus results in a deposit that can only be effectively removed by a conventional dental prophylaxis involving dental scaling. Therefore, it is desirable to identify measures that prevent the accumulation of dental plaque and the formation of calculus.

Although regular toothbrushing is a proven means of removing dental plaque thereby preventing calculus formation and is routinely recommended by veterinarians, client compliance is generally rather poor. As a result a number of different preventive approaches have been proposed and evaluated. Since the beneficial impact of dry foods on improved plaque removal through mastication has been known for many years, much of the effort in the past decade has focused on the development of complete diets with the appropriate texture and kibble size to provide enhanced oral health. Other approaches have utilized dietary treats or chew products, either with or without chemical additives to enhance their efficacy. Additional approaches have utilized oxtails, polyurethane chew toy, and rawhide strips, with or without chemical coatings to remove or reduce calculus formation. The purpose of the present investigation was to determine the impact of an extruded and chemically-coated rawhide preparation containing sodium tripolyphosphate and cetyl pyridinium chloride on the prevention of dental calculus, plaque, and gingivitis.

Materials and Methods
This study involved the use of 16 adult mixed-sex beagle dogs between 6 and 11 years of age housed in stainless steel cages and maintained in an AAALAC-accredited facility in the Indiana University School of Dentistry and the protocol was reviewed and approved by the School's Institutional Animal Care and Use Committee prior to initiation. The general health of the dogs was assessed based on a CBC and chemistry profile performed annually and daily observations by the facility's attending veterinarian or facility staff. The periodontal health of the dogs was relatively good with only gingivitis noted as they received a supragingival scaling and crown polishing every 4 to 8-weeks usually in relation to a similar clinical study. The investigation was designed as a 2-way crossover study using the so-called "clean mouth" approach with 4-week test periods and a 1-week washout period between the two test periods. The animals were maintained on tap water ad libitum and a measured amount of commercially-available dry dog diet to maintain constant body weight that was assessed weekly. The dogs were stratified into 2 groups of 8 using a random block procedure with the animals blocked on the basis of calculus scores obtained during a previous study to define normal formation rates.

Prior to the initiation of each test period, the dogs received a supragingival scaling and crown polishing that was preceded by administration of atropine (0.04 mg/kg SC) 20-minutes before administering anesthesia. The dogs were anesthetized using ketamine HCl (5.0 mg/kg), butorphanol (0.15 mg/kg), and medetomidine (0.025 mg/kg) intramuscularly. Following the tooth cleaning procedure, the dogs were administered atipamezole (0.05 mg/kg) intramuscularly to reverse the medetomidine. The dogs were then provided their assigned regimen of either no treat or one soft rawhide piece daily about 4-hours after feeding the dry chow diet. The rawhide was prepared to contain 0.72 % sodium tripolyphosphate as a calcium sequestrant and 0.04 % cetyl pyridinium chloride as an antimicrobial agent.

The dogs were anesthetized as described previously and clinically examined for gingivitis, plaque, and calculus by an experienced examiner (JWP). To maintain the integrity of the study, the examiner and the recorder were unaware of the dogs' assigned regimens and the dogs were presented in a randomized manner. All examinations were made on the buccal surfaces of the maxillary I3, C, P2, P3, P4, M1 and the mandibular C, P2, P3, P4, M1 teeth. Gingivitis was first assessed using a modification of a clinically examined for gingivitis, plaque, and calculus by an experienced examiner (JWP). To maintain the integrity of the study, the examiner and the recorder were unaware of the dogs' assigned regimens and the dogs were presented in a randomized manner. All examinations were made on the buccal surfaces of the maxillary I3, C, P2, P3, P4, M1 and the mandibular C, P2, P3, P4, M1 teeth. Gingivitis was first assessed using a modification of a numerical scale of: 0 = no gingivitis; 1 = incipient or very mild gingivitis (red
and/or swollen but no bleeding on probing); 2 = mild gingivitis (red and swollen with delayed bleeding on probing); 3 = moderate gingivitis (red and swollen with immediate bleeding on probing); and 4 = severe gingivitis (ulcération or spontaneous hemorrhaging and profuse bleeding on probing). The gingival margin of each tooth surface was divided into thirds (mesial, buccal, distal) and graded using these criteria; the mean score for the 3 sites was the tooth score and the average score for each tooth was considered to be the score for each dog.

Plaque was then assessed following disclosure with 1.5 % D&C red. This method grades the occlusal and gingival halves of each tooth surface and uses the numerical scale of: 0 = no observable plaque; 1 = scattered plaque covering less than 24 % of the buccal surface; 2 = plaque covering 25 - 49 % of the tooth surface; 3 = plaque covering 50 - 74 % of the tooth surface; and 4 = plaque covering more than 75 % of the tooth surface. Plaque thickness was also visually graded: 1 = light (pink to light red); 2 = moderate (red); 3 = heavy (dark red). The score for each tooth half was calculated by multiplying the coverage and thickness scores while the sum for the halves was the tooth score; the average tooth score was used for statistical analyses.

A toothbrush was used to remove the plaque and the teeth were rinsed with a dental air-water syringe to gently air dry any exposed calculus. Calculus was assessed by dividing the tooth surface into mesial, buccal and distal thirds and each section graded. The amount of surface coverage by calculus was classified using the following numerical scale: 0 = no observable calculus; 1 = scattered calculus covering less than 24 % of the tooth surface; 2 = calculus present on 25 - 49 % of the surface; 3 = calculus covering 50 - 74 % of the surface; and 4 = surface coverage greater than 75 %. Thickness was also graded with the aid of a graduated periodontal probe as: 1 = light (< 0.5-mm); 2 = moderate (0.5 to 1.0-mm); and 3 = heavy (> 1.0-mm). The coverage score was multiplied by the thickness score for each section and totaled for each tooth with the average tooth score used for data analyses.

Data analyses were performed using the SAS statistical package and included ANOVA analyses of the effects of treatment sequence, and legs and identity within blocks as well as differences between the test regimens. Indicated inter-group differences were evaluated using Tukey's multiple comparisons test procedure.

**Results**

Only 14 of the 16 dogs consumed at least half the rawhide treat on at least half of the days of the test period and only the data for these 14 dogs are presented. There were no adverse effects of the rawhide treat noted during the study period and no differences in individual body weights observed between the regimens. Likewise there were no significant effects of treatment sequence or legs.

Calculation data indicated that the average calculus score was 2.98 when the dogs ingested only the control dry diet regimen during the test period while the average score was 2.14 when the dogs ingested the soft rawhide treat in addition to the control dry diet during the test period (Table 1). The inter-group difference of 28.2 % was statistically significant.

The no-treat control regimen resulted in an average plaque score of 8.68 while the dry diet plus the rawhide treat regimen resulted in an average score of 7.07. This inter-group difference of 18.5 % was also statistically significant (Table 2).

The mean gingivitis score for the control (no-treat) animals was 0.92 while that for the dogs provided the rawhide treat was 0.50. The difference of 45.7 % was statistically significant (Table 3).

**Discussion**

Previous investigations have noted difficulties related to the consumption of conventional rawhide products. In previous studies of rawhide strips, the studies have been designed to involve
parallel groups of dogs and the dogs that were found to consume the rawhide were placed in the test group while those that did not like the rawhide were placed in the control group. The potential effect of this procedure upon the results of these studies through the creation of groups of dogs with different chewing habits remains unknown. It has also been noted that the acceptability of rawhide strips was much poorer than dog biscuits. However, in the present study 14 of the 16 dogs (or approximately 88%) regularly consumed at least one-half the soft rawhide suggesting that the soft rawhide product may be more acceptable to dogs than conventional rawhide strips.

The significant reduction in calculus formation of 28% in the present study was somewhat less than that observed in a previous study in a small number of client-owned chihuahuas. In the latter study, the daily feeding of a soft rawhide chew resulted in a reduction in calculus formation of 54%. It is likely that differences in the rate of calculus formation between dogs of different sizes may have contributed to this difference since it has been reported that the calculus formation rate appears to be inversely related to body weight.

In the study reported here, the daily ingestion of the soft rawhide chew containing sodium tripolyphosphate and cetyl pyridinium chloride resulted in a reduction in plaque formation of 18.5% which is comparable to that of a number of other studies of other types of preventive measures. For example, twice daily feeding of rawhide strips resulted in a similar 19.0% decrease in plaque accumulation while a series of studies involving the daily feeding of a dental hygiene chew resulted in no significant impact on plaque after 3-weeks in two studies and reductions of 15.0% in two other studies after 3-weeks and 21-months. Slightly greater reductions in plaque of 23.0 and 34.0% were observed with other types of dental chew products after 4-week test periods in small and large dogs, respectively.

The daily provision of a soft rawhide chew in this study resulted in a reduction in gingivitis of 45.7%. While the impact of the rawhide strip on gingivitis was not reported in one study, very modest positive effects of the dental hygiene chew were observed in another study. Even more modest effects on gingivitis of 9.0 to 11.0% were observed with other types of dental chew products following 4-week test periods. Thus, the beneficial impact on gingivitis (often a precursor to periodontitis) of the rawhide used in the present study appears to be substantially greater than that of several other treat-type products intended to promote periodontal health.

One of the major concerns regarding the use of rawhide by dogs relates to the potential for chunks of the rawhide strips to become lodged in esophagus as has been reported. Interestingly, the soft rawhide product utilized in the present study was minced and extruded resulting in a rawhide material that is fibrous in nature and with minimal potential for choking. There were no choking incidents observed in this or other studies with this product. The fibrous component of such products is considered important for its mechanical cleansing action. Regardless of the mechanisms responsible for the oral health benefits reported here, there can be little doubt that this soft rawhide product can contribute to improved dental health of dogs.

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References


