

Comparison of a Vegetable-Based Dental Chew to 2 Other Chews for Oral Health Prevention

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Abstract

Giving dental chews to dogs is part of the passive homecare that helps prevent the formation of plaque and tartar. The objectives of these studies were to assess the effectiveness of a vegetable-based dental chew (VF) to maintain oral health, and to compare it to 2 different reference chews (RC) with a proven effectiveness. The first study was conducted on 45 small dogs (<10 kg) and the second on 60 larger dogs (15-30 kg) who were randomly assigned to 3 different groups. During 30 days, one group received no chew (control) while the second and third group received either one RC (RC1 or RC2) or one VF per day. All dogs had their teeth scaled on Day 0. On Day 30, scores were given for plaque and calculus. Gingival parameters were also assessed. Statistical analysis (analysis of variance and Tukey tests \pm Bonferroni's adjustment) were performed to compare groups with α set at .05 for significance.

The 3 types of chews were found to be efficacious to reduce plaque and calculus formation and the gingival bleeding compared to control ($P < .05$). There was no significant difference between RCs and VF in both trials except for the gingival bleeding parameters which showed a greater improvement with VF. Therefore, daily administration of the VF is effective to reduce plaque and calculus formation and gingival bleeding and has a better efficacy on gingival bleeding than the other reference products tested. It can therefore be used with confidence at home for preventative dental care.

Keywords

dental chew, dental homecare, periodontal disease, dental deposits, gingivitis, dental plaque, dental prevention, VeggieDent

Introduction

Periodontal disease is the most prevalent oral disease in dogs and cats.¹ It has been under the attention of clinicians and researchers not only to find its etiopathogenesis and treatment but also to provide preventive care. Prevention strategies of periodontal disease are focused on control of accumulation of dental deposits, namely dental plaque and calculus. Such control can be achieved by oral homecare, which is further divided into active (involving direct interaction between owner and pet), and passive modalities. Without a doubt, the most efficient methods are active (like tooth brushing), however the compliance of owners performing this type of hygiene is low, with an overall rate of 1%.² This fact has led to the development of passive homecare modalities, which include dental diets, treats, chews, water additives, and nutritional supplements. Moreover, because of the low compliance for tooth brushing, passive homecare may be superior to active homecare simply due to the fact that it is actually performed.³

There are numerous products available, but only a few have scientific evidence that they produce any health benefit. Therefore, it is recommended that veterinary professionals review the literature to determine for themselves whether or not to recommend a particular product.⁴

The Veterinary Oral Health Council (VOHC), a nonregulatory agency which includes representatives from professional dental colleges as well as allied veterinary groups, provides an objective means of recognizing commercially available products that meet preset standards of effectiveness in controlling accumulation of dental plaque and calculus (tartar) in dogs and cats.⁵

The daily addition of dental chews and treats was proven to reduce plaque and calculus accumulation as well as gingivitis and halitosis.⁶⁻¹⁰ Even among the available products that

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have been awarded the VOHC seal, there are differences in palatability, prescriptions, and effectiveness. A growing number of food allergies and/or intolerances increases the need for developing products which will carry lower risk of such side effects.

The vegetable-based dental chew tested (VEGGIEDENT® FR3SH™, Virbac; called VF) has been shown to be safe,¹¹ totally soluble in vitro by digestive enzymes,¹² palatable¹³ and efficient in reducing bad breath according to owners.¹⁴

The objectives of the 2 studies were: (1) to assess the effectiveness of this VF in reducing plaque and calculus formation and in limiting gingival bleeding in owner's dogs and (2) to compare its effectiveness to reference chews (RCs) that have a proven effectiveness in the reduction of both plaque and calculus accumulation, according to the VOHC seal awarded.

The unicentric, randomized, single-blinded, controlled studies were performed with the use of the following indices measuring the oral health status: plaque index (PI), calculus index (CI), gingival bleeding index (GBI), and oral health index (OHI). The Total Mouth Periodontal Score-Gingivitis (TMPS-G) was also calculated.

The 2 studies were conducted on dogs of different sizes and the comparison was made with a different RC in each study.

Materials and Methods

Animals

Animals included in the study were client-owned and all procedures performed during the study were conducted according to standard veterinary care procedures and following Polish Regulations (Art.1 ust.2 pkt1 Dz. U.2015 poz. 266). The studies were approved by an ethical committee (Approbation numbers: EU-ERC/201805-04 for trial 1 and EU-ERC/201902-04 for trial 2).

To be included, dogs had to be in good general health and have mild to moderate gingivitis (Gingivitis index ≤ 2). All teeth to be scored (maxilla: I3, C, P3, P4, M1 and mandible: C, P3, P4, M1) had to be present, with no sign of periodontal disease greater than second stage (PD2).

All animals participating underwent qualification for anesthesia including a physical examination as well as blood and urine collection. If qualified, the dogs were anesthetized and professional teeth cleaning procedure performed. Owners accepted all of the above procedures by signing a consent form.

For trial 1, 45 dogs weighing less than 10 kg were recruited (24 Jack Russell terriers and 21 Miniature Schnauzer dogs) while, for trial 2, 60 dogs weighing between 15 and 30 kg were recruited. Dogs in the latter group belonged to 15 different breeds, mainly Alaskan Huskies (17), Greysters (13), and Greenland dogs (9).

Products and randomization

The animals were randomly and equally distributed (15 dogs per group in trial 1 and 20 per group in trial 2) in 1 of the 3 following groups:

- the control group received no chew.
- the reference group received 1 RC per day: Hill's® Prescription Diet® Dental Care Chews (RC1) in trial 1 and Greenies™ dental treats, Mars Petcare—size medium or large depending on the bodyweight of the dog (RC2) in trial 2. Both RCs have been awarded the VOHC seal for plaque and tartar, suggesting the efficacy for both these criteria have been proven.^{9,15}
- The third tested group received 1 Veggiedent® Fresh™ (VF) chew (Virbac—size S in trial 1 and size M in trial 2) per day.

The randomization list was obtained using the randomization program Research Randomizer.¹⁶ One coordinator allocated the dog, in one specific group, according to the randomization list but the rest of the team conducting the clinical study (procedures and scoring) were blinded concerning the treatment received.

All dogs received the same diet fed dry (Hill's® Pet Nutrition Maintenance diet mini-kibbles) for the duration of the study and owners were instructed not to brush their dog's teeth or give any other chew than the one tested during the trial.

Design

The dogs received one of the chews cited above (or none) for 30 days. On Day 0, all animals had a general physical examination including visual assessment, heart and lung auscultation, capillary refill time assessment, body weight measurement, general body condition score, and body temperature measurements. Additionally, an oral examination was performed on awake animals to qualify dogs for the trial and included the check for the presence of required teeth and periodontal status. Blood and urine were collected for immediate laboratory work (general biochemistry, hematology, urine analysis) and an intravenous catheter was inserted into the cephalic vein. Laboratory results were used to assess suitability for anesthesia. Sedation was performed with the use of medetomidine and butorphanol at recommended doses followed by preoxygenation with an oxygen mask. After sedation was achieved, the animal received propofol at recommended doses for induction of general anesthesia. An endotracheal tube was then placed and cuff filled according to the size of the dog and tube. Fluid therapy was introduced with Ringer's solution at standard infusion rates. During anesthesia, cardio-respiratory functions were monitored. A temperature maintenance system was also put in place. After dental procedures were done, the animal was allocated to an Intensive Care Unit cage with oxygen supply and received medication to reverse sedation.

The comprehensive oral health assessment and treatment consisted of: dental charting, full mouth radiography, a professional dental cleaning procedure under general anesthesia and with endotracheal tube placed, scaling and polishing of the teeth. Scaling effectiveness was evaluated by use of a disclosing solution to ensure that all plaque and calculus were removed. If unsuccessful, the scaling and polishing procedure was repeated.

On Day 30, the veterinarian assessed the animal before sedation (same drugs and doses as on Day 0) and oral assessment was performed by one scorer who is an experienced researcher in the periodontal field and a board certified specialist in veterinary dentistry (JG).

The oral assessment methods for gingivitis, plaque, and calculus were applied to the following 9 (5+4) target teeth: Maxilla—I3, C, P3, P4, M1; Mandible—C, P3, P4, and M1. The entire buccal surface of the target teeth on both sides of the mouth was scored by an experienced scorer who evaluated all 3 parameters in the following order: GBI, plaque, and calculus indices. The scores obtained for each tooth were then averaged to obtain a mean mouth score per dog, for each parameter.

The GBI¹⁷ was first scored as follows: 0 = no inflammation; 1 = mild inflammation; 2 = Moderate inflammation, and 3 = Severe inflammation. The PI was scored with Modified Logan & Boyce index¹⁸ with the use of plaque disclosing solution (IC plaque, IM3) to score coverage and thickness of the plaque. Plaque was brushed from the surface of the teeth prior to calculus coverage assessment. Finally CI¹⁹ was evaluated with the use of a dental explorer.

The OHI²⁰ was assigned as the sum of 4 scores related to: lymph node condition (0: normal; 1: slightly enlarged; 2: moderate to significantly enlarged); dental lesion and gingivitis (0: none; 1: presence of gingivitis; 2: periodontitis); plaque (0: none; 1: up to 50% of dental crown surface; 2: > 50% of dental crown surface) and tartar (0: none; 1: up to 50% of dental crown surface; 2: > 50% of dental crown surface).

Finally, the TMPS-G (TMPS-G based on GBI) was calculated to have an idea of the gingivitis and periodontitis extent. This method adjusts the GBI to the size of teeth and size of dog.¹⁶

The percentage of change seen between Day 0 and Day 30 was calculated for OHI and TMPS-G scores by reporting the difference of scores obtained on Day 30 and Day 0 to the score obtained on Day 0 [(score on Day 30–score on Day 0)/score on Day 0] for each individual.

Statistics

The Gaussian distribution of raw data was evaluated using D-Agostino & Pearson normality test. A one-way analysis of variance test, followed by a Tukey test in case of significance, was used to compare groups between them (Prism 7 software—Graphad company). When appropriate, a Bonferroni's correction for multiple comparison was applied (CI, PI, GBI on Day 30). A difference between groups was considered as significant for a *P* value <.05 (Tukey's test) or <.0167 when the Bonferroni's correction for 3 outcomes was applied. Data are presented as mean ± SD.

Results

All dogs in the RC and VF groups consumed the chews entirely and every day, as per protocol. According to the owners, there was no indigestion among observed dogs which could have influenced distribution of food or products.

Comparison of the Scores on Day 30

Gingival Bleeding Index. The GBI was first assessed on each tooth to measure the gingival health of the dogs in the different groups and the effect the chews may have on gingivitis prevention. On Day 30, a significantly lower mean value was found for

Table 1. Oral Indices on Day 30 Obtained in Trial 1, Comparing the Reference Chew 1 (RC1) and the Tested Chew (VF).

Trial 1		Control	RC1	VF
GBI	Min-Max	0.06-0.89	0-0.44	0-0.17
	Mean ± SD	0.54 ± 0.23 ^a	0.16 ± 0.14^b	0.04 ± 0.05^b
	% reduction	-	71%	92%
Plaque index	Min-Max	1.94-4.11	1.11-2.33	1.22-2.22
	Mean ± SD	2.70 ± 0.53 ^a	1.71 ± 0.34^b	1.50 ± 0.30^b
	% reduction	-	36%	44%
Calculus index	Min-Max	0.44-1.33	0.11-1	0.17-0.72
	Mean ± SD	0.89 ± 0.23 ^a	0.51 ± 0.26^b	0.40 ± 0.18^b
	% reduction	-	42%	55%

a, b: values with different superscript letters in each column differ significantly (*P* < .0167—Tukey's multiple comparisons test with Bonferroni's correction for 3 outcomes; *n* = 15 in each group). In bold: significant difference versus control. % reduction: % of score reduction versus control.

Table 2. Oral Indices on Day 30 Obtained in Trial 2, Comparing the Reference Chew 2 (RC2) and the Tested Chew (VF).

Trial 2		Control	RC2	VF
GBI	Min-Max	0.17-1.22	0-0.78	0.06-0.39
	Mean ± SD	0.72 ± 0.26 ^a	0.35 ± 0.23^b	0.16 ± 0.09^c
	% reduction	-	52%	78%
Plaque index	Min-Max	2.06-3.94	0.89-2.83	0.89-2.39
	Mean ± SD	2.58 ± 0.49 ^a	1.89 ± 0.53^b	1.64 ± 0.45^b
	% reduction	-	26%	36%
Calculus index	Min-Max	0.56-1.33	0.11-1	0.00-1.06
	Mean ± SD	0.90 ± 0.18 ^a	0.61 ± 0.25^b	0.40 ± 0.23^b
	% reduction	-	32%	55%

a, b, c: values with different superscript letters in each column differ significantly (*P* < .0167—Tukey's multiple comparisons test with Bonferroni's correction for 3 outcomes; *n* = 20 in each group). In bold: significant difference versus control. % reduction: % of score reduction versus control.

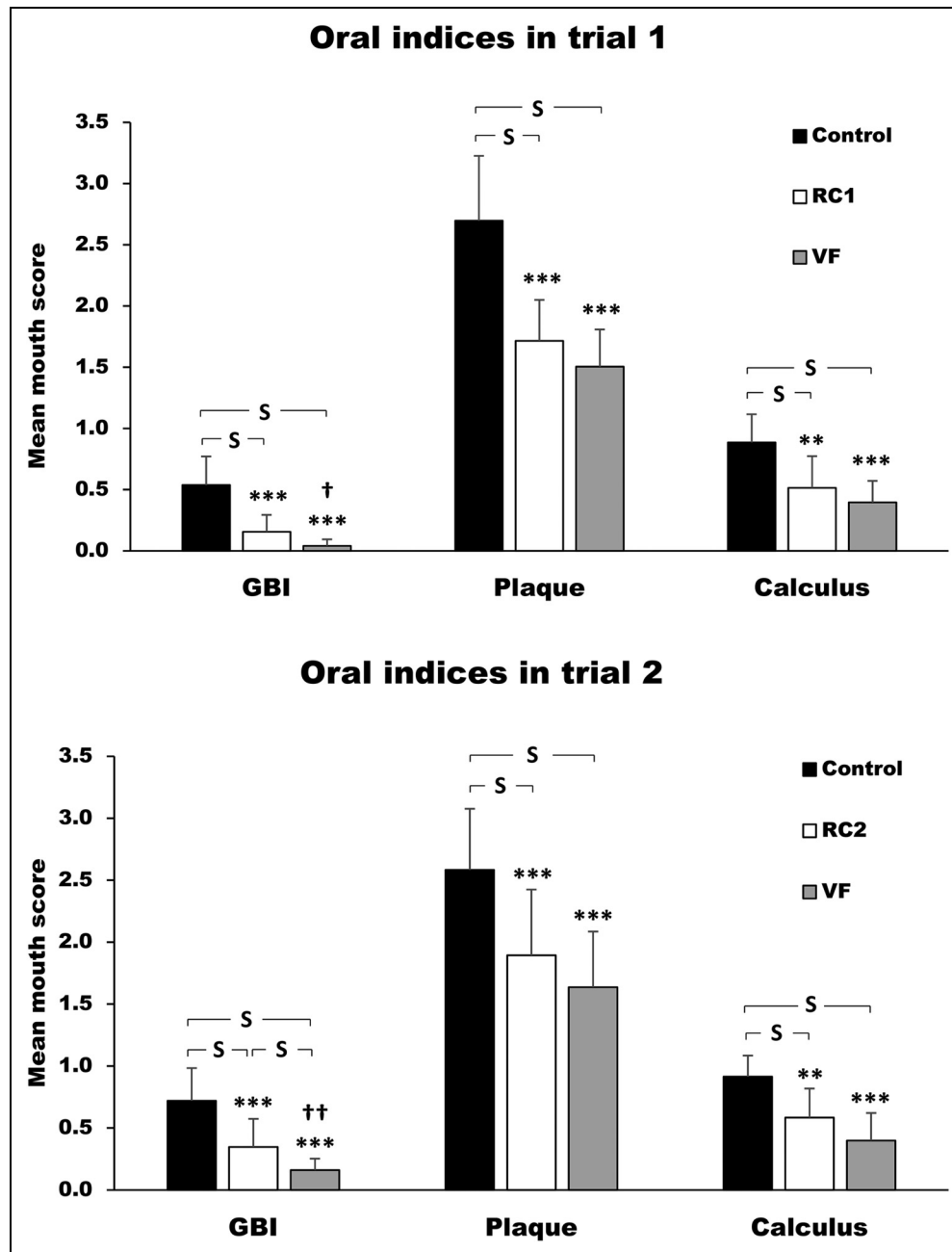


Figure 1. Dental and gingival indices in trials 1 and 2. Gingival bleeding index (GBI), plaque index and calculus index obtained in trial 1 (top) and 2 (bottom) from the control group (black), the reference group (RC1 and RC2—white) and the tested group (VF—grey). Data are represented as mean mouth scores and SD. Trial 1: $n = 15$ in each group. Trial 2: $n = 20$ in each group. ** $P < .01$ and *** $P < .001$ compared to control group; † $P < .05$ and †† $P < .01$ compared to RC1 or RC2 (analysis of variance and Tukey's multiple comparisons tests). S: significant difference after Bonferroni's correction for 3 outcomes ($P < .0167$).

GBI in the groups receiving the RC or VF chews, compared to the control group ($P < .001$ —Tukey's multiple comparisons test; significant difference [S] when applying Bonferroni's correction for 3 outcomes; Tables 1 and 2 and Figure 1). Compared to the mean scores obtained in the control groups, a reduction of 71% and 52% was observed with the RC and of 92% and 78% with the VF in trials 1 and 2, respectively (Tables 1 and 2). A difference was also observed between the RC1 and VF

groups in trial 1 (0.16 ± 0.14 vs 0.04 ± 0.05 , 75% difference in means, $P = .03$ —Tukey's multiple comparisons test; not significant [NS] when applying Bonferroni's correction for 3 outcomes) and between the RC2 and VF groups in trial 2 (0.35 ± 0.23 vs 0.16 ± 0.09 , respectively, 46% reduction with VF compared to RC2, $P = .009$ —Tukey's multiple comparisons test; significant difference [S] when applying Bonferroni's correction for 3 outcomes; Tables 1 and 2 and Figure 1).

Table 3. Oral Health Indices (OHI) Obtained on Day 0 and Day 30 and Percentage of Change From Day 0 (% Change vs Day 0) Calculated in Both Trials—Data are Presented as Mean \pm SD.

Oral health index		Control	RC	VF
Trial 1	Day 0	3.60 \pm 1.92	3.93 \pm 1.67	2.87 \pm 1.64
	Day 30	3.67 \pm 0.90	1.27 \pm 0.59	1.00 \pm 0.38
	% change versus Day 0	18.3 \pm 72.9% ^a	-64.2 \pm 15.0% ^b	-52.7 \pm 31.0% ^b
Trial 2	Day 0	5.40 \pm 1.27	5.50 \pm 1.05	5.00 \pm 1.26
	Day 30	3.95 \pm 0.89	1.25 \pm 0.79	1.05 \pm 0.39
	% change versus Day 0	-22.4 \pm 27.7% ^a	-76.4 \pm 17.2% ^b	-77.9 \pm 10.1% ^b

a, b: values with different superscript letters in each column differ significantly ($P < .05$, Tukey's multiple comparisons test, $n = 15$ and 20 in each group in trials 1 and 2, respectively). RC, reference chew, VF, tested chew [Veggedent Fresh]).

Plaque Index. To evaluate the efficacy of the chew to reduce plaque formation, the coverage and thickness of the plaque on the target teeth were assessed and averaged to obtain a combined PI for each dog. On Day 30, a significantly lower mean PI was found in the RC and the VF groups compared to the control group in both trials ($P < .001$ in both trials—Tukey's multiple comparisons test; significant difference [S] when applying Bonferroni's correction for 3 outcomes; Tables 1 and 2 and Figure 1). Compared to the mean scores obtained in the control groups, a reduction of 36% and 26% was observed with the RC and of 44% and 36% with the VF in trials 1 and 2, respectively (Tables 1 and 2). No significant difference was observed between the RC and VF groups in any of the trials.

Calculus Index. To evaluate the efficacy on calculus (or tartar), the plaque was removed (brushing) after the plaque scoring and a CI, depending again on coverage and thickness on the target teeth, was given. Comparison between groups showed that the CI was also significantly lower in the groups given one RC or VF chew daily, compared to the control group in both trials ($P < .01$ —Tukey's multiple comparisons test, still statistically significant after Bonferroni's correction for multiple outcomes; Tables 1 and 2 and Figure 1). Compared to the

mean scores obtained in the control groups, a reduction of 42% and 32% was observed with the RC and of 55% and 55% with the VF in trials 1 and 2, respectively. No significant difference was observed between the RCs and VF groups in any trial (Table 2, Figure 1).

Evolution of OHI and TMPS-G Between Day 0 and Day 30 in the Different Groups

Oral Health Index. The OHI—taking into account the lymph node condition, dental lesion and gingivitis as well as the plaque and tartar accumulation—was calculated on Day 0 and Day 30. The percentage of change between Day 0 and Day 30 in each group was then calculated to be able to compare between groups. The results showed a statistically significant difference between the control groups and the groups receiving the RC (RC1 or RC2) or the tested chew (VF) (greater difference in RCs and VF groups, $P < .001$ —Tukey's multiple comparisons test; Table 3 and Figure 2) but no difference between the RC and VF groups, in both trials.

Total Mouth Periodontal Score for Gingivitis. Based on the GBI and adjusted to the sizes of teeth and dogs, the TMPS-G was

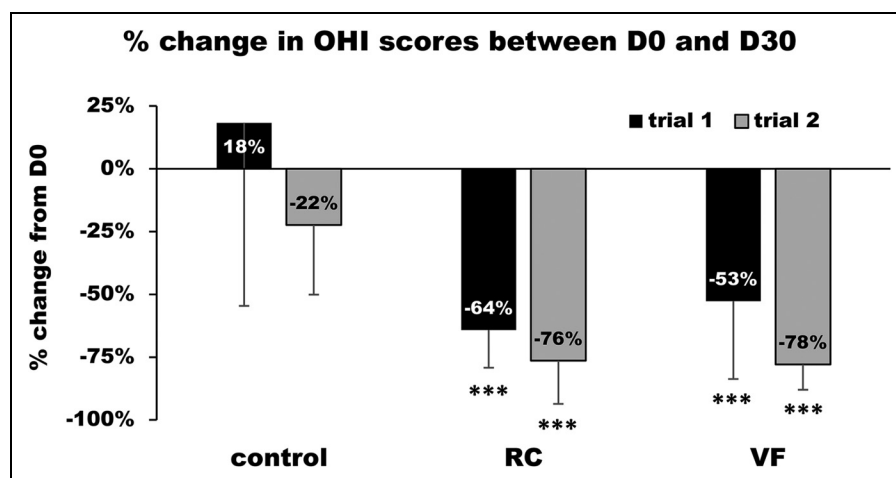


Figure 2. Variation of oral health indices (OHI) scores between Day 0 and Day 30, expressed in percentage (relative to the score obtained on Day 0). Data are presented as mean % and SD for the control (control), reference chew (RC), and tested chew (VF) groups, in trial 1 (black) and trial 2 (grey). *** $P < .001$ between the control group and the RC or VF group (Tukey's multiple comparisons test).

Table 4. TMPS-G Scores Obtained on Day 0 and Day 30 and Percentage of Change From Day 0 (% Change vs Day 0) Calculated in Both Trials—Data are Presented as Mean \pm SD.

TMPS-G		Control	RC	VF
Trial 1	Day 0	0.72 \pm 0.17	0.38 \pm 0.19	0.21 \pm 0.12
	Day 30	0.55 \pm 0.23	0.18 \pm 0.20	0.04 \pm 0.07
	% change versus Day 0	-24.6 \pm 25.3% ^a	-60.1 \pm 32.2% ^b	-86.2 \pm 23.2% ^c
Trial 2	Day 0	1.44 \pm 0.41	1.25 \pm 0.34	1.27 \pm 0.52
	Day 30	0.75 \pm 0.29	0.39 \pm 0.27	0.18 \pm 0.19
	% change versus Day 0	-41.6 \pm 31.2% ^a	-66.5 \pm 27.1% ^b	-86.8 \pm 13.9% ^c

a, b, c: values with different superscript letters in each column differ significantly ($P < .05$, Tukey's multiple comparisons test, $n = 15$ and 20 in each group in trials 1 and 2, respectively). RC, reference chew, VF, tested chew [VeggieDent Fresh].

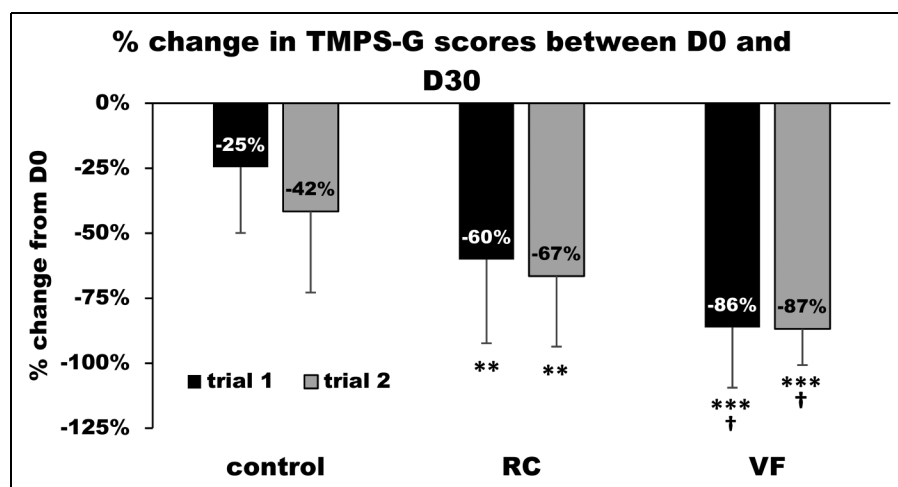


Figure 3. Variation of Total Mouth Periodontal Score-Gingivitis (TMPS-G) scores between Day 0 and Day 30, expressed in percentage (relative to the score obtained on Day 0). Data are presented as mean % and SD for the control (control), reference chew (RC) and tested chew (VF) groups, in trial 1 (black) and trial 2 (grey). ** $P < .01$ between the control group and the RC or VF group. † $P < .05$ between the RC and VF groups (Tukey's multiple comparisons test).

calculated for each dog on Day 0 and Day 30. The percentage of change between Day 0 and Day 30 was then calculated and compared between groups. In both trials, the change in TMPS-G score was significantly greater when dogs received a chew (RC or VF) compared to dogs in the control group ($P < .01$ —Tukey's multiple comparisons test; Table 4, Figure 3). The change from Day 0 (% difference) was also significantly greater in the VF groups than in the RC groups (trial 1: $-86.2 \pm 23.2\%$ vs $-60.1 \pm 32.2\%$, respectively, 30% difference in means; trial 2: $-86.8 \pm 13.9\%$ vs $-66.5 \pm 27.1\%$, respectively, 23% difference in means, $P = .036$ in both trials—Tukey's multiple comparisons test; Table 4, Figure 3).

These data on OHI and TMPS-G suggest that chewing a chew can help improve the OHI and periodontal scores for gingivitis and that the VF chew may have a greater impact on gingival parameters than the RCs tested, when given daily.

Discussion

By assessing different oral and dental indices, this study showed that chewing a dental chew of good quality can

reduce the accumulation of plaque and calculus in dogs after dental scaling. It also showed that it could help reduce the GBI and improve the oral health and periodontal score for gingivitis indices. Overall, these data show that the daily addition of the tested dental chews helps maintain dog's oral health.

These data are consistent with previous findings showing similar effects of different dental chews or sticks.^{4-6,21,22} The main beneficial effect of those products is achieved by the chewing action which allows tartar and plaque to be scraped away. Therefore, it is mostly effective on the chewing (caudal) teeth and should complement an active homecare (tooth brushing) which is, on the contrary, most effective on front teeth that are easier to access.²³ Additionally, the action of chewing stimulates saliva production which, when combined with the mechanical forces applied to the dental surfaces, helps flush away debris, food remnants and helps to detach deposits.²⁴ Active and passive homecare are necessary to maintain good oral health. Scaling dog's teeth, although highly effective, is not sufficient to keep the dog's mouth healthy on a long term basis, as plaque can form in 24h, calculus in 3 days and gingivitis can start in 2 weeks.¹³

Indices that assess gingiva, plaque, and calculus do not provide clear characterization of oral health. The addition of OHI to clinical observations intended to assess whether the reduction of dental deposits was indeed consistent with an improvement of the oral condition. In both studies, all parameters (GBI, plaque, calculus scores, and OHI) were improved with the chews, suggesting a good correlation between these parameters. Although usually measured on larger populations, OHI can still illustrate the oral situation even in smaller groups as in the present studies.²⁰

In the 2 studies presented here, the VF chew was compared to 2 other dental chews known to have an effect on both plaque and calculus accumulation based on the VOHC seal awarded for these 2 parameters. This chew (VeggieDent® FR3SH™) performed as well, if not better, than the RCs on all parameters tested. It was shown to be as efficient as the RCs in reducing plaque and calculus accumulation and to be even more efficient than the RC2 (and RC1, though not in a significant manner after applying the Bonferroni's correction) in reducing GBI on day 30. Furthermore, the results on TMPS-G confirmed the superiority of VF towards RC2 and also showed the superiority of VF towards RC1, when assessing the evolution of this parameter from Day 0 to Day 30. Compared to GBI, TMPS-G adjusts the GBI to the size of each tooth and the size of the dog and is then more adapted to each individual than the GBI itself. Therefore, the tested chew (VF) given daily seems to provide a better preventative measure for gingival bleeding than the 2 other RCs tested. The data on oral indices obtained with VF are consistent with a previous study made with a similar chew.⁵

It has to be noted, though, that a variability may have existed between groups in terms of dental deposit accumulation since no stratification based on this parameter was performed before allocation into groups. A pretrial measurement of the rate of deposition of plaque and/or calculus to then allocate evenly the dogs in the different groups based on this parameter would have limited this variability.

This article provides, for the first time, a comparison of different chews to maintain good oral health in dogs and emphasizes the need for home dental care in prevention of periodontal disease. It also highlights the possible differences between the chews and the necessity to find the right product to use. The finding that the VeggieDent® FR3SH™ chew provides better prevention of gingivitis is of importance for dogs that are prone to develop gingivitis and periodontal disease. Furthermore, the lack of common food allergens and animal derivatives in this veterinary chew also appears as an additional benefit for patients who suffer from food intolerance or allergies.

Finally, in both studies, the chews were given after a professional dental scaling in order to assess their preventive effectiveness on plaque and calculus accumulation and the consequent effect on gingival bleeding. Although never assessed, it is unlikely that a chew itself could improve oral health without a proper and regular professional dental cleaning.

Therefore, adding a daily dental chew should become part of the oral health strategy for the patient together with other modalities and regular (annually or more frequently if required) dental controls by professionals.

Delivering several hygienic homecare methods simultaneously does not necessarily ensure life-long oral health and thus clinical follow-up is mandatory.

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References

1. Niemiec, BA. Periodontal disease. *Top Companion Anim Med.* 2008;23(2):72-80.
2. Miller, BR, & Harvey, CE. Compliance of with oral hygiene recommendations following periodontal treatment in client owned dogs. *J Vet Dent.* 1994;11(1):18-19.
3. Vrieling, HE, Theyse, LF, Van Winkelhoff, AJ, Dijkshoorn, NA, Logan, EI, & Picavet, P. Effectiveness of feeding large kibbles with mechanical cleaning properties in cats with gingivitis. *Tijdschr Diergeneeskd.* 2005;130(5):136-140.
4. Roudebush, P, Logan, EI, & Hale, F. Evidence-Based veterinary dentistry: a systematic review of homecare for prevention of periodontal disease in dogs and cats. *J Vet Dent.* 2005;21(1):6-15.
5. Veterinary Oral Health Council. <http://www.vohc.org/index.html> - Accessed August 31, 2020.
6. Hennes, P, Servet, E, & Venet, C. Effectiveness of an oral hygiene chew to reduce dental deposits in small breed dogs. *J Vet Dent.* 2006;23(1):6-12.
7. Clarke, DE, Kelman, M, & Perkins, N. Effectiveness of a vegetable dental chew on periodontal disease parameters in toy breed dogs. *J Vet Dent.* 2011;28(4):230-235.
8. Stookey, GK. Soft rawhide reduces calculus formation in dogs. *J Vet Dent.* 2009;26(2):82-85.
9. Gorrel, C, & Bierer, TL. Long term effects of a dental hygiene chew on the periodontal health of dogs. *J Vet Dent.* 1999;16(3):109-113.
10. Quest, BW. Oral health benefits of a daily dental chew in dogs. *J Vet Dent.* 2013;30(2):84-87.
11. Nicolas, CS, Lloret, F, & Bouchez, C. Tolerance evaluation in dogs of a dental chew containing the FR3SH™ technology (VEGGIEDENT® FR3SH™). Presented at the 33rd Annual World

- Dentistry Summit; April 2019; Toronto, Ontario, Canada. Available on line: <https://americandental.conferenceseries.com/2019/eposter/tolerance-evaluation-in-dogs-of-a-dental-chew-containing-the-fr3sh-technology-veggiedent-fr3sh-world-dentistry-2019> (last access April 2020).
12. Nicolas, CS, Lloret, F, & Navarro, C. Evaluation of the in vitro digestibility of Veggiedent® FR3SH™ and five other dental chews for dogs. Proceedings of the 25th World Congress on Dentistry and Oral Health. *Oral Health Dent Manag*; 2019;18:52.
 13. Nicolas, C, Navarro C, & Lloret F. Evaluation of acceptability and chewing time of six dental chews in dogs: A randomized, blinded control trial. Proceedings of the 31st International Conference on Dentistry & Oral Care. *Oral Health Dent Manag*. 2018;17:27.
 14. Chala, V, Chaix, G, & Espuna, G. Evaluation of breath freshening effect in dogs following chew administration: an open field trial. Proceedings of the Voorsjaardagen congress; 2018; The Hague, NL.
 15. Veterinary Oral Health Council - Accepted products for dogs. http://www.vohc.org/VOHCAcceptedProductsTable_Dogs.pdf Accessed April 30, 2020.
 16. Urbaniak, GC, & Plous, S. 2013. Research Randomizer (Version 4.0) [Computer software]. Retrieved on August 28, 2020, from <http://www.randomizer.org/>
 17. Harvey, CE, Laster, L, Shofer, F, & Miller, B. Scoring the full extent of periodontal disease in the dog: development of total mouth periodontal score (TMPS) system. *J Vet Dent*. 2008;25(3):176-180.
 18. Hennet, P, Servet, E, Salesse, H, & Soulard, Y. Evaluation of the logan and boyce plaque index for the study of dental plaque accumulation in dogs. *Res Vet Sci*. 2006;80(2):175-180.
 19. Logan, EI, & Boyce, EN. Oral health assessment in dogs: parameters and methods. *J Vet Dent*. 1994;11(2):58-63.
 20. Gawor, JP, Reiter, AM, Jodkowska, K, Kurski, G, Wojtacki, MP, & Kurek, A. Influence of diet on oral health in cats and dogs. *J Nutr*. 2006;136(7 Suppl):2021S-2023S.
 21. Beynen, AC, Van Altena, F, & Visser, EA. Beneficial effect of a cellulose-containing chew treat on canine periodontal disease in a double-blind, placebo-controlled trial. *Am J Anim Vet Sci*. 2010;5(3):192-195.
 22. Brown, WY, & McGenity, P. Effective periodontal disease control using dental hygiene chews. *J Vet Dent*. 2005;22(1):16-19.
 23. Niemiec, BA, Gawor, J, Nemec, A, et al. World Small Animal Veterinary Association Global Dental Guidelines. Available online: wsava.org/global-guidelines/global-dental-guidelines/
 24. Eubanks, DL, & Woodruff, KA. The basics of saliva. *J Vet Dent*. 2010;27(4):266-267.