

Independent Study Confirms that THE EFFECTIVENESS OF DENTAL CHEW PRODUCTS CAN VARY SUBSTANTIALLY IN THEIR ORAL HEALTH BENEFITS FOR DOGS

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ABSTRACT

An independent study confirms that dental chew products differ greatly in their effectiveness on the reduction of plaque, gingivitis, calculus and halitosis in adult dogs when administered daily over 28 days. Using a clean mouth test protocol, this study compared feeding a commercial dry diet only to one of three test groups that featured feeding a commercial dry diet with the daily addition of a dental chew, being either Chew A, Chew B or Chew C.

The dental chews were all commercially available products, sold globally in pet specialty outlets and differed not only in their site and styles of manufacture but also their ingredients, texture and finished shape. Chew A was a firmer texture dental chew associated with increased fibre levels and was made of limited vegetarian ingredients. Chew B and C were both softer dental chews with a more flexible texture that can be more quickly chewed by dogs. Eighty adult dogs in total were allocated into 4 groups of 20 dogs based on pre-test plaque stratification to minimise bias and included Group 1, the control and Groups 2, 3 and 4 which were the dental chew test groups (Chew A, B and C). The control group received the dry diet only. The 3 test groups received the same dry diet and 1 dental chew each day that was the correct size appropriate dental chew based on their body weight and the brand recommendations. At the end of the study on Day 28, measurements of plaque and calculus accumulation and evaluations of oral halitosis and gingival health were performed.

Only one dental chew (Chew A) achieved a statistically significant reduction in plaque, tartar, gingivitis and halitosis. Chew B and C had minimal mean plaque improvements versus the control group and both of these results were non-statistically significant. As plaque is a key contributor in triggering the progression of dental disease, this study highlights that not all dental chews deliver the same benefits. With such differences across the key dental health measures it furthermore highlights the importance of clinicians only recommending products that will best support the success of their clients at home dental care programs. Ensuring the dental chew product that the client is using is scientifically proven to promote a superior reduction in dental deposits is essential for optimal oral care health.

INTRODUCTION

Periodontal disease is the most common health condition affecting dogs with incidence rates estimated to be 80% of all adult dogs (Wiggs & Lobprise, 1997; Gorrel & Robinson 1995). Whilst periodontal disease is not a new ailment affecting dogs, recent incidence reports have shown a 23.3% rise in the prevalence of dental disease in dogs over a 10 year period from 2006 with a steady growth each year (Banfield State of Health Report 2016).

Periodontal disease refers to a group of inflammatory conditions caused by the presence of the pathogenic microflora in the biofilm or dental plaque present on a tooth. The presence of these bacteria subsequently triggers an immune and inflammatory response by the

host and the consequential development of inflammation in the periodontal tissues such as the gums, periodontal ligament, root cementum and alveolar bone. For the patient this can present as early stages of periodontal disease such as swollen, bleeding gums and signs of gingivitis or if the disease has further progressed, the patient could be showing advanced and severe signs of periodontitis that occur with loosening of the teeth. The end result of untreated periodontal disease is the subsequent loss of tooth supporting structures causing eventual tooth loss and associated discomfort to the affected animal. (Harvey 1998; Marreta, 2001)

With the alarming incidence of periodontal disease in adult dog populations and the reality that advanced periodontitis can cause extreme pain for a dog, it is crucial that clinicians always encourage clients to provide adequate dental prophylaxis to their dog.

The development of a comprehensive oral health care program should always include a combination of both veterinary professional care as well as frequent at home preventative care recommendations. Regardless of the method or products used, the goal of all dental at home care should be to always remove plaque from the tooth surfaces and the gingival sulcus before it mineralizes into calculus, a process that can occur within one week (Harvey, et al 1982).

Whilst daily tooth brushing is seen as the gold standard of at home dental care to effectively remove plaque (Harvey, Emily 1993; Wiggs, Lobprise 1997; Holmstrom, Frost, Eisner, 1998), the compliance levels of pet owners is noted to be exceptionally low with approximately only 2% of clients completing the daily tooth brushing recommendations (AAHA 2003). The key to the success of any at home preventative care program is that the recommendation for a patient must be acceptable to the client otherwise as seen by the low brushing compliance rates, a patient may not receive any care at all.

The more successful the client is in caring for their pet's teeth will have a direct correlation to a greater daily removal of plaque, the reduction of tartar build up and also lower the frequency that the pet will require professional dental care and general anesthesia. Whilst clinicians should always focus on teaching tooth brushing techniques, clients must also realise there is no solution to replace adequate at-home care. If daily tooth brushing is deemed impractical for their pet then alternative solutions that will also help reduce plaque accumulations need to be determined for the client to support the dental health and wellbeing of their pet.

The provision of a daily dental chew offers clients a useful alternative to brushing should they be unable or unwilling to brush their pet's teeth. With a distinct advantage of the ease of administering, dental chews are often deemed to be enjoyable for both the client and the pet. Designed to work to mechanically abrade the teeth as the dog chews, dental chews subsequently help disrupt the plaque accumulation (Hennet, 1995). Chewing is hypothesized to also stimulate the flow of saliva, known for having anti-bacterial properties which can additionally help clean the mouth (Gorrel, 2001). Numerous studies have shown that when administered daily, dental chews can reduce dental plaque deposits (Brown & McGenity, 2005; Gorrel & Bierer, 1999; Gorrel & Rawlings, 1996; Gorrel, Warrick & Bierer, 1999) leading to an overall reduction in the accumulation of dental deposits helping maintain periodontal health and increases the time interval between professional periodontal interventions.

With a multitude of dental chew products available and the high variability in their ingredients, texture and shapes, this study was designed to independently investigate the comparative effectiveness between 3 leading dental chews products when administered daily over 28 days. Whilst each dental chew product claims to promote a dental health benefits, this study quantifies the efficacy of each chew to determine if there are product differences in the ability of each chew to reduce plaque, calculus, gingivitis and halitosis.

MATERIALS AND METHODS

Conducted at Summit Ridge Farms, an independent kennel located in Susquehanna, PA, United States, the study involved 80 adult dogs of both sexes aged between 1 and 6 years of age. The dogs were then placed into 4 equal numbered (20 dogs) study groups by stratifying them according to their plaque scores to help reduce the variability between groups. All animals were in apparent good health, with all teeth present, normal occlusion noted and an absence of complete furcation defects at the time of selection for inclusion on this study.

A 7 day pre-test period was included before the 28 day study. Each animal had its teeth scaled and polished on Day -7 and all dogs consumed a reference control diet consisting of an AAFCO complete and balanced commercial adult dry dog food¹ that was fed according to manufacturer recommendations for ideal body condition. On Day 0, each dog's halitosis, gingivitis and plaque were evaluated and scored before each dog's teeth were again cleaned and polished under general anesthesia. The plaque scores determined for each dog were then used to stratify the dogs into 4 groups so that dogs with similar scores were evenly distributed into the 4 study groups. This approach helps ensure that dogs who are predisposed naturally to higher dental issues are not distributed disadvantageously in an attempt to

reduce the variability among the study groups. An equal number of 20 dogs were assigned to each of the study groups with the number of animals used considered adequate to provide a reliable assessment of the efficacy of the test results over 28 days.

STUDY DESIGN

During the test phase (Day 0 to Day 28) all dogs were fed the reference control diet once daily for approximately one hour according to their ideal body condition. Dental Chews administered were the appropriate size for the body weight and age recommendations for the dogs used in the study based on the manufacturer's feeding guidelines.

The following assignments were implemented for the groups:

- ▶ **GROUP 1** Reference Diet Only
- ▶ **GROUP 2** Reference Diet + Chew A
- ▶ **GROUP 3** Reference Diet + Chew B
- ▶ **GROUP 4** Reference Diet + Chew C

The products tested in this study were three different dental hygiene chews all designed for use in adult dogs. All three products are dental chews currently sold globally in the pet specialty channel and produced and designed to support a dog's dental health. Each chew differed in regards to their site of manufacture, ingredients, shape, firmness and texture but all dental chews were consistent in that they each claimed to help reduce dental plaque and promote overall dental health. Dental Chew A is not complete and balanced per AAFCO guidelines for adult maintenance but alternatively intended for intermittent or supplementary feeding use. This chew is also firmer in texture due to an increased fibre content that encourages a longer chew time and is made a limited number of vegetarian ingredients. Chew B and C are formulated to be nutritionally complete for AAFCO guidelines for adult maintenance. These chews are flexible in their texture enabling a faster chew time. All chews had a similar shape being long with varying grooves that enable a dog to easily hold it between their paws while chewing and Chew A and B had a knuckle or toothbrush shape appendage on one end. The test chews were offered to the dogs as received by the manufacturer, unaltered in any way.

Test treats were initially offered to dogs in Groups 2, 3 and 4 approximately 2 hours after the reference diet was removed but after Day 8 all dogs were offered the treat prior to the reference diet due to low treat consumption in the majority of the dogs. The treats were offered for a minimum of one hour and treat consumption recorded daily. During the study no other edible or inedible chews, treats or any other products were offered during any of the phases that might interfere either mechanically or chemically with the study or give any oral benefit to any

of the four groups of dogs.

After 28 days, evaluation of halitosis, gingivitis, calculus and plaque were performed on each dog. Dental evaluations were performed under general anesthesia. Each dog was evaluated for halitosis, gingivitis and calculus by one technician and plaque by a second technician. The qualified dental scorers were furthermore not involved in any study-related activities apart from dental scoring. To further minimise any bias, each dog was identified by a 5 or 7 digit number that had no correlation to the dog's group assignment and all dogs were selected in random order as well as brought into the dental room by a technician other than the dental scorer.

The protocol of this study was reviewed and approved prior to the study initiation by the Summit Ridge Farms' Institutional Animal Care and Use Committee (AICUC) and was in compliance with the Animal Welfare Act.

DENTAL SCORING

HALITOSIS was evaluated with the use of a halimeter with readings obtained by positioning the straw end of the halimeter between the cheek and jaw inside each animal's mouth whilst ensuring that the lips were maintained closed around the straw to ensure accurate readings.

GINGIVITIS was evaluated by a modified gingival index based on Lobene et al. 1986. The MGI scoring system was used with each tooth being assigned a numerical score based on the degree of inflammation. The sum of the teeth scores were divided by the number of teeth examines (18) to obtain a whole mouth mean gingivitis score for each animal.

GINGIVITIS SCORING METHOD

SCORE	DEGREE OF INFLAMMATION
0	Absence of inflammation
1	Mild inflammation; slight change in color, little change in texture of any portion of the marginal or papillary gingival unit, no bleeding on probing
2	Mild inflammation; criteria as above but involving the entire marginal or papillary gingival unit, bleeding on probing within 30 seconds
3	Moderate inflammation; glazing, redness, edema, and/or hypertrophy of the marginal or papillary gingival unit, immediate bleeding on probing
4	Severe inflammation; marked redness, edema and/or hypertrophy of the marginal or papillary gingival unit, spontaneous bleeding, congestion or ulceration

CALCULUS was scored quantitatively using modifications of a method developed by Schiff. Calculus was recorded after air-drying the tooth surface to help distinguish calculus versus plaque by turning the calculus dull and light gray to white in colour. Each tooth was assigned a numerical coverage score based on the total percentage of whole tooth calculus coverage as per the scoring chart below. The sum of the teeth scores was divided by the number of teeth examined (18) to obtain a whole mouth mean calculus score for each animal

CALCULUS SCORING METHOD

SCORE	% OF CALCULUS COVERAGE
0	No calculus coverage
1	1 - 24
2	25 - 49
3	50 - 74
4	75 - 100

PLAQUE was evaluated using a modification of the Quigley and Hein (1962) (Turesky, 1970) plaque index. Plaque coverage and plaque thickness were assessed by placing a disclosing agent (2% Eosin) on the teeth and rinsing off the excess with tap water. The teeth were visually halved horizontally into gingival and occlusal halves. The score of each tooth was calculated by multiplying the coverage and thickness scores. The sum of the teeth scores was divided by the number of teeth evaluated (18) to obtain a whole mouth mean plaque score per animal. Plaque formation was then scored according to the table below:

PLAQUE SCORING METHOD

SCORE	% OF CALCULUS COVERAGE
Score	% of Plaque Coverage
0	No plaque coverage
1	1 - 24
2	25 - 49
3	50 - 74
4	75 - 100

SCORE	PLAQUE THICKNESS	DISCLOSING AGENT COLOR
1	Light	Pink to Light Red
2	Medium	Red
3	Heavy	Dark Red

RESULTS

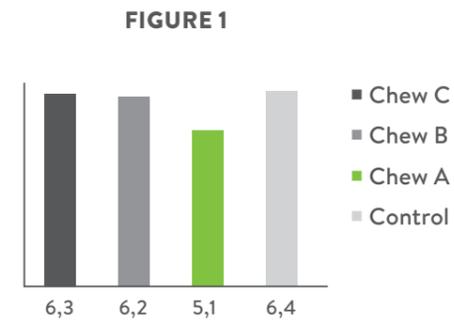
Significant reductions were noted on Day 28 in the recorded results for Chews A, B and C versus the control group and key differences were highlighted between the Dental Chews across the results in plaque,

tartar, gingivitis and halitosis. On Day 28 Chew A had statistically significant reductions in plaque, tartar, gingivitis and halitosis with mean reductions calculated at 19% < the mean plaque score of control dogs, 78% < the mean tartar reduction, 64% < the mean gingivitis reduction and 37% < the mean halitosis reduction. On Day 28 Chew B had only a statistically significant reduction of 38% < the mean tartar reduction and achieved non statistically significant reductions of 3% < the mean plaque reduction, 10% < the mean gingivitis reduction and 13% < the mean halitosis reduction. On Day 28 Chew C had only statistically significant reductions of 48% < the mean tartar reduction and 42% < the mean gingivitis reduction and achieved non-statistically significant results of 0.6% < the mean plaque reduction and 16% < the mean halitosis reduction (Figures 1-4)

The presence of inflammation, ulceration or laceration anywhere in the oral cavity was not observed in any of the dogs during the dental scoring on Day 0 and Day 28. Adverse clinical signs were not observed in any of the dogs during the conduct of the study.

The mean average weight change for dogs receiving the control diet only was -0.20kg (-1.59%) and the mean average weight change for dogs receiving the test treat was -0.57kg (-4.59%)

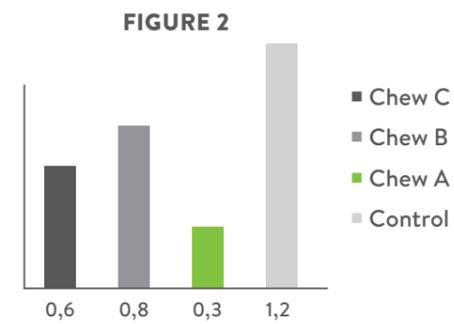
Dogs that did not meet the body weight requirement or consistently declined the treats were removed from analysis. Mean scores, standard error and standard deviation functions were performed on all dental parameters with statistical comparisons made between Group 1 (control) and Groups 2,3 and 4 (Dental Chews A, B and C). Individual t tests were performed on all data in Group 2 and data from Group 2 and 4 that exhibited normal distribution. If the data was found not to have a normal distribution, a non-parametric analysis (Kruskal-Wallis) was used to determine statistical significance.



PLAQUE REDUCTION %

Group 2 - Chew A	19.1% **
Group 3 - Chew B	3%
Group 4 - Chew C	0.6%

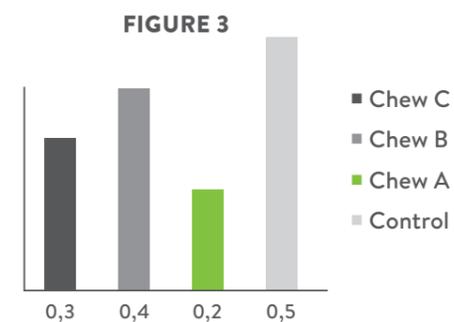
** t Test statistically significant (P<0.01) compared to Gr1



TARTAR REDUCTION %

Group 2 - Chew A	78.4% >>
Group 3 - Chew B	38.2% **
Group 4 - Chew C	48.9% **

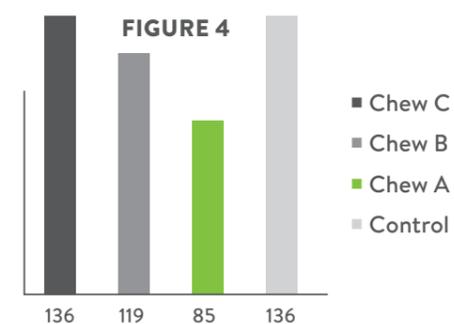
** t Test statistically significant (P<0.01) compared to Gr1
>> Kruskal-Wallis statistically significant (P<0.01) compared to Gr1



GINGIVITIS REDUCTION %

Group 2 - Chew A	64.7% **
Group 3 - Chew B	10.2%
Group 4 - Chew C	42.6% **

** t Test statistically significant (P<0.01) compared to Gr1



HALITOSIS REDUCTION %

Group 2 - Chew A	37.5% >>
Group 3 - Chew B	13.1%
Group 4 - Chew C	16.6%

>> Kruskal-Wallis statistically significant (P<0.01) compared to Gr1

DISCUSSION

The gold standard for at home dental care remains the recommendation that clients should be educated on how brush their pet's teeth on a daily basis to help remove plaque and calculus accumulations to intern support gingival health and minimise breath malodour. Challenging the success of this recommendation however is the extremely low compliance rates amongst dog owners with 98% estimated to not follow this recommendation (AAHA 2003). Dental chews make for a suitable adjunctive measure for at home dental care and numerous studies have shown that when administered daily, dental chews can reduce dental plaque deposits (Brown & McGenity, 2005; Gorrel & Bierer, 1999; Gorrel & Rawlings, 1996; Gorrel, Warrick & Bierer, 1999) leading to an overall reduction in the accumulation of dental deposits helping maintain periodontal health and increases the time interval between professional periodontal interventions.

With so many companies recognizing the commercial opportunity of dental chews, the number of brands available with varying unique features and claims has increased substantially in the past decade making the selection process challenging with each brand all communicating similar messages. Numerous studies have shown the benefit of dental chews to kibble and other adjunctive measures but scientific data was limited in the direct comparison between differing dental chew products. As this 28 day study demonstrated the associated reductions in plaque, tartar, halitosis and gingivitis are highly variable suggesting that the texture and ingredients of each chew plays a substantial role in the performance. Only Chew A was able to achieve a statistically significant reduction across all four dental health measures including plaque, the key objective of reduction for at home dental care.

Whilst total chew time or the number of bites per treat were not recorded, it can only be hypothesized that one of the key reasons for this performance difference of Chew A over Chew B and C is the increased fibre and firmer texture which promoted a greater abrasive action against the tooth surface and longer chew time leading to a more effective tooth cleaning. Chew B and C showed a reduced efficacy overall with lower mean results in all areas measured versus Chew A. Similar hypotheses could therefore also be drawn in that as these chews have a softer and more flexible texture that they may not provide an as effective chewing action or duration that was required to promote a comparative improvement across all four dental health indicators measured. Further investigation is recommended to completely understand the correlation between the texture of a chew and the associated mechanical abrasion performance and chew time duration.

With so many brands available, this study highlights the importance of clinicians recommending products that

will best support the success of their clients at home dental care programs by ensuring the dental chew the client uses is scientifically proven to promote the reduction in dental deposits for optimal oral care health.

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