

Unraveling a Commercial Formula to Relieve Halitosis in Dogs

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KEY WORDS: Halitosis, clinical evaluation, nutraceutical diet, oxytetracycline

ABSTRACT

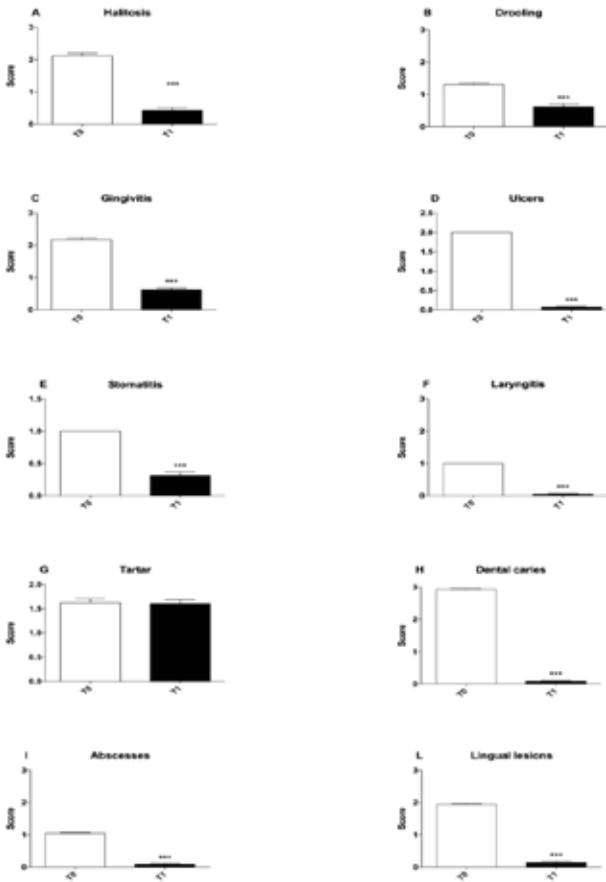
Halitosis represents a cause of social problems despite of the availability of commercial aids to counteract it. A dietary approach represents an innovative solution. The aim of this clinical evaluation was to assess the efficacy of a commercially available nutraceutical diet in a cohort of dogs suffering from chronic halitosis and manifesting at least one symptom among drooling, gingivitis, ulcers, stomatitis, laryngitis, tartar, dental caries, abscess, lingual lesions. Dogs were fed the nutraceutical diet over a period of 30 days, receiving a veterinary inspec-

tion before and at the end of the evaluation. Most of symptoms resulted in significant improvement at the end of the evaluation period. We hypothesize that halitosis may be a consequence of a daily intake of food contaminated with oxytetracycline.

INTRODUCTION

Halitosis, produced by gram-negative bacteria present within the mouth, is considered a cause of social problems.¹ Amino acids, the main energy source of such bacteria, are responsible for the production of some volatile sulphur compounds (i.e. methyl mercaptan, hydrogen sulfide and dimethyl sulfide). As a consequence of a high protein intake, dogs and cats can easily develop halitosis. Clinical studies also revealed that dogs and

Figure 1. Graphical representations of score trend of each symptom before (T0) and after 30 days of evaluation (T2). (A) halitosis; (B) drooling; (C) gingivitis; (D) ulcers; (E) stomatitis; (F) laryngitis; (G) tartar; (H) dental caries; (I) abscesses; (L) lingual lesions, *** $p < 0.001$.



cats can develop plaque deposits on the teeth and tongue, representing another source of oral malodor and even periodontal disease.²⁻⁴ According to literature reports, oral malodor and periodontal disease result from a 2-stage process that begins with microbial biofilm accumulation and flows into an inflammatory reaction.

However, as a matter of fact, daily tooth brushing, which is considered the most reliable approach to remove plaque and in turn reduce the onset of gingivitis, periodontal disease, and oral malodor,⁵ is accomplished only by approximately 2% of pet owners.⁶

Many effective aids have been proposed and commercialized to counteract halitosis and dental plaque formation such as chews,⁷ treats,⁸ drink solutions,⁹ and topical gels.¹⁰ However, a dietary approach to fulfil both daily nutritional requirements and improve halitosis could represent an innovative solution for “lazy” but careful pet owners.

The diet used in this clinical evaluation consisted in a mixed formula of fish proteins and rice carbohydrates enriched with *Ribes nigrum*, *Salvia officinalis L*, *Thymus L*, egg white lysozyme, propolis, bioflavonoids, and vitamin C. Literature reports highlighted the *in vitro* antibacterial activity exerted by *Ribes nigrum* (blackcurrant) juice on bacterial strains associated with gingival inflammation, oral malodour, and dental caries formation.¹¹⁻¹² An antimicrobial activity was also observed for *Salvia officinalis L* (Sage) that, in a tablet formulation with Lavender and Mastic or zinc gluconate, also significantly reduced volatile sulphide compound (methylmercaptan and hydrogen sulphide) levels.^{13,14}

On the other hand, *Salvia officinalis L* has been also used for the treatment of ulcers and inflammation.¹⁵ As to bioflavonoids and vitamin C, they have shown anti-inflammatory and bacteriostatic activity, while propolis, rich in flavonoids endowed with antibacterial, antifungal, antiviral, antioxidant, and anti-inflammatory proprieties, is used for plaque control, oral lesions treat-

ment, intracanal medicaments, and wound healing.¹⁶⁻¹⁸

The aim of this clinical evaluation was to assess the efficacy of a commercially available nutraceutical diet in a cohort of dogs suffering from chronic halitosis and manifesting at least one symptom among drooling, gingivitis, ulcers, stomatitis, laryngitis, tartar, dental caries, abscess, or lingual lesions.

MATERIALS AND METHODS

One hundred four dogs of different breeds (mean age \pm SEM; 6.8 ± 0.3 years and mean weight \pm SEM; 31.22 ± 0.6 Kg; 68 males, 36 females) suffering from chronic halitosis and manifesting at least one symptom among drooling, gingivitis, ulcers, stomatitis, laryngitis, tartar, dental caries, abscess, and lingual lesions were enrolled in this clinical evaluation. Dogs were fed a commercially available nutraceutical diet over a period of 30 days.

Operative procedures and animal care were performed in according to national and international regulations (Italian regulation D. Lgs. 116/1992 and European Union regulation 86/609/EC). ARRIVE guidelines in animal research were also consulted and considered.¹⁹

The Diet

The diet was industrially prepared according to recommendations of Nutritional Guidelines established by The European Pet Food Industry Federation. It was composed of dry kibbles and heart-shaped tablets composed of 60-80% hydrolyzed proteins and 20-40% minerals added to titrated and standardized nutraceutical substances (*Ribes nigrum* 0.0040%, *Salvia officinalis* L 0.0087%, *Thymus* L 0.0127%, egg white lysozyme 0.0078%, propolis 0.0161%, bioflavonoids 0.0077%, and vitamin C 0.025%).

Symptoms Evaluation

All dogs received veterinary inspections before and at the end of the evaluation. Halitosis, drooling, gingivitis, ulcers, stomatitis, laryngitis, tartar, dental caries, abscess, and lingual lesions were graded by a well-trained

vet according to the following score: 0 = absent, 1 = tolerable, 2 = moderate, 3 = marked.

Statistical Analysis

Data were analyzed using Prism 6 (Graph-Pad software, Inc., San Diego, USA). All data are presented as the means \pm standard error of the mean and were first checked for normality using the D'Agostino-Pearson normality test. Differences in drooling, gingivitis, ulcers, stomatitis, laryngitis, tartar, dental caries, abscess, and lingual lesions before (T0) and at the end of the evaluation period (T1) were analyzed using a Mann-Whitney test. A value for $*p < 0.05$ was considered significant.

RESULTS

One hundred four dogs suffering from chronic halitosis and manifesting at least one symptom among drooling, gingivitis, ulcers, stomatitis, laryngitis, tartar, dental caries, abscess, and lingual lesions were enrolled in this evaluation, and received a commercially available nutraceutical diet for 30 days. No adverse effects were reported during the evaluation. In Figure 1, the score trend of each symptom, before (T0) and at the end of the evaluation period (T1), are shown.

Halitosis significantly decreased from a T0 score of 2.11 ± 0.08 to 0.43 ± 0.07 at T1 ($***p < 0.001$). Also drooling resulted significantly decreased from a T0 score of 1.31 ± 0.04 to 0.61 ± 0.09 at T1 ($***p < 0.001$). A similar trend was observed also for gingivitis, ulcers, stomatitis, laryngitis, dental caries, abscesses, and lingual lesions. In particular:

- gingivitis significantly decreased from a T0 score of 2.17 ± 0.05 to 0.62 ± 0.04 at T1 ($***p < 0.001$)
- ulcers significantly decreased from a T0 score of 1.98 ± 0.01 to 0.08 ± 0.02 at T1 ($***p < 0.001$)
- stomatitis significantly decreased from a T0 score of 1.01 ± 0.01 to 0.33 ± 0.04 at T1 ($***p < 0.001$)
- laryngitis significantly decreased from a T0 score of 1.02 ± 0.01 to 0.03 ± 0.01

at T1 (**p < 0.001)

- dental caries significantly decreased from a T0 score of 2.9 ± 0.02 to 0.07 ± 0.02 at T1 (**p < 0.001)
- abscesses significantly decreased from a T0 score of 1.04 ± 0.02 to 0.08 ± 0.02 at T1 (**p < 0.001), and
- lingual lesions significantly decreased from a T0 score of 1.94 ± 0.02 to 0.14 ± 0.03 at T1 (**p < 0.001).

DISCUSSION

We found that a nutraceutical based on *Ribes nigrum*, *Salvia officinalis* L, *Thymus* L, egg white lysozyme, propolis, bioflavonoids, and vitamin C significantly improved halitosis and related symptoms in a cohort of dogs. These results are in agreement to what we previously observed in dogs affected by chronic halitosis achieving an overall and long-lasting improvement due to a significant reduction of methyl mercaptan, hydrogen sulfide, and dimethyl sulfide.²⁰

Canine halitosis, a very common complaint for pet owners, is known to have different origins such as gastrointestinal disorders, renal failure, and respiratory infections.^{2,3} Along with gingivitis, ulcers, stomatitis, laryngitis, abscess, and lingual lesions, halitosis shares an overall inflammatory condition that can also be a consequence of a daily intake of contaminated food.^{21,22} In fact, we recently identified the presence of an antibiotic (oxytetracycline), widely used in the intensive farming²³ that tends to bind bone of treated animals remaining fixed for long periods, causing inflammatory and cytotoxic phenomena *in vitro* (24-27) and *in vivo*.^{21,22,28} Moreover, the bone percentage employed in pet food production ranges between 20-30% v/v. In light of these observations, we hypothesize a role for oxytetracycline as a possible cause of the inflammatory condition that characterizes halitosis, and that a diet deprived of such antibiotic may represent a valuable alternative to counteract such unpleasant condition.

Statement of Authorship

The authors hereby certify that all work con-

tained in this article is original. The authors claim full responsibility for the contents of the article.

Conflict of Interest

The authors confirm that they do not have any conflict of interest

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