

Studies Confirm That Reformulated Greenies® Canine Dental Chews Are More Soluble, Digestible And Easier To Chew

In 2006, veterinary internal medicine specialists reported esophageal and small intestinal obstructions linked to the canine dental chew category, which included Greenies® brand dental chews. S&M NuTec, LLC “The Greenies Company,” in consultation with specialists in the fields of veterinary gastroenterology, dentistry and nutrition, introduced a new formulation for its Greenies® dental chews in September 2006. The formulation was specifically designed to address potential issues, employing:

- Protein isolates selected for high solubility and digestibility.
- Biometric studies of various skull shapes and sizes of dogs. Each of the five product sizes—based on weight ranges—was created to be easily chewed by dogs with the weakest bite force in each of the respective weight ranges.¹
- Subtle but important changes to the product’s iconic toothbrush shape. Grooves, ridges and other refinements to the shape encourage thorough chewing and lessen the likelihood of dogs biting off large chunks.

Two studies—one internal and one independent—confirm that the new formulation is highly soluble and not likely to cause obstructions in the esophagus or small bowel. Solubility in these cases is defined as the susceptibility or extent of a solid dissolving or breaking down in a liquid.

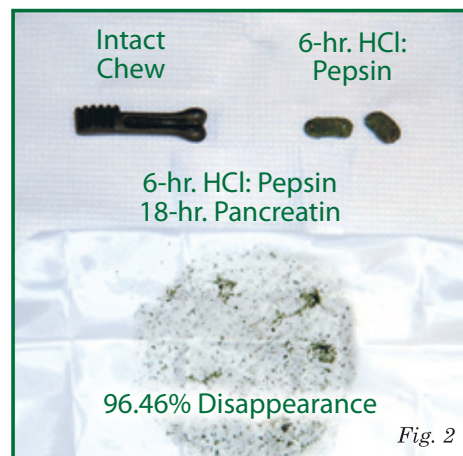
In the first study,² Greenies® canine dental chews were exposed to a canine saliva solution designed and employed extensively by the WALTHAM® Centre for Pet Nutrition. This internal study simulated solubility of the product in the mouth and esophagus. Intact Petite Greenies® dental chews were exposed to the saliva solution at a pH of 8.5. Gentle motion was used to ensure that the chews remained bathed in the solution. There was no abrasive contact. The proteins in the reformulated chew were shown to be readily soluble, and the chew became soft and mushy. After six hours, the chews had lost structural integrity. (Fig. 1)



The second study³ was conducted by Dr. George Fahey, Professor, Animal and Nutritional Sciences, University of Illinois at Urbana-Champaign. The study employed an *in vitro* system based upon established, respected models developed by Boisen and Eggum⁴ and Boisen⁵ that involves two steps simulating gastric and small intestinal digestion.

The study steps include exposing intact samples of each of the five sizes of Greenies® dental chews to enzyme solutions at a fixed pH and temperature during a fixed period of time. For gastric digestion, Greenies® dental chews were exposed to hydrochloric acid and pepsin at a pH of 2.0 for six hours. After gastric digestion, the samples were then exposed to pancreatic enzymes at a pH of 6.8 for 18 hours, simulating small intestinal digestion.

Outcomes of both the gastric and small intestinal digestion are determined by the percent disappearance of solid matter, among other measures. In the Greenies® dental chew study, outcomes measured also included the percent dissolvability and decrease in dimensions of the intact dental chews.



All sizes of the new formulation Greenies® dental chews, tested as intact chews, broke down and lost structural integrity. (Fig. 2, Petite Greenies®)

Within minutes of contact with a liquid, the surface of Greenies® dental chews begins to hydrate and become soluble. Proper and complete chewing of Greenies® dental chews—as will happen in a majority of dogs—and mechanical action *in vivo* should further enhance their solubility by increasing the surface area exposed to saliva and digestive fluids. Any residue remaining after digestion will be soft with no intact, hard pieces. In addition, both tests indicate that the reformulated chew is highly soluble regardless of the pH of the fluid.

Clinics that would like to see for themselves may request a sample Greenies® dental chew at www.greenies.com.

¹ Biometric studies of various skull shapes and sizes of dogs, Mars Petcare USA, 2005. Data on file.

² Greenies® canine dental chews shown to dissolve in a canine saliva solution, S&M NuTec, LLC, 2007. Data on file.

³ *In vitro* solubility of Greenies® canine dental chews, Dr. George Fahey, University of Illinois, 2007. Data on file.

⁴ Boisen, S., and B.O. Eggum, 1991. “Critical evaluation of *in vitro* methods for estimation of digestibility in simple-stomach animals.” *Nutr. Res. Rev.* 4:141–162.

⁵ Boisen, S. 1991. “A model for feed evaluation based on *in vitro* digestible dry matter and protein.” *Digestion In Vitro*. M.F. Fuller, editor, pp. 135–145. Commonwealth Agricultural Bureaux International, Slough, UK.