Food Allergy in Dogs

Food allergy, or food hypersensitivity, is an immunologically-mediated, adverse reaction to an ingested food. Food hypersensitivity may contribute to pruritus in up to 62% of dogs presenting with non-seasonal allergic skin disease. In addition to dermatologic symptoms, food hypersensitivity appears to be involved in some chronic gastrointestinal diseases of dogs. Proper and effective nutritional management of food hypersensitivity requires an understanding of mechanisms by which food interacts with the physiological systems responsible for the symptoms. This article provides a review of food hypersensitivity, including an overview of the underlying mechanisms and a critical evaluation of the types of dietary management employed to control the condition.

Figure 1: Three Natural Defense Systems Against Development of Food Allergies
Food Allergy in Dogs

continued from page 1

What Is a Food Allergen?
Food allergens are almost exclusively proteins. All dietary proteins are potentially allergenic because they are recognized as foreign by the body’s immune system. The ability of a dietary protein to induce a hypersensitivity appears dependent upon the size and structure of the protein. Most common food allergens are proteins with molecular weight of 18,000 to 36,000 daltons.3

Exposure to Food Allergens
The gastrointestinal tract offers an unusual environment that can significantly affect the structure of most molecules.4 Most labile food allergens are rendered immunologically inactive during the digestive process.5,6 However, some food proteins remain immunologically active, pass through the epithelium and enter the circulatory system or lymphatic system.7-14

A dog’s gastrointestinal tract processes a tremendous amount of food through its lifetime; thus, it is exposed to great quantities of a vast array of potential allergens. Yet only a small percentage of the canine population develops food hypersensitivity. It is clear that the gastrointestinal system is designed to avoid potential deleterious immune responses to food.

Natural Defenses Against Exposure to Food Allergens
Given the obligate exposure of the gastrointestinal tract to many potential allergens, it is not surprising that this organ has evolved to provide defense mechanisms that prevent foreign, intact proteins from gaining entry into the body. Figure 1 illustrates the normal defense mechanisms utilized by the dog to prevent food hypersensitivity.

Digestion of protein represents the most common and effective preventive process. However, not all protein is reduced to non-antigenic size. In humans, intestinal uptake of small quantities of immunologically intact macromolecules occurs in adults15 prompting immune responses even in normal individuals.11

Effect of Sodium Intake on Mean Arterial Blood Pressure in Normal Cats


Cats fitted with radiotelemetry implants were used to measure the effects of dietary sodium, angiotensin converting enzyme (ACE) inhibitor or nitric oxide production inhibitor on systemic arterial blood pressure. In normal cats, there was no difference in mean arterial pressure (106.3 +/- 9.3 vs 105.3 +/- 9.9 mmHg) in cats fed a low sodium diet (35 mg/kg body weight) or a normal sodium diet (65 mg/kg body weight). The combined use of ACE inhibitor and sodium restriction resulted in decreased blood pressure and increased heart rate (p < 0.05). Use of the nitric oxide inhibitor and normal sodium diet resulted in increased blood pressure and reduced heart rate (p < 0.05). Whether or not the treatment effects noted will occur in hypertensive cats or cats with cardiovascular disease remains to be determined. Regardless of treatment, increases in blood pressure were observed whenever laboratory or research personnel were present. This suggests that clinical measurements of indirect blood pressure will deliver a value that is different from a cat’s normal blood pressure due to the cat’s response to handling.
(GALT). In most food antigen exposures, hypersensitivity is prevented via the carefully controlled exposure of small quantities of intact proteins to the GALT. Suppression of local and systemic immune responses upon subsequent antigen exposure (oral tolerance) is apparently achieved by involvement of T-suppressor cells which prevent over-reactivity. Breakdown in any of these defense systems may predispose the animal to food hypersensitivity.

**Mechanism of Food Allergy**

IgE-mediated reactions to antigens are termed allergies. As depicted in Figure 2, the antigen is presented to specific immune cells which respond by triggering the production of allergen-specific IgE. The IgE antibodies attach to and sensitize circulating immune cells. If these sensitized cells come in contact with the allergen, a cross-link is formed, bridged by the surface bound IgE which triggers cell degranulation with release of stored or new mediators. These mediators in turn elicit the clinical signs and symptoms of allergic diseases.

**Nutritional Management of Food Allergy**

**Novel-protein strategy**

Nutritional management of food hypersensitivity involves the identification and avoidance of the offending antigenic protein. Identification of the specific dietary protein responsible for the hypersensitivity requires that the dog be fed an elimination diet containing no ingredients previously ingested for an extended period. Three week elimination-diet feeding trials are common in many clinics, although longer periods may be required before symptoms resolve. If symptoms remain after an appropriate feeding trial, food hypersensitivity can likely be ruled out. If symptoms resolve during the elimination-diet feeding trial, food hypersensitivity should remain a candidate diagnosis.

Confirming identification of the specific offending protein(s) requires single-protein challenge testing. Each protein source previously ingested by the dog must be individually included in the dog’s diet for another pre-determined period.

**Clinical Signs of Food Allergy in Dogs**

Distribution of pruritus in 51 dogs with suspected food allergy. Most dogs were affected in multiple locations. For 24%, pruritus in the ear region was the only clinical sign.

**The Bacterial Flora in the Proximal Small Intestine of Healthy Cats Fed a Dry Cat Food Diet**

Nearly 60 different species of bacteria were isolated and identified from the small intestine of normal, healthy cats fed a nutritionally complete dry cat food. Common isolates included *Clostridium perfringens, Enterococcus faecalis, Streptococci, E. coli.* and others. Aerobic and anaerobic bacteria were identified in 100% and 92% of the samples, respectively, with mean bacterial counts of 5.6 +/- 1.0 (aerobic), 4.9 +/- 1.1 (anaerobic) and 5.8 +/- 0.9 (total), all expressed as log10 cfu/ml +/- SD. The numbers of bacteria isolated varied considerably within individual cats, despite continuing on a single diet. This study suggests that significant bacteria counts are normal in the small intestine of cats and substantial fluctuations in the flora occur over time in individuals while maintained on the same diet.
time period. If symptoms reappear, followed by resolution after removal of the suspected protein, the dog likely has developed a hypersensitivity to that specific protein. The dog can then be fed a diet which does not contain that specific protein source. Many “novel-protein” products are available which are formulated with ingredients not commonly found in pet foods.

Novel-protein products are not hypoallergenic. The effectiveness of any novel protein in reducing symptoms associated with food sensitivity is due only to its novelty. No intact animal or vegetable protein is known to be inherently less allergenic than another. The “novel-protein” strategy can fail if the animal develops a hypersensitivity to the new protein. This situation is not uncommon in dogs suffering from inflammatory bowel disease, presumably because of mucosal barrier failure.

**Modified protein strategy**

Unlike the “novel-protein” strategy, molecular modification of dietary protein alters the physical characteristics of the molecules, rendering the protein unable to elicit an immune response. Molecular alteration through proteolysis can be used to produce proteins that are truly hypoallergenic. To be effective, this process must reduce the molecular weight of the protein below 18,000 daltons, which represents the lower limit for most common food antigens.

**Conclusions**

Many dogs that suffer from allergic conditions would likely benefit from nutritional management. “Novel protein” products are now readily available. These “novel-proteins” are not hypoallergenic and their effectiveness in reducing the symptoms associated with food hypersensitivity is due only to the fact that the animal may not have been previously exposed to that specific protein. If a genetic predisposition exists, or if the intestinal mucosal barrier is damaged, the dog may become sensitized to the “novel” protein.

Based on the underlying immunological mechanisms responsible for food hypersensitivity, feeding the animal a diet containing protein modified to achieve an average molecular weight well below 18,000 daltons should prove beneficial.

**REFERENCES**


**Diagnosing Food Allergy in Dogs**


The current recommendation for an elimination diet trial to diagnose food allergy is to feed a novel antigen diet for three weeks. Fifty-one dogs suspected of food allergy participated in a prospective study to determine if this is an appropriate recommendation. Dogs were fed a home cooked diet with a single novel meat and grain (e.g., lamb and rice) based on individual diet history for at least 60 days. If equivocal results were achieved at 60 days, an additional 30 days were allowed. For many dogs, up to 10 weeks were required to achieve complete resolution of clinical signs. Up to two weeks were required for signs to reoccur following challenge with the previous diet.
Effects of dietary oilseed supplements on subjective measures of skin and hair coat were evaluated in adult dogs. Dogs were acclimated to a complete and balanced basal diet for two weeks, then supplemented with either 3% w/w whole ground flaxseed (FLX) or 3% w/w whole ground sunflower seed (SUN). The diets contained high linoleic acid (i.e., more than two to three times the AAFCO profile). The FLX diet had about six-fold greater α-linolenic acid than the SUN diet. Diets were fed for 84 days and assessments performed on days 0, 14, 28, 56 and 84. Plasma phospholipid fatty acid profiles were used to assess changes in poly-unsaturated to saturated fat ratios (P/S). Skin and hair coat scoring was conducted by six evaluators. Pearson Correlation Coefficients were used to identify evaluator correlations for subsequent ANOVA analysis. For hair assessments, five out of six evaluators correlated with each other; for skin scores, four out of six evaluators correlated. Hair coat evaluations, matched for time, revealed no significant differences between the two diet groups by ANOVA. However, a significant time effect overall was found and analysis of the combined data revealed significant improvement (more reflective and soft, p = 0.002) of hair score on day 28 compared with day 0, but not thereafter. No time or diet effects or time/diet interactions were seen in skin condition scores but an improvement (p = 0.008) between day 14 and day 28 was noted in the FLX group. Dogs in this group had somewhat lower scores than the SUN group at the start (day 0) and on day 14. Improvements with oilseed supplements may be more noticeable in animals starting with less than optimal skin scores. It is concluded that whole flaxseed or sunflower seed supplements can result in hair coat improvement over a short-term period. We hypothesize that, with high linoleic acid diets, modest improvements in skin and hair coat scores occur with polyunsaturated oilseed supplements and are mediated by an overall P/S effect rather than by polyunsaturated fat type.

Bauer JE et al., reprinted from the 1997 Purina Nutrition Forum Proceedings

---

**Research Abstracts**

**The Influence of Feeding on Serum Feline Trypsin-like Immunoreactivity (fTLI)**

The goal of this study was to evaluate the potential change in serum fTLI after feeding healthy cats two different diets. Six domestic shorthair cats owned by volunteers were enrolled into the project. Cats were assigned to two groups. Group A (cats 1, 2 and 3) was fed diet 1 (Purina CNM CV-Formula feline canned diet, 42.53% protein and 26.79% fat) during the first 10 days of the first study period, while Group B (cats 4, 5 and 6) was fed diet 2 (Purina CNM UR-Formula feline dry diet, 35.43% protein and 11.61% fat) during the same period. On day 11, cats were admitted to the hospital, sedated, and jugular catheters were placed. After withholding food for a total of 24 hours, blood for serum fTLI assay was taken and the cats were offered one-half their daily caloric allowance. After one hour, the food was removed and another blood sample for fTLI assay collected. Subsequent samples for fTLI assay were taken at 2, 4, 6, 12 and 24 hours. During the second study period, all cats were fed the other diet and the study was repeated. Data were analyzed by repeated measures ANOVA. The mean serum fTLI of the five cats on diet 1 (cat 6 refused to eat during the second study period and was therefore excluded from analysis) over all time points was 22.66 ug/l (SD 5.75 ug/l; range 13.7 - 44.8 ug/l) and was 21.06 ug/l (SD 4.96 ug/l; range 13.9 - 36.6 ug/l) in the six cats on diet 2.

There were no statistically significant differences (α = 0.01) in serum fTLI concentration between cats fed the two different diets (p = 0.4553) nor in serum fTLI concentrations for the seven time points (p = 0.086), or when the first and second time point were compared alone (p = 0.1587). In conclusion, serum fTLI in normal cats does not increase significantly after feeding. Whether feeding changes serum fTLI in cats suffering from acute or chronic pancreatitis or exocrine pancreatic insufficiency remains to be determined.

Steiner JM, Williams DA., adapted from the 1997 Purina Nutrition Forum Proceedings

---

**Effect of Dietary Flaxseed and Sunflower Seed Supplements on Skin and Hair Coat Evaluations in Dogs**

The effects... may be more noticeable in animals starting with less than optimal skin scores.
Hypoallergenic Diets

continued from page 1

dog food provides true hypoallergenic qualities. Since the antigenic content of the diet is directly proportional to the protein content, a hypoallergenic diet should provide adequate, but not excessive, protein to the animal.

A truly hypoallergenic diet should be formulated to restrict the use of other ingredients which might contribute significant amounts of intact protein. Carbohydrates and fat should be provided by ingredients that minimize additional protein contribution to the diet. Starches contain virtually no protein whereas whole grains and flours contain protein levels of 4 to 8%. Animal fats should be avoided since these ingredients may contribute significant animal proteins. Careful attention to the other components of the diet can help minimize exposure to proteins from other ingredients such as the fat and carbohydrate source. Even the carrier systems used in vitamin and mineral premixes should be scrutinized as potential protein contributors.

Stringent quality control should be employed by the manufacturer to assure the product meets the criteria of a hypoallergenic product. ELISA testing of the protein source used in formulation of the product and of the product itself will assure that the protein modification process successfully altered the physical characteristics of the protein such that the epitopes which can stimulate the immune system are no longer recognized by antibodies of the un-modified protein. Protein molecular weight distributions of the product should indicate a clear reduction in high molecular weight protein and confirm that the vast majority of the protein in the product is derived from the modified protein ingredient.

Diets with these characteristics may also be used as elimination diets to aid in diagnosis of food hypersensitivity and in identification of offending allergens. If complete and balanced, such diets may also be effective for long-term maintenance of allergic dogs. ☞