

# ASPECTS OF FOOD AND FOOD SUPPLEMENTS IN SKIN DISEASE

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The skin is the largest organ of the body, representing between 12% and 24% of body weight. The skin performs a myriad of functions, most important of which is protecting the internal organs. It also regulates body temperature, stores and synthesizes nutrients, receives sensory input, regulates immune functions, and provides pigmentation. Because of its size and very active metabolism, the skin uses a large proportion of the body's energy and nutrients (up to 30% of the animal's daily protein intake.) Therefore, the quality and quantity of food has a direct effect on the skin; malnutrition, food allergy, or intestinal problems can result in skin disease.

In general, the nutritional requirements of the skin are similar to those of the rest of the body. During the past two decades, the scientific and medical community have focused their attention on animal nutrition. Guidelines for nutrient requirements have been established for livestock and companion animals. Requirements for specific nutrients are constantly updated as medical knowledge increases. Because many superbly formulated commercial diets are readily available for companion animals, nutritional deficiencies and imbalances are uncommon. In general, it can be difficult to determine if a dermatosis has a nutritional basis because skin diseases can look similar despite widely varied causes. Scaling, hair loss, and a dull haircoat are commonly associated with nutritional disease; however, these signs are frequently seen in other dermatoses as well. Confirming a nutritional dermatosis requires diagnostic testing as well as clinical improvement of the skin in response to specific diet manipulations.

## FOOD HYPERSENSITIVITY

This article focuses on three nutrition-related topics affecting the health of the skin. The first, cutaneous food hypersensitivity, is an often suspected, but infrequently diagnosed, cause of dermatitis. Food hypersensitivity is the least common allergic cause of skin disease in the dog, yet food is often incriminated when itching and scaling are present. Food allergy may represent less than 1% of the cases of skin disease seen in general practice and less than 10% seen in the dermatology practice. Ingested materials provide a constant barrage of potential allergens to the intestine. Major food ingredients of commercial diets are similar to the "table scrap" diets of yesterday, so it is unlikely that many dogs are allergic to their diets. The plethora of special "hypoallergenic" diets on the market has caused great confusion and has made it difficult to diagnose food allergy. Thus, other causes of skin disease must be investigated before blaming the problem on food allergy.

The body obtains the nutrients it needs by absorbing substances via the intestinal tract. Dramatic changes occur from the time food is chewed until unused waste products are excreted. Digestive enzymes from the salivary glands and stomach reduce proteins and carbohydrates to basic compounds, normal gut bacteria degrade less digestible nutrients, and gastrointestinal cells alter and absorb molecules, bringing food particles into the body. These nutrient components may then join other molecules for transportation, and are finally altered by individual body cells for their use. At any point along this route, nutrient molecules can either lose or gain their allergenic potential. Proteins are especially good allergens. Therefore, when considering food as a possible cause for allergic skin disease, three concepts are important to remember: (1) allergic skin reactions caused by food are uncommon; (2) the specific nutrient that becomes allergenic may not be in the same form as it was when ingested; and (3) proteins are more likely to cause reactions than are other nutrients.

With cutaneous food allergy, the allergenic nutrient is usually a major component of the food or food additive. Unless drastic changes occur in the diet formulation, most dogs will receive the allergen daily. The ingredients commonly associated with allergy include beef, milk products, and grains. Sensitization can be very gradual, and most dogs that develop cutaneous food allergy have eaten the offending diet for months or years. Breeds that may be predisposed to food allergy include the miniature schnauzer, golden retriever, West Highland white terrier, Scottish terrier, and Shar pei. Food allergy has been reported most often in dogs under six months of age and in dogs over six years of age.

The immune response to a food allergy is believed to be an immediate-type hypersensitivity. The body produces a specific antibody against the food allergen. When the allergen is ingested, it combines with its antibody and causes specialized immune cells (mast cells) to release histamine and other potent inflammatory chemicals. Other types of immunologic responses have been proposed for food hypersensitivity and the precise mechanism responsible for food allergy is probably quite complex.

Cutaneous food allergy reactions can look like many itchy or non-itchy dermatoses. Severe itchiness is usually present with this condition and can result in self-mutilation. The itch associated with food allergy does not vary with the season of the year. Nonetheless, if the animal has concurrent seasonal allergies, the signs of disease may worsen when these other allergies flare-up. Clinical signs of disease vary, but tend to localize around the face and neck. Severe and recurrent ear infections, face-rubbing, licking between the toes, and scratching of the neck and armpit regions are signs suggestive of food allergy. In a few cases, only ear disease may be present. Unfortunately, food allergy can also present in many unusual ways, making diagnosis difficult. Compared with inhaled allergic dermatitis (i.e., pollen allergy, hay fever, or atopy), food allergy does not usually improve very much with the administration of steroids or antihistamines.

Gastrointestinal food intolerance (i.e., vomiting, diarrhea) is seen in less than 20% of dogs with food allergy; conversely, dogs with gastrointestinal signs of food allergy are rarely itchy. Animals previously diagnosed with other cutaneous allergies (e.g., flea-bite hypersensitivity, inhaled allergic dermatitis) are at a higher risk for developing food allergy; the predisposition to allergy appears to be inherited.

Diseases other than cutaneous food allergy that should be considered for dogs with severe head and ear itchiness include flea-bite hypersensitivity, inhaled allergic dermatitis, scabies, primary ear infection, and bacterial skin infection. Because other, but less

frequent, types of dermatoses can be similar in appearance, a qualified veterinarian with dermatology experience should examine animals with skin disease before changes in diet are made.

The diagnosis of food allergy relies primarily on a food elimination trial and subsequent challenge. Other diagnostic tools include skin biopsy and serum allergy testing. Suspicion of food allergy can increase with compatible findings in biopsied skin samples. Although similar biopsy results may be found with all skin allergies, a pathologist trained specifically in skin diseases (dermatopathologist) may be able to determine if a food allergy is a possible cause of the disease. Serum allergy testing, which measures allergen-specific antibody in the blood of animals, is now used frequently for diagnosing inhaled allergic dermatitis. This test is less accurate for food allergy, however. Serum allergy testing is not consistently diagnostic for either food allergy or inhaled allergic dermatitis. Nonetheless, this test may help to determine which specific allergen(s) is producing the disease. Intradermal skin testing is considered the most precise method for diagnosing inhaled allergic dermatitis. With this test, small amounts of suspected allergens, including food components, are injected into the skin. The skin is then observed for reactions. Others and myself have noted a poor correlation between results of serum testing, intradermal testing for food allergens, and clinical results of feeding trials. Therefore, these indirect forms of testing cannot be recommended for diagnosis of cutaneous food allergies.

A recent controversial test for food allergy involves applying food allergens directly onto the stomach wall. Using an endoscope, the stomach wall is sprayed with food proteins and then observed for allergic reactions. This test is usually impractical because it requires the animal to be anesthetized and can only be used to test a limited number of foods. With modifications, the test may become beneficial.

The food elimination trial remains the most reliable means of diagnosing food allergy. Food trials are not easy to perform, however. Owners must be prepared to feed their pets certain restrictive diets for a long period of time. Ideally, the pet should be fed one protein source and one carbohydrate source that it has never eaten before. With the current trend toward unusual diet formulations, finding an appropriate trial food can be challenging. Examples of useful proteins include pinto beans, tofu, fish (for dogs only; commercial cat diets frequently contain fish products), pork, venison, or rabbit. Carbohydrate sources are more limited and include potatoes and whole-grain rice. The availability and palatability of the food and the pet's feeding history must be taken into account when choosing the protein and carbohydrate sources. It is imperative that all other foods and treats, including rawhide chews, flavored biscuits, pet vitamins, and flavored chewable medications (including meat-based heartworm preventatives) are removed from the pet's diet. Food elimination trials may frequently fail because of inadvertent feeding of an inappropriate treat.

Simply substituting one commercial diet for another is **not** an appropriate food elimination trial. Most commercial diets are nutritionally balanced and contain very similar ingredients. Even diets advertised as "hypoallergenic" contain more ingredients than one protein source and one carbohydrate source. One recent study demonstrated that more than 15% of dogs diagnosed with food allergy could not tolerate a commercial diet formulated specifically for this disease. In the near future, several food companies are expected to release limited-antigen diets that contain a minimal number of ingredients. These diets will be available only by prescription. Hopefully, they will make diagnosing and managing food allergy more tolerable.

A food elimination trial must continue until improvement is noted. In some instances, a response may be seen in as few as 3 weeks or in as long as 10 weeks. Once improvement is seen, the pet is then "challenged" with the original diet. If symptoms return within seven days, the animal has a cutaneous food allergy. The elimination diet is fed until signs resolve again; single food items may then be introduced to find an acceptable commercial diet. It must be remembered that food elimination diets are intentionally incomplete and unbalanced. Therefore, they cannot be used for longer than 12 weeks without risking malnutrition. The eventual goal is to find a tolerable commercial food or a balanced home-cooked diet for long-term maintenance.

To summarize, food allergy is an uncommon cause of skin disease in pets. Signs most often involve itchiness of the face, feet, and ears. Food allergy should be suspected in animals for which other causes of nonseasonal itch cannot be determined or in which previously controlled itch has become nonresponsive to treatment. Diagnosis relies on the feeding of a restrictive elimination diet and the recurrence of signs when the original diet is reinstated. Lifelong control of the problem requires finding an acceptable balanced diet for the pet.

## **MALNUTRITION**

As mentioned above, malnutrition in companion animals is rare in the United States because of the large variety of balanced and palatable commercial diets available. In other countries, where dogs must rely on scraps, garbage, or poor-quality commercial diets, dermatoses caused by malnutrition are more frequent. For example, dogs with demodectic mange responded dramatically to vitamin E supplementation in a study from South America. Similar results were not noted in dogs treated in the United States, perhaps because the South American dogs lacked adequate dietary vitamin E.

Some commercial diets may fail to provide adequate nutrition for all stages of an animal's life. The growing, working, pregnant, or nursing pet requires a diet that is of higher quality and has more calories than does the sedentary, older animal. Also, the published minimal nutritional requirements represent the lowest acceptable level for individual nutrients only. Nutrient types, such as protein and fat, are not indicated, as well as the specific availability of these nutrients from the diet. For instance, a diet with a high protein content may actually provide a protein source that the animal cannot utilize. Even the moderately active dog may require a diet that supercedes published guidelines. In general, most dogs will ingest an adequate amount of nutrients if fed a sufficient quantity of a balanced commercial diet.

Any animal that loses a great deal of weight must be examined for metabolic disease. If a physiologic reason for the weight loss is ruled out, a comprehensive evaluation of the circumstances involving the feeding of the animal should be made. Physiologic reasons for weight loss include primary gastrointestinal disease (i.e., the inability to absorb or metabolize nutrients) and general systemic illness. Nonphysiologic malnutrition in the adult animal is most often associated with either:

\*Poor-quality (generic) commercial food;

- \* Outdated food in which the nutrient potency has declined
- \* Excessive supplementation of a specific nutrient;
- \* Insufficient amount of food (or excessive competition for food);
- \* A diet consisting primarily of table scraps; or
- \* The extended use of a nutrient-restricted, unbalanced diet (food elimination trials).

For example, nonphysiologic malnutrition can occur from feeding improperly stored food that allows fats to leach out or become rancid. Malnutrition resulting from the above causes can be easily corrected by feeding animals separately, by feeding fresh, properly stored food, and by using only high-quality diets.

Malnutrition resulting from the feeding of elimination diets for longer than 12 weeks may be more common than currently thought. When an animal improves after being fed one of these diets, some owners may not be willing to risk a relapse by weaning the dog onto a balanced diet. After a period of time, essential nutrients and body stores of basic dietary components are exhausted.

Signs of malnutrition can be obvious or inapparent. For example, a recent association between fatal heart disease in cats and the lack of taurine (an amino acid) in commercial cat diets resulted in the reformulation of most of these diets. More classic signs of malnutrition include excessive scaling; a dry, greasy, or brittle haircoat; abnormal shedding or hair loss; and weight loss.

The skin has high requirements for fat, protein, and essential nutrients. Changes in the appearance of the skin and coat caused by malnutrition reflect alterations in the skin's production of hair, cells, and natural oils. These changes reduce the skin's ability to fight disease and to stop the growth of abnormal bacteria, predisposing the skin to secondary infections.

Currently, concentrations of individual nutrients in the skin cannot be easily measured. Therefore, the diagnosis of malnutrition is usually confirmed by correcting the cause of the dietary insufficiency. After instituting a nutritionally balanced diet, good health should return within 12 weeks. Failure to respond to a balanced diet requires reassessment of the diagnosis.

## ESSENTIAL FATTY ACIDS

Deficiency of essential fatty acids in companion animals is uncommon for the reasons mentioned above. There has been great interest in the response of various skin diseases to high-level supplementation of fatty acids, however. Dietary fats (also referred to as oils or lipids) are a source of essential fatty acids. All essential fatty acids are polyunsaturated (i.e., the long carbon chains of these nutrients contain double bonds; the position of the double bond also determines the fatty acid name). The term *essential* indicates that these nutrients are required for normal body function and cannot be manufactured by the body (i.e., they must be supplied by the diet). Essential fatty acids are important to the skin as major cell membrane components and as inflammatory chemical precursors. The most important essential fatty acid is linoleic acid, which is derived from vegetable oils, especially safflower oil. Other essential fatty acids include  $\alpha$ -linolenic acid, which is derived from leafy vegetables;  $\gamma$ -linolenic acid, which is derived from the oil of the evening primrose; and eicosapentaenoic acid, which is derived from fish oil. Normal levels of these nutrients, as supplied in balanced diets, are important for healthy skin and hair.

Certain inflammatory skin diseases are partially caused by abnormal fatty-acid metabolism or increased levels of inflammatory chemicals, specifically eicosanoids. Both proinflammatory and anti-inflammatory mediators can be produced. The eicosanoid mediators, which are known as *prostaglandins* and *leukotrienes*, are chemicals produced from arachidonic acid in cell walls. These two classes of molecules are exceptionally potent and cause severe reactions when released. Depending upon the specific prostaglandin or leukotriene synthesized, proinflammatory or anti-inflammatory reactions can predominate.

The pathways that produce proinflammatory and anti-inflammatory prostaglandins and leukotrienes are as complex as their names. By supplementing specific types of fatty acids, pathways that produce anti-inflammatory chemicals are favored. This results in an overall decrease in inflammation as the skin's chemical components change.

Unlike other drugs that can produce serious side effects, essential fatty acids use the body's natural biochemistry to reduce inflammation. Therefore, if side effects, such as pancreatitis, vomiting, and diarrhea, occur at all, they are generally mild. These effects can often be eliminated by reducing the amount of fats or other fatty acids in the diet.

Essential fatty acid supplementation is not a cure-all. Other causes of inflammation, such as fleas, infections, or allergies, must be controlled first. Essential fatty acids can make an itchy dog less itchy. Nonetheless, it is unrealistic to expect clinical signs to resolve by only using fatty acids. In recent investigations, an adequate response to essential fatty acid supplementation was reported in up to 20% of cases with inhaled allergic dermatitis. In the majority of dogs studied, essential fatty acids decreased the level of itch and, most importantly, decreased the dosages of other medications.

A minimum of three to six weeks of supplementation is required to attain sufficient levels of essential fatty acids in the skin. The dosage of essential fatty acids necessary to achieve these results is currently unknown. Several reports have suggested that supplementation at two to five times the dosage currently recommended by manufacturers may increase the response to therapy. Excessive amounts of essential fatty acids, however, may decrease their efficacy. Therefore, until effective dosages have been established, supplementation at the manufacturer's recommended level should be administered initially. If a response is not noted within eight weeks, the animal's condition should be reassessed and an increase in the dosage should be considered.

## CONCLUSION

The skin is a dynamic organ that requires a significant level of nutrition for healthy development. Diets that fail to supply sufficient levels of nutrients to the skin are rare in the United States. Nonetheless, some skin diseases are produced by (or respond to) a change in feeding habits, foods, or adding supplements to the diet.

Cutaneous food allergy is the least common of the skin-related allergies. It is best diagnosed by feeding a strict elimination diet and then challenging the animal with the original diet. The availability of limited-antigen diets, available only by prescription, will make it more convenient to diagnose this ailment. Malnutrition is also uncommon and is easily corrected with a quality balanced diet that is

properly fed and stored. Supplementing the diet with essential fatty acids has been shown to be effective in assisting in the control of itchy skin diseases. When used in conjunction with a proper diagnosis and the control of concurrent problems, essential fatty acids are safe for augmenting the body's natural responses toward disease.

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#### **DEFINITIONS**

**dermatosis**--a disease of the skin

**dermatitis**--inflammation of the skin

**sensitization**--exposure to allergen that results in the development of hypersensitivity

**scabies**--a contagious skin disease caused by *Sarcoptes scabiei*

**biopsy**--the removal and examination of tissue from the body

**endoscope**--an instrument for examining the interior of a hollow organ

**demodectic mange**--a noncontagious skin disease caused by a species of *Demodex*

**pancreatitis**--inflammation of the pancreas

Source: Breeder Forum, Pedigree<sup>R</sup> food for dogs, 3250 East 44th Street, PO Box 58853, Vernon, CA 90048-0853. Volume 2, Number 1, pp. 3-9.

SKINDI.