Healthy Skin and Haircoat

The Importance of Nutrition

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A pet’s skin and haircoat are among the most visible signs of health and vitality. The skin and haircoat are of vital importance to the body’s protective mechanisms against environmental insults of all kinds, from infectious agents to temperature gradients.¹ In addition, hair is of great aesthetic importance to owners and a source of great concern when it is not normal.²

Maintaining Skin Hydration

The stratum corneum plays a pivotal role in preventing excessive water loss from the body.¹² The extracellular space of the stratum corneum contains glycolipids and glycosaminoglycans as well as several immunologically important substances. The glycolipids appear to be critical in supporting the water barrier function of the stratum corneum. Water diffuses out from the body and is lost at the skin surface. This water loss is referred to as transepidermal water loss (TEWL) and is driven by the steep concentration gradient between the hydrated internal body tissues with a moisture content of approximately 75% and the drier external atmosphere.¹³ Normal skin contains 10 to 40% water, with about 35% water in the stratum corneum considered optimal.³ Moisture content in canine skin depends on anatomic location, with ear pinna, chest and groin skin having the highest moisture levels.⁴ Low skin hydration is associated with increased TEWL and reduced skin surface lipid content. Such changes are characteristic of defective epidermal barrier function and typical of atopic dermatitis and various scaly dermatoses.⁵⁶⁷ Atopic dogs also show abnormal water-absorptive (hygroscopic) and water-holding capacity.⁸

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Nutritional deficiencies of many types may be manifested by alterations in this highly visible organ system. Perhaps because of these issues, nutritional supplements and nutraceuticals are widely used in skin and hair care.

Good nutrition is essential to normal skin health. Normal keratinization requires an adequate supply of several nutrients, including protein, fatty acids, zinc, copper, vitamin A and B vitamins. Deficiencies in numerous essential amino acids, fatty acids, vitamins or minerals can cause various deviations in skin structure or function. Epidermal atrophy occurs with protein, calorie and vitamin deficiencies. Hyperkeratosis or acanthosis can occur with magnesium, zinc, pantothenic acid, pyridoxine, biotin, vitamin A or essential fatty acid deficiencies, while parakeratosis is symptomatic of zinc deficiency. Pigment changes may be seen with deficiencies of copper, cysteine or panthothenic acid. Alopecia or changes in the sebaceous glands may occur with zinc, biotin or riboflavin deficiencies. In addition to these direct effects, suboptimal nutrition may increase susceptibility to parasites, such as mange mites, fleas and lice, as well as enhance susceptibility to skin infections.1,3,5

Suboptimal protein intake can decrease hair diameter, length and breaking strength.

Providing minimum nutrient requirements, by definition, should eliminate all dermatologic signs associated with dietary deficiencies. However, certain animals may have genetic or metabolic differences that may respond to intakes greater than are considered adequate to avoid recognized dietary deficiencies. In addition, most pet owners do not exclusively feed complete and balanced pet foods.6,7 Excessive or imbalanced supplements can contribute to nutritional imbalances. Thus, an assessment of a pet's total diet may reveal areas that could benefit from nutritional modifications.

Protein
Skin contains a significant amount of protein and serves as a major source of protein reserves when intake is inadequate.8 The hairshaft is composed primarily of alpha-keratin protein. Specific skin effects from gross protein deficiency include hyperkeratosis, epidermal hyperpigmentation, flaky skin, loss of hair pigmentation, and increased hair fragility.8,9

This may be seen as crusty skin lesions with patchy alopecia and dry, brittle haircoats. Microscopic changes include puffing and flaking of the keratin layer and foamy-looking collagen layers.4 Hair root changes occur in protein malnutrition, with an increased number of follicles in telogen phase and a decreased number in anagen phase.10 Subclinical protein deficiency may be less noticeable. Suboptimal protein intake can decrease hair or wool production and decrease fiber diameter, length and breaking strength.5,11,12

Increasing dietary protein or sulfur amino acid intake increased the rate of division of cells in the follicle bulb matrix, which increased keratin gene expression, protein deposition and follicle growth rate.3,13

Optimum dietary protein for dogs, based on measures of protein turnover in muscle and liver, appears to be at least 20% of calories from high-quality protein.8 Even

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Optimal hydration of the stratum corneum is the single most important factor influencing microfloral growth at the skin surface.8 Moisture moving outward through the skin hydrates the cells prior to being evaporated into the atmosphere. Dry skin is characterized by a lack of moisture in the keratinized stratum corneum. Disturbances in keratinization or other disorders in the stratum corneum may increase its permeability, allowing either increased water loss or over-hydration. An over-moist stratum corneum is a less efficient barrier while an abnormally dry stratum corneum becomes brittle and inflexible, resulting in painful fissures as well as breaks in the physical barrier of protection.3

Some environmental factors that have been shown to affect skin hydration and TEWL include diet, bathing, soaps, shampoos and moisturizers.3,5,10,11 Dietary alterations of protein, amino acids and lipids may influence hydration and moisture kinetics. A deficiency of protein or essential amino acids can lead to dry skin, among other changes. Adequate dietary fat and omega-6 fatty acids are critical to normal skin hydration. The role of omega-3 fatty acids in TEWL remains undefined. One study suggested a beneficial effect when flaxseed oil was added to the diet.10 On the other hand, a recent study found no changes in TEWL or other indices of skin and haircoat condition over a range of dietary omega-6:omega-3 fatty acid ratios.12 Various shampoos and humectants had differing effects on TEWL and skin hydration. Of several products tested, Hylyt (DVM Pharmaceuticals), Sesame Oil Rinse (Veterinary Prescriptions) and Alpha Keri (Bristol-Meyers Squibb Co.) were
greater quantities may be beneficial for enhanced haircoat quality.

**Fat and Fatty Acids**

Generalized flaky desquamation, coarse, lusterless haircoats or alopecia, and pruritus are among the changes seen with essential fatty acid deficiency. Essential fatty acids may be oxidized and denatured in poor quality foods, foods stored too long or at high temperatures, or those inadequately preserved with antioxidants. Animals fed these foods may show evidence of essential fatty acid deficiency. Such signs also may be observed in pets fed low-fat diets over extended periods, pets with fat malabsorption syndromes, or those with unusually high requirements for these nutrients. Numerous fatty acid supplements are available; however, response to fatty acid supplements in open clinical trials has been highly variable. Pet health and overall diet quality should be addressed to identify underlying problems prior to administering supplements.

**Vitamins**

Riboflavin deficiency can cause a dry flaky dermatitis with reddening of the skin and hair loss. Biotin deficiency can cause the hair to become thin or lose pigment and the skin to become dry and flaky or greasy. Pantathenic acid deficiency can lead to loss of hair pigment and hair loss. Such deficiencies of B-vitamins are rare among pets fed quality commercial pet foods. However, since table scraps, treats and other foods can make up a large portion of the diet for many pets, deficiencies should be considered if these signs are observed. Various forms of vitamin supplements are available. Most contain all the B-vitamins so it is not necessary to identify the specific deficiency. Vitamin A deficiency can appear like an essential fatty acid deficiency and lead to dry, scaly skin. Excessive vitamin A also causes skin lesions that appear similar to those of vitamin A deficiency, including dry skin, alopecia and pruritus. On the other hand, vitamin A or related compounds have been used topically to treat various skin problems in humans. Retinoic acid (a form of vitamin A) has been shown to be involved in regulation of epidermal keratinocytes by regulating gene transcription. Dietary supplementation with vitamin A has been used to treat seborrhea in American cocker spaniels while topical treatments have been used for a number of skin conditions in various breeds. The vitamin A supplement, given at 10 to 25 times the requirement of 100 IU/kg body weight/day, appeared most useful in patients with marked follicular plugging and hyperkeratosis.

Active vitamin D (1,25-dihydroxycholecalciferol) has been investigated in human medicine as a treatment for psoriasis and ichthyosis, both hyperproliferative conditions. Cells of the outer root sheath and epidermal cells have vitamin D receptors. In vitro data shows that active vitamin D inhibits the proliferation of keratinocytes and dermal fibroblasts. Vitamin D supplements (2 ug/day orally) were beneficial in human patients with psoriasis. Active vitamin D itself can be toxic, so safety as well as efficacy must

the most effective in decreasing TEWL, while Humilac (Allerderm-Virbac) was most effective at increasing the hydration of the stratum corneum.

REFERENCES

Minerals
Zinc is critical for normal skin development, and deficiency leads to parakeratosis and dermatitis. Zinc-responsive dermatitis generally is reported in puppies or zinc-sensitive breeds (primarily Siberian Huskies and Alaskan Malamutes), although it can occur in other breeds. A similar condition reported in dogs fed generic or low-cost commercial dog foods was presumed to be zinc deficiency secondary to poor zinc bioavailability.

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REFERENCES

Common Food Allergens
This graph shows the most frequently tested single-ingredient food challenges and the percentage of positive responders among 58 food allergic dogs. More than half of the dogs reacted to more than one protein source.

REFERENCES
**Objective:** The objective of this study was to evaluate a commercial hypoallergenic diet in dogs known to have had a pruritic dermatosis that was eliminated after a change in diet and to determine if these dogs would remain symptom-free when fed Purina® CNM® HA-Formula.†

**Methods:** Three board certified veterinary dermatologists each selected canine patients with confirmed food-related pruritic disease that had been controlled at least 50% with dietary management. These dogs were each offered Purina® CNM® HA-Formula® for a seven-day period and then re-evaluated for a return or worsening of the pruritus. At the time of this challenge, the dogs were at least 50% less pruritic than upon original presentation. If they were being treated with antibiotics, anti-yeast medications, antihistamines or hyposensitization, or were being bathed with medicated shampoos, these were not altered.

**Results:** Twenty-four dogs were identified that fulfilled the criteria established. All of the dogs had their symptoms of pruritus well-controlled with a variety of diets. Two dogs (8%) experienced increased pruritus with the diet. The remaining 22 (92%) were able to eat Purina® CNM® HA-Formula® with no worsening of the pruritus. Of the dogs currently maintained on a home-cooked diet, 100% (n=12) were able to eat Purina® CNM® HA-Formula® with no increase in pruritus.

**Conclusion:** In attempting to identify dogs that are pruritic as a result of an adverse reaction to something they are being fed, if an owner cannot home-cook a novel two-ingredient diet and chooses to feed a commercial diet, feeding Purina® CNM® HA-Formula® can identify about 92% of these patients.

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†The name of this brand has changed to Purina Veterinary Diets™ HA HypoAllergenic™ brand canine formula.

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**Evaluation of the Usefulness of Purina® CNM® HA-Formula®† Brand Veterinary Diet for Dogs with Pruritic Dermatosis that Respond to a Change of Diet**

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**Total and Allergen-Specific Serum and Fecal IgE Responses to Dietary Change in Dogs with Suspected Food Hypersensitivity**

This study explores the dynamic changes in serum and fecal allergen specific IgE in a group of dogs suspected of having food hypersensitivity on the basis of clinical signs (pruritus and diarrhea), absence of other pruritic skin diseases and response to dietary allergen restriction. Five dogs were fed a commercial soy hydrolysate diet for nine weeks before oral challenge with milk. Then, after a 12-day washout period on the hydrolysate, their regular diet containing multiple allergens including milk, wheat and corn was reintroduced. Before and after each dietary change, the dogs were examined and given a clinical score reflecting evidence of pruritus. Serum and feces also were collected at these times. A worsening of cutaneous clinical signs developed in all dogs with milk challenge. Four developed diarrhea, and one vomited. No significant rise in fecal or serum milk specific IgE was noted, except in the dog that vomited. This was accompanied by a rise in total, corn and wheat specific fecal IgE. Dermatitis was again induced by challenge with the regular diet in all dogs. This was accompanied by an increase in allergen specific and total fecal IgE in three of the five dogs. Total serum IgE rose significantly in all dogs after this challenge. No consistent correlation between fecal and serum allergen specific or total IgE was observed. In conclusion, local gastrointestinal IgE production may reflect a specific response to dietary proteins in the pruritic dog and warrants further investigation as a marker of dietary hypersensitivity.

Jackson HA, Kates CR, Hammerberg B.

This abstract was published in Veterinary Dermatology, Volume 11, Supplement 1, 2000, and presented at the Fourth World Congress of Veterinary Dermatology, San Francisco, September 2000: Abstracts of the Fourth World Congress of Veterinary Dermatology, and is reproduced here with permission from the conference organizers and the publishers, Blackwell Science.
Client compliance, whether it relates to controlling diet or administering drugs, is often less than desired. A recent study evaluated how well pet owners followed through when asked to treat their dogs for 10 days with a course of antibiotics. Each owner was provided a prescription for antibiotics to be administered orally two or three times daily for various bacterial infections. Twenty-two percent of the owners initiated treatment on the day of the veterinary visit, while 70% initiated treatment the next day. Of the 95 dog owners, 44% were judged to have been 100% compliant by providing all of the prescribed medication. Another 44% were at least 80% compliant, based on the number of tablets remaining. Compliance was significantly higher for those owners who felt their veterinarian provided adequate discussion time with them. Neither treatment regimen (twice vs. three times daily) nor the client’s perception of treatment efficacy altered the compliance rate.


How Well Do Your Clients Follow Your Instructions?

In previous publications, a subepidermal linear alignment of mast cells (SLAM) was reported to occur in nearly half of dogs with Malassezia dermatitis. Another study has now evaluated the occurrence of SLAM in conditions other than Malassezia. The retrospective histologic study of 419 canine skin biopsies examined tissues from dogs with demodicosis, sarcoptic mange, dermatophytosis, pemphigus foliaceus, pemphigus erythematosus, discoid lupus erythematosus, systemic lupus erythematosus, erythema multiforme, dermatomyositis, staphylococcal pyoderma, primary seborrhea, arthropod bites, contact hypersensitivity, flea bite hypersensitivity, atopy and food hypersensitivity. Only three cases (0.07%) were identified with SLAM. Thus, based on these results, SLAM appears much more commonly in Malassezia dermatitis than in other inflammatory skin diseases.


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