

## Nutritional Considerations in Canine Dermatological Disorders

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<https://doi.org/10.5281/zenodo.8352529>

### Abstract

Nutrients play a major role in the health status of skin and hair coat in dogs. Nutritional deficiencies are reported as an indirect cause of dermatological disorders resulting from reduced intake of diet, unbalanced diet or reduced absorption or utilization of the nutrients as a result of disease or genetic factors. Most often nutritional deficiency and excess are not commonly identified as direct causes of dermatological disorders but dietary modifications often found to reduce the severity of such diseases. Hence knowledge on common clinical conditions caused by deficiency or excess of these nutrients will provide useful information on nutritional interventions for correcting the problems. This article discusses on the role of various nutrients in health of skin and coat of dogs.

**Keywords:** Canine, Dermatology, Nutrients

### Introduction

A healthy lustrous skin and coat indicate vitality and health status of pet dogs. Nutrients have an important role in the health status of skin and hair coat in dogs. Nutrients such as proteins and amino acids are required for keratinization, pigmentation and hair growth. Polyunsaturated fatty acids are essential for sebum production which is associated with skin and coat protection. In addition to this, several minerals and vitamins are also playing important roles in the health of skin. Nutritional deficiencies are encountered due to reduced intake of diet, unbalanced diet or reduced absorption or utilization of nutrients as a result of disease or genetic factors. Dietary interactions as a result of errors in formulation, prolonged storage or injudicious over supplementation can also result in reduced nutrient availability. Typical signs of nutritional dermatosis include excessive scale, erythema, alopecia or poor hair growth and greasy skin, which may be accompanied by secondary bacterial infection and pruritus. It is generally accepted that signs become evident only after feeding deficient diets for several months. Hence, knowledge on common clinical conditions caused by deficiency or excess of these nutrients will provide useful information on nutritional interventions for correcting the problems.

## Protein

Proteins and amino acids are essential for skin and hair production. Hair is composed of approximately 95 percent of protein. Hence there is high demand of protein for normal hair growth and skin keratinization (Scott *et al.*, 1995). Phenylalanine and Tyrosine are precursors of melanine, the skin pigment (Anderson *et al.*, 2002) and methionine and cysteine are present in large amounts in hair. Hence their deficiency may reduce hair growth and increase hair fragility (Prelaud and Harvey, 2006). Proline, a non-essential amino acid, is essential for formation of collagen in skin. If diet is not containing adequate protein the dog may develop areas of hair slow re-growth and depigmentation of hair and hair become dry, dull and brittle. There will be excessive scaling and hyperpigmentation of skin and it becomes thin and in-elastic.

Dermatological disorders due to protein deficiency are usually rare in clinical practice. Protein deficiency is usually encountered due to starvation, disease induced inappetence or feeding of an unbalanced diet. Primary protein deficiency can occur in young growing pups and pregnant or lactating female dogs due to increased protein demand for growth and development. Protein deficiency can also result from excessive protein loss due to chronic illness or protein losing nephro-enteropathies. Dietary correction can be made by supplementing good quality protein sources such as meat, egg and milk, but prognosis depends on the cure from underlying diseases.

## Fat

Fat is another important group of nutrients for good quality of skin and hair coat in dogs. Essential fatty acids have a structural role in cell membranes, act as precursors for eicosanoids such as prostaglandins and leukotrienes and are vital for maintaining normal skin structure and function (Watson, 1998). Essential fatty acids (EFA) must be provided in the diet because the body cannot synthesize them. Deficiency of EFA results in scaly and dry skin with poor elasticity. Linoleic acid appears to be the most important for maintaining normal skin (Kirby *et al.*, 2009). Dandruff, thin hair, discolored hair, increased shedding and poor healing are all associated with low linoleic acid levels in skin and diet. Omega-3 fatty acids, such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), may reduce inflammation secondary to allergic disease in affected dogs (Bauer, 2011). Omega-3 fatty acids help to protect the skin and coat and keep it shiny. Sources of omega-3 fatty acids include fish and algae oil. Dietary deficiencies of essential fatty acids are uncommon but may occasionally occur in dogs that are fed poor quality, low fat dry foods or unbalanced home-prepared diets. Levels of polyunsaturated fatty acids may also be reduced in food after oxidative damage resulting from prolonged storage or inadequate levels of antioxidants such as Vitamin E. Rarely, fatty acid deficiency may occur in association with malabsorption due to hepatic, pancreatic or gastrointestinal disease. Prolonged deficiency results in alopecia, greasy skin particularly on the ears and between the toes and secondary pyoderma.

In uncomplicated cases, response to fatty acid supplementation will be visible within three to



eight weeks (Scott *et al.*, 1995). Deficiency can be corrected by changing to higher fat diet, by the addition of edible oils to diet or by administration of fatty acid supplements. Vegetable oils such as sunflower oil are a rich source of linoleic acid, but arachidonic acid is found only in animal fats. Feeding a better-quality prepared pet food or a balanced veterinary supplement containing essential fatty acids, Vitamin E and Zinc is preferable (Harvey, 1993). Dietary fatty acid supplementation is also useful for management of some inflammatory skin disorders, particularly those associated with hypersensitivity reactions.

## **Vitamins**

Vitamins that play critical roles in the skin health of dogs include Vitamin A, E and B.

### **Vitamin A**

Vitamin A is required for epidermal differentiation and normal sebum production and its deficiency is rare in dogs as they can convert beta-carotene to retinol (NRC, 2006). Vitamin A-responsive dermatosis is characterized by skin proliferation and keratinization. It has a genetic basis and is more commonly encountered in American cocker spaniels. Lesions include crusts and plaques mostly seen on the ventral and lateral chest and abdomen. The hair coat may be dull, dry, scaly and secondary bacterial or yeast infections are common.

The diagnosis of Vitamin A-responsive dermatosis is made by first ruling out other common causes of crusty, scaly skin and by skin biopsy. Biopsy of affected skin shows marked excessive scaling of skin and hair follicles. Most affected animals require lifelong Vitamin A supplementation at a dose rate of 10,000 IU orally with a fatty meal for a period of 6-8 weeks. Antiseborrheic shampoos and moisturizing conditioners are also helpful. Dogs should be treated for secondary bacterial or yeast infections if any.

### **Vitamin E**

Vitamin E is the primary antioxidant in cell membranes and alpha-tocopherol is the form with greatest activity in cells, although others may be added to commercial diets as natural preservatives. Deficiency of Vitamin E has been implicated in the development of various dermatological disorders in dogs. Skin disorders characterized by an early keratinization defect and a later inflammatory phase with a tendency to develop secondary pyoderma were experimentally produced by Vitamin E deficiency. Supplementation of Vitamin E has been found to be effective in dogs with discoid lupus erythematosus. Scott and Walton (1985) reported that Vitamin E therapy @ 200 mg twice daily was effective for gradual elimination of pruritus, inflammation, lichenification, greasiness and odour in dogs with acanthosis nigricans after 60 days of treatment. Even though there is no record of naturally occurring Vitamin E deficiency in dogs, use of Vitamin E in the treatment of canine discoid lupus erythematosus and primary acanthosis nigricans with variable success has been reported.

### **Vitamin B**

Vitamins B are involved in many biochemical reactions in body and their deficiency is



associated with variety of skin lesions. Vitamin B<sub>3</sub> (Niacin) and B<sub>5</sub> (Pantothenic acid) supplementation has reduced trans-epidermal water loss in dogs and contributed to the integrity of the stratum corneum (Watson *et al.*, 2006). Biotin and B-Vitamins play important roles as co-factors in many of the body's metabolic processes, including fat metabolism. This is important in the skin because Biotin and B Vitamins are involved in aiding linoleic acid function in the epidermis and dermis.

### **Minerals**

Among the minerals, Zinc and Copper have an important role in maintaining good skin and hair coat quality.

### **Zinc**

Zinc is an important co-factor of many metalloenzymes involved in cell functions and is particularly important for maintenance of epidermal integrity. It is critical for transition of nucleated epidermal cells to anucleate squamous cells in stratum corneum. The presence of Zinc is of particular importance in rapidly dividing cells and is also for biosynthesis of fatty acids, participates in both the inflammatory and immune systems and is involved in metabolism of Vitamin A. Zinc is also associated with immunity, neurological and intestinal functions. Zinc deficiency can result in hair loss, skin ulcers and areas of skin thickening and cracking, particularly over joints and on foot pads. Appetite may be depressed in affected animals as a result of diminished sense of taste and smell. Prolonged deficiency can result in weight loss, impaired wound healing, conjunctivitis and keratitis. Generalized lymphadenopathy is also a common feature, particularly in young animals. The skin-related signs of mineral deficiency clear up quickly with appropriate levels in diet.

Zinc responsive dermatoses due to nutritional deficiency are associated with reduced dietary availability of Zinc. It can be due to reduced levels of Zinc in diet due to other factors which reduce the availability of Zinc present in the diet. Absorption of Zinc can be inhibited by excessive levels of dietary calcium, iron and copper, which compete with Zinc for intestinal absorption sites. Dietary phytate, which is found in cereal-based diets, chelates Zinc and high levels may also hinder intestinal Zinc absorption. Such types of dermatoses are more common in rapidly growing pups of large breeds such as Great Dane. Prolonged enteritis or other malabsorption syndromes may also prevent normal Zinc absorption and may precipitate clinical signs of deficiency, particularly when combined with other predisposing factors.

Clinical signs associated with Zinc responsive dermatoses include erythema, alopecia, crusting and scaling around the mouth, eyes and ears. Lesions are also seen in other mucocutaneous areas such as vulva, scrotum and anal areas. Hyperkeratosis is also observed especially at pressure points such as the elbows and footpads. Clinical signs may vary in individual dogs and in presence of concurrent bacterial or fungal dermatitis. Severely affected dogs may have growth retardation, fever and depression. Diagnosis of the condition can be achieved from the history, clinical signs, skin biopsy results and response to Zinc supplementation. In cases of Zinc- responsive dermatoses due to



metabolic abnormality, lifelong Zinc supplementation is necessary. Supplementation with Zinc sulphate (10 mg/kg daily) or Zinc methionate (1.7 mg/kg daily) is usually adequate. But for lifelong therapy, the dosage may be adjusted for long term maintenance (Scott *et al.*, 1995). In deficiency cases, dietary correction alone may be curative and signs will resolve after a change to a diet with greater Zinc concentrations and/or with reduced Zinc-binding compounds.

### Copper

Copper serves as a co-factor in the enzymatic conversion of tyrosine to melanin. Copper deficiency causes a dull and dry hair coat with patchy hair loss and loss of normal hair pigment resulting in a washed-out appearance of coat. Copper along with tyrosine, is essential for development of healthy hair. If one of these two substances is missing, the hair will grow incorrectly pigmented (Zentek *et al.*, 1991).

### Conclusion

Understanding the various clinical manifestations associated with deficiency of nutrients, vitamins and minerals and their therapeutic management will help in correcting the problems and maintaining the health status of skin and hair coat in dogs.

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