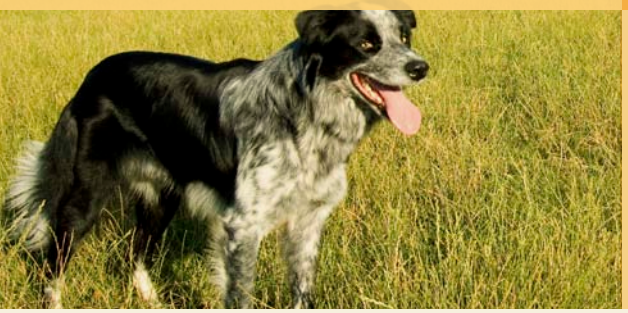


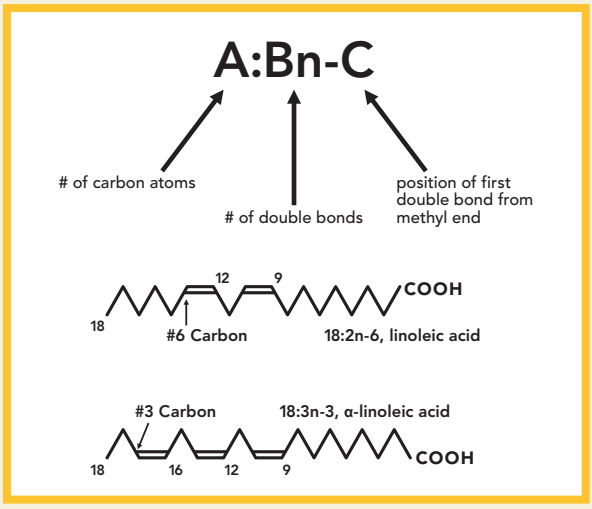
Dietary Fats and Canine Skin and Hair Coat

John E. Bauer, DVM, PhD, DACVN

Pet owners often perceive skin and hair coat condition as an indicator of their animal's optimal nutrition and well-being. In this regard, the essential fatty acids are known to have an important role.

One of the hallmarks of essential fatty acid (EFA) deficiency in animals is a matted hair coat and unkempt appearance. The provision of dietary EFA helps maintain the water permeability barrier of the skin and supplies fatty acid precursors of eicosanoids and other important physiologic mediators for normal cell function.

The epidermal water barrier of skin depends on the omega-6 fatty acid (i.e., linoleic acid or LA) content of the cellular membrane component called ceramide. These lipid components enhance skin cell cohesion which imparts an effective water barrier to the epidermis. Because linoleic acid is directly involved, many instances of dry, dull hair coats and scaling, nonpruritic skin disorders in dogs generally respond to dietary vegetable oil supplements rich in this fatty acid. Corn oil, soybean oil and canola oil are rich sources of linoleic acid for this purpose.



Several studies have been published on fatty acids and skin health in dogs. In dogs with atopy, the importance of LA in skin health was also observed when this fatty acid was significantly reduced compared to normal animals. Another study found that cutaneous fatty acids in dogs with seborrhea also have decreased LA content. With respect to the omega-3 fatty acids, one study found that increased amounts of a dietary α-linolenic acid (ALA) fed to normal dogs for 56 days significantly lowered epidermal water loss with notable hair coat improvement. Because flaxseed oil provided the source of α-linolenic acid in the diet, it was suggested that this omega-3 fatty acid may also function as does LA due to its incorporation into skin ceramides. However, it appears from studies in the author's laboratory that the α-linolenic acid (omega-3) effect may be due, in part, to the sparing of linoleic acid (omega-6) because of the known metabolic competition between these two fatty acid types.

Fatty Acids and Inflammatory Skin Disorders

When inflammation exists, omega-3 fatty acids—and some omega-6 fatty acids—may be needed to help control the inflammatory response. This effect is mediated via the production of less pro-inflammatory mediators from precursors.

Omega-3 Fatty Acid Effects

The n-3 fatty acids have increasingly gained popularity in the treatment of pruritic and inflammatory skin conditions such as atopy in dogs. Because of competition between omega-3 and omega-6 fatty acids for conversion to inflammatory mediators, the inflammatory response can be regulated. Thus, when physical or chemical trauma to the skin occurs, omega-6 fatty acids (primarily arachidonic acid or AA) are converted into prostaglandins of the 2 series (PGE_2) and leukotrienes of the 4 series (LTB_4).By

contrast, the omega-3 fatty acids, when present, are transformed into 3-series prostaglandins (PGE_3) and 5-series leukotrienes (LTB_5), which are less pro-inflammatory than their corresponding n-6 fatty acid isomers. The synthesis of these omega-3 based mediators serves to inhibit neutrophil activation and thus diminish any allergic or inflammatory condition.

Clinical evidence for the above effect was reported in a study in which dogs with canine pruritic skin disease were supplemented with high dietary amounts of n-3 marine fish oil (66 mg/kg of body weight per day) over a six week period. At the end of the study, dogs showed significant improvement in pruritus as well as skin and hair coat character. The diets of these dogs were not otherwise controlled in this study.

Typical EFA Sources

Omega-6	Omega-3
LA: Sunflower, Safflower, Soybean, Corn Oils	**ALA:** Flaxseed, Soybean Oils
GLA: Borage, Black Currant Seed, Evening Primrose Oils	**EPA/DHA:** Fish, Marine, Algae Oils
AA: Liver, Other Animal Products	

Omega-6 Fatty Acid Effects

An antiinflammatory effect of omega-6 fatty acids also exists. In this case, it involves dietary γ-linolenic acid (GLA) which results in the accumulation of dihomo-gamma-linolenic acid (DGLA). When cells are stimulated to form eicosanoids, the DGLA also gives rise to less-inflammatory cell mediators compared to those arising from arachidonic acid. DGLA itself may also slow the release of arachidonic acid from cell membranes, which may limit an over-reactive inflammatory response. A rich source of GLA is borage oil that is present in some commercial preparations in combination with the long chain omega-3 fatty acids. This combination may provide reduction of inflammation via both omega-3 and omega-6 mechanisms.

Use of Omega-3 Fatty Acid Supplements for Skin Disorders

Primary indications for dietary fatty acid supplement therapy include pruritis associated with dietary hypersensitivity such as flea bite dermatitis, atopic dermatitis and disorders associated with abnormal fatty acid metabolism, including keratinization defects. Generally, for dogs with dry flaky skin without concomitant inflammation, LA-containing supplements may be helpful. Bear in mind that each gram capsule of oil will contain approximately 9 kcal and that a teaspoon serving of vegetable oil is approximately 4.6 grams (about 42 kcal).

Switching to a higher fat diet may also be useful in this setting, but care should be taken to not add too many calories to diets of small-breed dogs or obesity-prone animals. Where inflammation is a component of the disorder, omega-3 fatty acid supplements or dietary modification with omega-3 (marine oils) and some omega-6 fatty acids (borage oil) may be beneficial. As mentioned above, one clinical study has shown that supplementing dogs with pruritic skin disease with marine fish oil at a dosage of 66 mg/kg body weight daily for six weeks was effective. This dosage is presently recommended for a therapeutic effect and has a reasonable margin of safety.

Although some dogs may respond to supplemental fatty acid therapy in as few as four weeks, more consistent results are observed after seven weeks. A study in the author's laboratory has observed additional benefits in normal dogs with both omega-3 and omega-6 fatty acids at 12 weeks of feeding compared to saturated fat diets, although higher fat diets *per se* will generally improve skin and hair condition to some extent. In this same study it appeared that a total dietary fat effect, independent of fatty acid type, may have been due to increased cholesteryl ester content of skin sebum lipids, but this finding is preliminary at this time.

The Interplay Among Zinc, Fatty Acids and Skin Health

In addition to dietary fatty acids, zinc plays a vital role in regulating many aspects of cellular metabolism, many of which are concerned with the maintenance of healthy skin and hair coat. Zinc is required for the utilization of fatty acids by activating the Δ-6 desaturase enzyme essential for the conversion of LA to AA and is a participant in both inflammatory and immune mechanisms. One study supplemented an

existing diet with LA, zinc and a combination of LA and zinc, and assessed canine skin and coat quality. Significant improvements in skin and hair coat condition were found. Specifically, dogs fed increased amounts of both nutrients exhibited less scale, had more luster to their coat and showed less epidermal water loss compared to a control group. This study supports an important interaction between zinc and LA that appears to significantly enhance canine skin and hair coat. It was hypothesized that zinc and LA must be supplemented in combination with each other in a healthy dog's diet in order to realize improvements in skin condition. Some commercial fatty acid supplements now contain zinc for this reason.

Summary

Dietary supplementation or inclusion of both omega-6 and omega-3 fatty acids appear to have a positive benefit on canine skin health. Reasons for this benefit include direct epidermal enrichment of the essential fatty acids and a possible sparing effect of ALA on LA in skin ceramide lipid fractions with less water loss. A synergistic effect between greater-than-minimal dietary amounts of LA and zinc exists, which was also found to improve canine hair coat.

Diets containing increased total dietary fat *per se* also appear to result in improved hair gloss and softness. This effect may be related to increased amounts of cholesteryl ester deposited on the hair shaft surface when high fat diets are fed. Indeed, diets containing increased amounts of total fat are known to result in plasma cholesteryl ester elevations, which may translate into increases in this lipid on the hair shaft. It should be noted, however, that such a modest elevation in cholesteryl ester does not appear to place dogs at risk for coronary artery diseases as affects humans. However, adding additional dietary fat using properly balanced omega-6 and omega-3 polyunsaturated fatty acids in canine diets provides a combination of higher total dietary fat with appropriate amounts of individual omega-3 and omega-6 fatty acids, all of which contribute to optimized lipid nutrition for dogs.

Effect of dietary omega-3, omega-6 plus zinc on skin and hair coat at 12 weeks

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