



The Function of Fats

A close-up look at the role of fat in canine diets shows that its nutritional value extends far beyond providing a readily digestible, highly palatable and dense source of energy. Purina Nutrition Scientist Mark Waldron, Ph.D., says, "Fatty acids have a host of functions. Fats are biologically important in providing energy, insulation, essential vitamins, essential fatty acids and mechanical structure to every cell."

During the past 30 years, several studies have produced new insights about the impact of fat in diets for dogs. Veterinary nutritionists became interested in learning more about how fat affects dogs after Danish scientists published reports in the early 1970s showing that heart disease was greatly reduced in Eskimos who ate high-fat fish diets.

Among the findings related to dogs, veterinary nutritionists have learned that fat contributes to healthy skin and haircoat, healthy immune function, regulation of the inflammation process, and prenatal development.

Chemical Profile of Fats

Understanding how fats and fatty acids function in dogs requires understanding the chemical makeup of fats. There are more than 40 different types of fatty acids from animal, plant and fish sources. Fats are made up of chains of carbon atoms containing oxygen atoms at one end, the alpha end, and three hydrogen atoms at the other end, the omega end.

Fatty acid chain types vary according to the number of carbons and whether the carbons are connected with single or double bonds. Triglycerides, the primary fat in food, consist of three fatty acids attached to a glycerol molecule. Triglycerides may contain saturated, monounsaturated or polyunsaturated fatty acids.

Saturated fats are those that are attributed to high serum cholesterol and cardiovascular disease in humans when consumed in excess quantities. They are straight carbon chains with no double bonds, thus they are saturated with hydrogen atoms. Saturated fats are dense, solid fats, such as the white fat in meat, that stay solid at room temperature.

Unsaturated fats have one or more double bonds and are considered good fats.

Monounsaturated fatty acids have one double bond. Those containing two or more double bonds are polyunsaturated fatty acids, which include the essential fatty acids.

An essential fatty acid is one that cannot be synthesized by a dog but is required for normal body function (see "Evaluating Essential Fatty Acids" on page 14). Two groups of fatty acids are considered to be important — omega-6 and omega-3 fatty acids — however, linoleic acid is the only recognized essential fatty acid.

Linoleic acid is an omega-6 fatty acid, which means the first double bond in its carbon chain is six carbons from the omega end. If the first double bond were three carbons away from the omega end, it would be an omega-3 fatty acid.

Basic Functions

Fat primarily is known for its role as an important and concentrated source of energy. The gross energy of fat is 9 kilocalories per gram compared to 4 kilocalories per gram for both protein and carbohydrates. The digestibility of fat generally is higher than protein or carbohydrate, and fat is highly palatable and impacts the texture of dog food.

Fat deposits are present under the skin as subcutaneous fat, around the vital organs and in membranes surrounding the intestines. These fat deposits provide energy when needed and storage when there is a surplus. The layer of fat under the skin provides insulation from temperature extremes, and the fat that surrounds vital organs cushions and protects from physical shock.¹

Fat also is required for cell membrane structure and cell function. Cell membranes must have a proper and balanced composition of essential fatty acids to maintain the fluidity necessary to transport water, ions, essential nutrients, hormones and cell products in and out of the cells. Cellular membrane fatty acid composition also is critical in regulating cellular response.

Essential fatty acids also serve as parent compounds for conversion into biologically active hormone compounds called eicosanoids, which are important in cell-to-cell communication, inflammation, immune function, blood flow control, pain recognition and blood clotting. Cells must have an ample supply and correct balance of essential fatty acids available for conversion as needed to appropriately respond to various challenges or stresses.

Healthy Skin and Haircoat

A dull, scruffy, dry coat, even flaky skin, is the most visible effect of a lack of adequate dietary fat. Dog foods formulated with very low fat content or poor-quality fat may cause an essential fatty acid deficiency and associated skin and coat disorders.

Deficiencies occur, in part, because there is a lack of omega-6 linoleic acid in the fat portion of epidermal cells, which functions as an essential barrier to prevent the loss of water and other nutrients. The correct balance of essential fatty acids in skin cell membranes is particularly important to help maintain the epidermal water barrier and to help keep skin soft and subtle.

One study of the effect of vegetable fats on dogs' skin and haircoat showed a short-term improvement regardless of the type of fat fed. John Bauer, D.V.M., Ph.D., the Mark L. Morris Professor of Clinical Nutrition at the College of Veterinary Medicine at Texas A&M University, says, "We noticed a short-term improvement in skin and haircoat condition after just 28 days, regardless whether dogs were fed fat from whole ground flaxseed or from whole ground sunflower seed." Flaxseed contains high amounts of omega-3 alpha-linolenic acid, whereas sunflower contains large amounts of omega-6 linoleic acid.

"Between 54 and 84 days, the improvement dropped back to the starting point, making it appear that a modest increase in vegetable oil fats produce a short-term improvement," Bauer says. "In essence, our study showed a benefit in feeding a fairly high-fat diet to improve a dog's sheen or feel of the skin."

Inflammation

Fatty acids — and the correct amount of each kind — are important in ensuring that a dog is equipped to properly respond to inflammation. Omega-6 and omega-3 eicosanoids both affect inflammation and immune cells. While the omega-6 eicosanoids tend to be potent and pro-inflammatory, the omega-3 eicosanoids are less potent and more anti-inflammatory.

Rebecca Remillard, Ph.D., D.V.M., a clinical nutritionist at Angell Memorial Animal Hospital in Boston, says, "The type of eicosanoid produced during inflammation depends on the host cell type, the fatty acid content of that omega-3 or omega-6 cell, and the enzyme system used to produce the eicosanoid. Omega-3 fatty acids are not a single treatment for inflammatory diseases, but rather offer a concurrent dietary therapy that may help modulate the immune response."

Immune Function

Allergies occur when a dog has an adverse reaction to an allergen such as dietary protein, pollen or dust. The immune system kicks in, and before long the inflammation process is activated. If a dog begins licking and scratching all over, it can lead to a cycle of self-trauma that sometimes includes secondary bacterial infections, such as hot spots.

As a doctoral student at Texas A&M University, Purina's Mark Waldron, Ph.D., studied whether the type of fatty acid influences cell function and reduces the inflammatory process in healthy dogs. "We looked at whether diets rich in omega-3 fatty acids from fish oil significantly altered

cell function compared to omega-3 fatty acids from linseed oil," he says. "Because the fatty acids from fish oil have two additional carbons compared to the omega-3 fatty acids from linseed oil, we found they are more readily incorporated into cellular membranes, where they contribute to a decrease in the inflammatory process.

"The bottom line is that it is not only the absolute amount of omega-3 fatty acids but also the type — whether it is an 18-carbon chain found in linseed oil vs. the 20-carbon chain in fish oil — that must be considered when formulating diets for specific conditions," Waldron says.

Early Development

Fatty acids increasingly are being evaluated for their contribution to prenatal, and possibly neonatal, development. In humans, long-chain polyunsaturated fatty acids — those with a chain length of 20 or more carbons — are considered of major importance in fetal and infant development, as well as adult health maintenance.² "Fatty acids also have a very important gestation story in dogs," Bauer says. "We have every reason to believe dogs, like humans, need a source of omega-3 long-chain carbons."

In his studies, Bauer found an accumulation of the omega-3 long-chain fatty acid docosapentaenic acid (DPA), from which the omega-3 docosahexaenoic acid (DHA) is synthesized, in the circulation, or plasma, of dogs fed the omega-3 alpha-linolenic acid. "The rapid and marked increase in DPA, which is an important substrate for subsequent retinal DHA synthesis, points to the fact that the canine retina, and presumably other nervous tissues, can synthesize and use DHA."

Fatty Acid Contributions

Increased knowledge about fatty acids and how they impact canine diets underscores the importance of feeding a complete and balanced diet to ensure that dogs receive an adequate supply of dietary fat. The contributions of fat to healthy skin and haircoat, healthy immune function and the inflammation process — as well as fat's importance as an energy source and in adding palatability to food — already present good reasons not to ignore the benefits of fat in canine diets. ©

1. Case LP, Carey DP, Hirakawa DA. Canine and Feline Nutrition: A Resource for Companion Animal Nutrition Professionals. (St. Louis: Mosby, 1995) p .22-24.
2. Waldron MK, Bauer JE. Fat & neurology: Long chain n-3 fatty acids in companion animal n

Desc:

Fats are an essential part of your dog's diet. Learn all the benefits of a diet with the right amount of fat.