

YOUR CAT'S NUTRITIONAL NEEDS

A Science-Based Guide For Pet Owners



NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

THE DIGESTIVE TRACT

Point of Departure

The mechanical breakdown of food begins in the mouth, where food is ingested, chewed, and swallowed. Chemical breakdown starts here as well, with the secretion of enzyme-laden saliva.

Automatic Transport

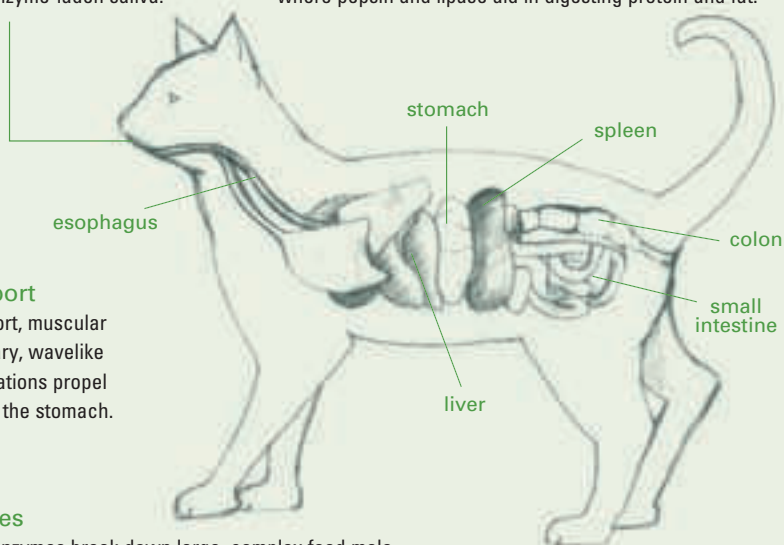
The esophagus is a short, muscular tube in which involuntary, wavelike contractions and relaxations propel food from the mouth to the stomach.

Treatment Facilities

In the small intestine, enzymes break down large, complex food molecules into simpler units that can be absorbed into the bloodstream. The pancreas is an organ that does double duty secreting digestive enzymes into the gut and hormones, including insulin and glucagon, into the blood. Important for fat metabolism, the liver produces bile and partially stores it in the gall bladder between meals.

Storage and Processing

The stomach acts as a temporary storage and processing facility before emptying its contents into the small intestine. Early stages of digestion take place in the stomach, where pepsin and lipase aid in digesting protein and fat.



End of the Line

The primary function of the large intestine is to absorb electrolytes and water. Also, this is where microbes ferment nutrients that have so far escaped digestion and absorption.

COMMITTEE ON NUTRIENT REQUIREMENTS OF DOGS AND CATS

DONALD C. BEITZ, *Chair*, Iowa State University

JOHN E. BAUER, Texas A&M University

KEITH C. BEHNKE, Kansas State University

DAVID A. DZANIS, Dzanis Consulting & Collaborations

GEORGE C. FAHEY, University Of Illinois

RICHARD C. HILL, University Of Florida

FRANCIS A. KALLFELZ, Cornell University

ELLEN KIENZLE, Zentrum Für Lebensmittel Und Tierernährung, Oberschleissheim, Germany

JAMES G. MORRIS, University Of California, Davis

QUINTON R. ROGERS, University Of California, Davis

Support for the development of this pamphlet was provided by the President's Circle Communications Initiative of the National Academies. The pamphlet was written by Dale Feuer based on a report by the Committee on Nutrient Requirements of Dogs and Cats. Illustration and design by Van Nguyen.

Copies of *Nutrient Requirements of Dogs and Cats* are available from the National Academies Press, 500 Fifth Street, NW, Washington, DC, 20001; 800-624-6242 or 202-334-3313 (in the Washington area); <http://www.nap.edu>.

Copyright 2006 by the National Academy of Sciences. All rights reserved.

CONTENTS

| | |
|--------------------------|----|
| Introduction | 1 |
| Proteins and Amino Acids | 2 |
| Fats and Fatty Acids | 3 |
| Energy Needs | 4 |
| Vitamins | 6 |
| Minerals | 8 |
| Feeding Practices | 10 |
| Food Choices | 12 |

INTRODUCTION

How much should I feed my cat? Does the food I'm providing meet my cat's nutritional needs? As our knowledge of the relationship between diet and health continues to advance and as the range of foods available for cats continues to expand, it's more important than ever to base feeding choices on good information.

The information in this pamphlet is based on *Nutrient Requirements of Dogs and Cats*, a technical report issued by the National Research Council as part of its Animal Nutrition Series. The Food and Drug Administration relies on information in the report to regulate and ensure the safety of pet foods. Other reports in the series address the nutritional needs of horses, dairy cattle, beef cattle, nonhuman primates, swine, poultry, fish, and small ruminants. Scientists who study the nutritional needs of animals use the Animal Nutrition Series to guide future research. The series is also used by animal owners, caretakers, and veterinarians to develop specialized diets for individual animals. Links to reports in the series can be found at <http://dels.nas.edu/banr>.

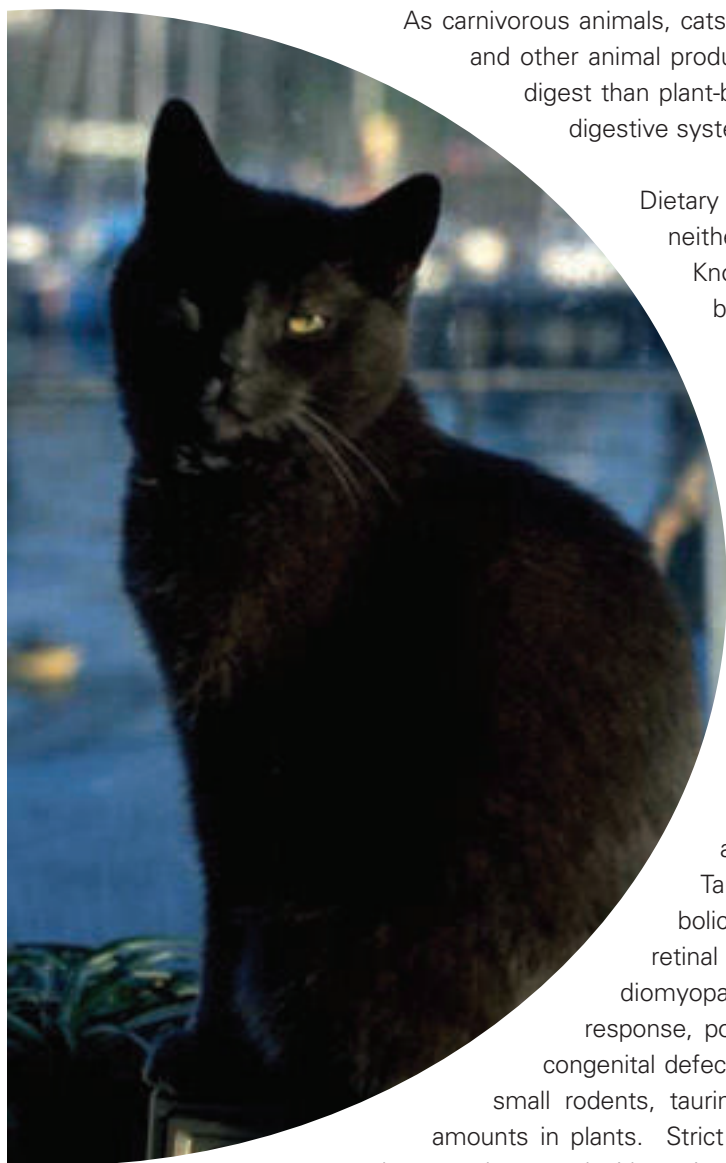
Cats need several different kinds of nutrients to survive: **amino acids from protein, fatty acids and carbohydrates, vitamins, minerals, and water.** The tables in this pamphlet provide recommended daily allowances for nutrients based on the amount required to maintain good health in normal cats. Your cat's unique nutritional requirements will depend on its size and its stage in life, among other factors. A better understanding of how cats use the various nutrients in food and how much of them they need can help you choose a healthy diet for your pet.

PROTEINS AND AMINO ACIDS

As carnivorous animals, cats derive most of their protein from meat, fish, and other animal products. Some animal-based protein is easier to digest than plant-based protein and is better suited to the cat's digestive system.

Dietary protein contains 10 specific amino acids that neither cats nor dogs can make on their own. Known as essential amino acids, they provide the building blocks for many important biologically active compounds and proteins. In addition, they provide the carbon chains needed to make glucose for energy. High-quality proteins have a good balance of all of the essential amino acids.

Deficiencies of single essential amino acids can lead to serious health problems. Arginine, for example, is critical to the removal of ammonia from the body through urine. Without sufficient arginine in the diet, cats may suffer from a toxic buildup of ammonia in the bloodstream. Although not the case for dogs, the amino acid taurine is a dietary essential for cats. Taurine deficiency in cats causes a host of metabolic and clinical problems, including feline central retinal degeneration and blindness, deafness, cardiomyopathy and heart failure, inadequate immune response, poor neonatal growth, reproductive failure, and congenital defects. Found abundantly in many fish, birds, and small rodents, taurine is either absent or present only in trace amounts in plants. Strict vegetarian diets are not appropriate for cats unless supplemented with nutrients essential for cats that are not found in plants.



FATS AND FATTY ACIDS

Dietary fats, mainly derived from animal fats and the seed oils of various plants, provide the most concentrated source of energy in the diet. Fats contain more than twice as much energy as protein and carbohydrates per gram. Dietary fats supply essential fatty acids that cannot be synthesized in the body and serve as carriers for important fat-soluble vitamins. Fatty acids play an important role in cell structure and function. Additionally, food fats tend to enhance the taste and texture of a cat's food.

The maximum amount of fat in the cat's diet can be reasonably high without any known adverse effects. In many cat foods, 50% or more of the energy comes from fat. Studies indicate that cat foods containing even higher amounts of fat are safe. At a minimum, cat foods should have a fat content of about 9% of dry matter.

Essential fatty acids are necessary to keep your cat's skin and coat healthy. Deficiencies in the so-called omega-3 family of essential fatty acids can lead to a host abnormalities of the nervous system, ranging from vision problems to impaired learning ability. Another family of essential fatty acids, known as omega-6, has been shown to have important physiological effects in the body. Tissues that perform such functions as storage (fat), metabolism (liver), mechanical work (muscle), and excretion (kidney) tend to have cell membranes in which omega-6 fatty acids predominate.

DAILY RECOMMENDED ALLOWANCES FOR PROTEIN AND FATS

| | KITTENS Weighing 1.8 lb | ADULT CAT Weighing 9 lb, consuming 250 Calories | NURSING CATS Weighing 9 lb with 4 kittens |
|---------------|----------------------------|---|--|
| Crude Protein | 10 g | 12.5 g | 41 g |
| Total Fat | 4 g | 5.5 g | 12 g |

Determining Grams of Essential Nutrients from Petfood Labels

Petfood labels do not generally list amounts of essential nutrients in grams. However, all pet food labels must state guarantees for the minimum percentages of crude* protein and crude fat, and the maximum percentages of crude fiber and moisture. To convert these percentages to grams, simply multiply the crude percentages times the weight of your cat's daily portion. For example, if you feed your cat one 6-oz (170-gram) can of food per day, and the food contains 8% crude protein, the grams of protein would be $0.08 \times 170 = 13.6$ grams.

*"Crude" refers to the specific method of testing the product, not to the quality of the nutrient itself.



ENERGY NEEDS

Cats need a certain amount of energy to sustain the normal activities of their daily lives. Growth, pregnancy, lactation, and exercise all increase these normal energy requirements. Generally measured in terms of calories, energy comes from three major dietary components: **carbohydrates, protein, and fats.**

While not essential in the diet, carbohydrates provide an abundant source of energy. The major sources of carbohydrates in commercial cat foods are cereals, legumes, and other plant foodstuffs. Because cats are carnivores, the short length of their long intestines limits their ability to ferment fibers that are found in many carbohydrates.

TIDBIT

Severe illness or trauma may increase a cat's energy needs. Whenever your cat becomes ill, please consult with your veterinarian or cat nutritionist about your cat's changed nutritional needs.

AVERAGE DAILY ENERGY NEEDS

| | CALORIES PER DAY (Kilocalories per day*) | | | |
|--|---|---------|-----------|-----------|
| | 5 lb | 10 lb | 15 lb | 20 lb |
| Kittens (after weaning) | 200 | — | — | — |
| Lean Domestic Cat | 170 | 280 | 360 | 440 |
| Overweight Domestic Cats | 180 | 240 | 280 | 310 |
| Exotic (wild) Cats | 100–480 | 170–810 | 230–1,100 | 200–1,360 |
| Pregnant/Nursing Cat (4 kittens/4 kittens at peak lactation) | 336 | 603 | 851 | 1,091 |

*1 Calorie = 1 kilocalorie = 1,000 calories. The term Calorie that is used on food nutrition labels is really a “food calorie” sometimes called a “large calorie.” It is equivalent to 1,000 calories (or 1 kilocalorie) as calories are defined scientifically (the amount of energy needed to warm 1 gram of water 1°C). In Nutrient Requirements of Cats and Dogs, energy needs are expressed in terms of kilocalories, which are equivalent to Calories in this document.

ENERGY NEEDS OF KITTENS

Before weaning, kittens need 20–25 Calories for every 100 grams of body weight. Cat owners should start supplemental feedings from 2.5 to 4 weeks after birth, because mother’s milk is no longer sufficient.

ENERGY NEEDS OF PREGNANT AND LACTATING CATS

New mothers typically suckle their kittens for 7 to 9 weeks and will lose weight while nursing no matter what you feed them. That is why it is important to feed your pregnant cat enough to allow her to increase her body weight by 40–50% by the end of her pregnancy. The energy needs of nursing cats generally increase with litter size and through the fourth week of nursing. As a rule of thumb, nursing mothers with more than two kittens need between 2 and 2.5 times the calories they needed at the time of mating. Lactating cats should be given free access to a highly palatable, high-calorie food.



UNDERWEIGHT



UNDERWEIGHT OR OVERWEIGHT?

Your cat is not getting enough to eat if it feels “bony” to the touch, has little or no fat on the ribs, and appears to “cave in” just behind the ribs. If chronically underfed, adult cats may experience damage to internal organs, impaired ability to nurse young, and increased susceptibility to bacterial infections and parasites; kittens may be stunted in their growth; adult cats may develop osteoporosis.

IDEAL



Your cat is at an ideal weight if it appears well-proportioned, shows a moderate waistline behind the ribs, and has a thin covering of fat over the ribs and abdomen.

OVERWEIGHT



Your cat is overweight if it has heavy fat deposits over the lumbar area, face, and limbs and if there is an obvious rounding or distension of the abdomen. Obesity occurs in one out of four cats in westernized societies and is more common in older and neutered animals. Health risks include diabetes and osteoarthritis.

VITAMINS

Vitamins are organic compounds that take part in a wide range of metabolic activities. Vitamin deficiencies can cause a variety of health problems. Cats cannot synthesize some vitamins from precursors (pre-vitamin structures) in the diet. For example, they must get all of the vitamin A and niacin they need directly from the food they eat. Deficiencies in vitamin A can adversely affect the health of the eyes. Adult cats deprived of niacin in the diet will lose weight and may die as a result. The diets fed to many cats, especially canned food containing fat-laden fish products, make them more susceptible to deficiencies of certain vitamins, such as vitamin E. Vitamin E, an antioxidant, provides protection against oxidative damage. Some vitamins are not only essential in small doses, but are also toxic in excess amounts. Too much vitamin A, a natural consequence of feeding large amounts of liver to growing kittens, can cause hypervitaminosis A, a condition characterized by a variety of skeletal lesions.

DAILY RECOMMENDED ALLOWANCES FOR VITAMINS

| | Functions | Daily Recommended Allowance* | Signs of Deficiency/Excess |
|--|--|------------------------------|---|
| Vitamin A | Vision; growth; immune function; fetal development; cellular differentiation | 63 µg | Conjunctivitis; cataracts, retinal degeneration and other eye problems; weight loss; muscle weakness; reproductive and developmental disorders Skeletal lesions in kittens, particularly outgrowths of the cervical vertebrae; osteoporosis |
| Vitamin D | Maintenance of mineral status; skeletal structure; phosphorous balance | 0.4 µg | Rickets; abnormalities in skeletal development; progressive paralysis; ataxia; lack of grooming; reduction in body weight and food intake Anorexia; vomiting; lethargy; calcification of soft tissues |
| Vitamin E | Defense against oxidative damage | 2.5 mg | Anorexia; depression; pain sensitivity in abdomen; fat tissue pathology |
| Vitamin K | Activation of clotting factors, bone proteins, and other proteins | 82 µg | Prolonged blood clotting times; hemorrhaging |
| Vitamin B₁ (thiamin) | Energy and carbohydrate metabolism | 0.33 mg | Neurological impairments including altered reflexes and convulsive seizures; heart-rate disorders; pathological changes in the central nervous system; severe learning deficits |
| Riboflavin | Enzyme functions | 0.27 mg | Cataracts; fatty livers; testicular atrophy |
| Vitamin B₆ | Glucose generation; red blood cell function; niacin synthesis; nervous system function; immune response; hormone regulation; gene activation | 0.16 mg | Stunted growth; convulsive seizures; kidney lesions |
| Niacin | Enzyme functions | 2.5 mg | Anorexia; weight loss; elevated body temperature; fiery red tongue, with ulceration and congestion |
| Pantothenic Acid | Energy metabolism | 0.4 mg | Stunted growth; fatty changes in liver; small bowel lesions |
| Vitamin B₁₂ | Enzyme functions | 1.4 µg | Weight loss; vomiting; diarrhea; intestinal disorders |
| Folic Acid | Amino acid and nucleotide metabolism; mitochondrial protein synthesis | 47 µg | Decreased growth rate; increased iron levels in blood |

*Daily needs for an adult cat weighing 9 pounds, consuming 250 Calories per day.
mg = milligram µg = microgram



MINERALS

Twelve minerals are known to be essential nutrients for cats. Calcium and phosphorus are crucial to strong bones and teeth. Cats need other minerals, such as magnesium, potassium, and sodium, for nerve impulse transmission, muscle contraction, and cell signaling. Many minerals that are present only in minute amounts in the body, including selenium, copper, and molybdenum, act as helpers in a wide variety of enzymatic reactions. The requirements for certain minerals may change as your cat ages.

Cats can get too much or too little of a specific mineral in their diets. An excess of dietary magnesium, for instance, has been implicated in the formation of stones in the urinary tract. Foods that maintain relatively low urinary pH levels, however, have been shown to prevent these stones.

DAILY RECOMMENDED ALLOWANCES FOR MINERALS

| | Functions | Daily Recommended Allowance* | Signs of Deficiency/Excess |
|-------------------|---|------------------------------|---|
| Calcium | Formation of bones and teeth; blood coagulation; nerve impulse transmission; muscle contraction; cell signaling | 0.18 g | Nutritional secondary hyperparathyroidism; loss of bone mineral content, which can lead to collapse and curvature of lumbar vertebrae and pelvic bones; bone pain, which can progress to pathological fractures Depressed food intake; decreased growth; increased bone mineral density; increased need for magnesium |
| Phosphorus | Skeletal structure; DNA and RNA structure; energy metabolism; locomotion; acid-base balance | 0.16 g | Hemolytic anemia; locomotor disturbances; metabolic acidosis |

| | | | |
|------------------|---|--------|--|
| Magnesium | Enzyme functions; muscle and nerve-cell membrane stability; hormone secretion and function; mineral structure of bones and teeth | 25 mg | Poor growth; overextension of the carpal joints; muscle twitching; convulsions Urinary tract stone formation in the presence of high pH |
| Sodium | Acid-base balance; regulation of osmotic pressure; nerve impulse generation and transmission | 42 mg | Anorexia; impaired growth; excessive thirst and drinking; excessive urination |
| Potassium | Acid-base balance; nerve-impulse transmission; enzymatic reactions; transport functions | 0.33 g | Anorexia; retarded growth; neurological disorders, including ataxia and severe muscle weakness |
| Chlorine | Acid-base balance; osmolarity of extracellular fluids | 60 mg | Increased sodium concentration in renal fluid; excess potassium excretion |
| Iron | Hemoglobin and myoglobin synthesis; energy metabolism | 5 mg | Poor growth; pale mucous membranes; lethargy; weakness; diarrhea Vomiting and diarrhea |
| Copper | Connective tissue formation; iron metabolism; blood cell formation; melanin pigment formation; myelin formation; defense against oxidative damage | 0.3 mg | Reduced weight gain; longer time to conceive |
| Zinc | Enzyme reactions; cell replication; protein and carbohydrate metabolism; skin function; wound healing | 4.6 mg | Skin lesions; growth retardation; testicular atrophy |
| Manganese | Enzyme functions; bone development; neurological function | 0.3 mg | No studies of deficiency in cats |
| Selenium | Defense against oxidative damage; immune response | 19 µg | No studies of deficiency in cats |
| Iodine | Thyroid hormone synthesis; cell differentiation; growth and development of puppies; regulation of metabolic rate | 88 µg | Enlargement of thyroid glands Excessive tearing, salivation, and nasal discharge; dandruff |

**Daily needs for an adult cat weighing 9 pounds at maturity, consuming 250 Calories per day.*

FEEDING PRACTICES

Q: Does my cat need to have meat and/or fish products in its diet?

A: Domestic cats are descended from strict meat-eaters, and their behavior reveals their carnivorous nature. When hunting, domestic cats will seek small prey such as mice, birds, and insects. They may even kill and eat a rabbit. They will stop eating a meal of commercial cat food and go off hunting if distracted by potential prey. The particular chemistry and structure of the cat's gastrointestinal system is well-suited to digesting and absorbing nutrients from animal-based proteins and fats. Unsupplemented vegetarian diets can result in harmful deficiencies of certain essential amino acids, fatty acids, and vitamins.

Q: How much fiber is good for my cat?

A: Fiber in the diet is probably good for overall gastrointestinal health and may help overweight cats trim down. Dietary fiber is thought to help maintain proper weight by diluting the caloric density of the food and through physical effects and hormonal interactions. For reasons not yet understood, dietary fiber also seems to help in the management of mild hyperglycemia (high blood sugar), a relatively common problem in older cats.

On the other hand, too much fiber in the diet can decrease the digestibility of other important nutrients. Also, certain features of the cat's intestinal tract, including a relatively small colon and nonfunctional cecum, suggest that cats may not be able to utilize dietary fibers as well as other animals. Meals should not have more than 10% fiber.

Q: How often should I feed and water my cat?

A: If given free access to food, cats will eat between 12 and 20 meals a day, evenly spread out over the 24-hour light-dark cycle. Cats should be fed more than once a day.

Fresh water should be available at all times, but the amount needed varies with the type of diet and the environmental conditions. Cats don't drink as much per kilogram of body weight as do dogs, perhaps because of their evolution as desert animals. Cats will drink approximately 2 milliliters of water for every gram of dry food they eat. Whereas dogs will drink enough water to replace 6% of their body weight in one hour, cats will take 24 hours to do the same. The weak thirst drive of cats puts some cats at higher risk of developing urinary tract stones. While



TIDBIT

Exposure to certain flavors and textures of food early in life can shape strong preferences later on, as can meal temperature, odor, texture, and taste. It's important to gradually mix the familiar food with the new food before switching completely.

they may be better off eating canned cat food, which contains 78–82% water, simply adding water to dry food will also help to protect against stone formation.

Q: How can I help my overweight cat trim down?

A: The most obvious answer is to put less of the same type of food in its bowl each day, still allowing it to eat at all times of the day. This is not the same as letting it eat as much as it wants at all times. About 30 to 40% of cats will overeat and become fat if given this latitude. Some cat owners offer less appealing food. Another option is to feed one of the low-calorie cat foods on the market. It's also important to remember to keep your cat from sampling the cat-next-door's food and to refrain from giving it table scraps.

Q: Is it true that cats are finicky eaters?

A: It is true that taste, texture, and moisture content of food is more important to cats than it is to dogs. Cats will choose foods on the basis of these features rather than nutritional adequacy. That is why it is important for cat owners to make sure their pets are getting the recommended amounts and mix of all of the essential vitamins, minerals, and other nutrients.

In contrast to dogs, cats will not eat a powdered, commercial diet. They will, however, eat the same diet if it is provided as pellets, in a mash, or in gel form. Typically, they like the gel form the best. They are more sensitive to bitter taste than dogs and prefer warm to cold food.



TIDBIT

Cats don't drink as much water as dogs do, perhaps because of their evolution as desert animals.

FOOD CHOICES

Commercial cat foods come in a variety of forms. The most common types are **dry, semimoist, and canned**. The moisture content of these foods ranges from 6 to 10% for dry, 15 to 30% for semi-moist, and 75% for canned. Most canned food has relatively more fat and protein and fewer carbohydrates than dry and semi-moist food, and generally contains much higher levels of animal products.

Pet food labels must list the percentage of protein, fat, fiber, and water in the food. When reading labels, it is important to remember that what may appear to be a big difference in the amount of a nutrient—for example, 8% protein in a canned cat food vs. 27% protein in a dry cat food—reflects the fact that there is more water in the canned food.

PET FOOD ADDITIVES

Some other substances that might be found in pet foods, which are not required nutrients, are described below:

Chondroprotective agents are used by the body to make cartilage and joint tissues. Although chondroprotective agents may be indicated for selected clinical conditions, widespread inclusion in the diets of healthy populations may not be warranted at this time.

Antioxidants work to prevent oxidative damage to nutrients and other compounds in the body and inhibit or quench the formation of free radicals. At this time, data are lacking to make specific recommendations beyond those for the essential vitamins and minerals that are components of antioxidants.



Herbs and botanicals are used in pet foods to provide flavor or, more often, to have a medicinal effect on the body. This is especially true in the case of extracts, where the classical nutritive components of the plant may be separated from the extract in the process. Because the intended functions are more pharmacologic versus nutritional in nature, discussion of potential benefit is beyond the scope of this publication.

Flavors and extracts derived from animal tissues such as poultry or fish are considered “natural” flavors. A wide variety of flavors can be derived from other animal and plant materials, including dairy products, eggs, herbs, and spices. Acceptable processing methods include roasting, extraction, and fermentation. Except for artificial smoke and bacon flavors, synthetic substances are rarely used in most dog and cat foods.

Colors are synthetic compounds used to replace or accentuate the inherent color of the food. Only certified colors approved for use in human foods are allowed in pet foods. Iron oxide is a synthetic but noncertified color that can be used at levels not to exceed 0.25% of the pet food product to give dog and cat food a red, meaty appearance. Titanium dioxide is another common color additive in human and pet foods because it can induce a “brightness” in foods by complementing other color additives. Its use is limited to 1% of the food by weight.



TIDBIT

Pet foods marketed as “snacks” are not required to have nutritional adequacy labels.



For more than 80 years, the National Academies has fostered improved understanding of the nutritional needs of pets, wildlife, laboratory-research species, and food-producing animals through its Nutrient Requirements of Domestic Animals series—a series that is considered the “gold standard” for animal nutrition in the United States and worldwide.

This pamphlet is based on recommendations from the 2006 release of *Nutrient Requirements of Dogs and Cats*. The report contains useful information for companion animal nutritionists, veterinarians, scientists in industry and academe, regulators, pet owners and anyone with an interest in the health and welfare of these important animals. To order the report, contact the National Academies Press, 500 Fifth Street NW, Washington, DC 20001; (800) 624-6242 or <http://www.nap.edu>.



For more information, contact the Board on Agriculture and Natural Resources (BANR) at **202-334-3062** or visit <http://dels.nas.edu/banr>. BANR is part of the National Academies' Division on Earth and Life Studies. Sign up for the division's free e-mail notifications of new reports, projects, committees, and events at <http://dels.nas.edu>.

THE NATIONAL ACADEMIES™

Advisers to the Nation on Science, Engineering, and Medicine

The nation turns to the National Academies—National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council—for independent, objective advice on issues that affect people's lives worldwide.

www.national-academies.org