

VETERINARY focus

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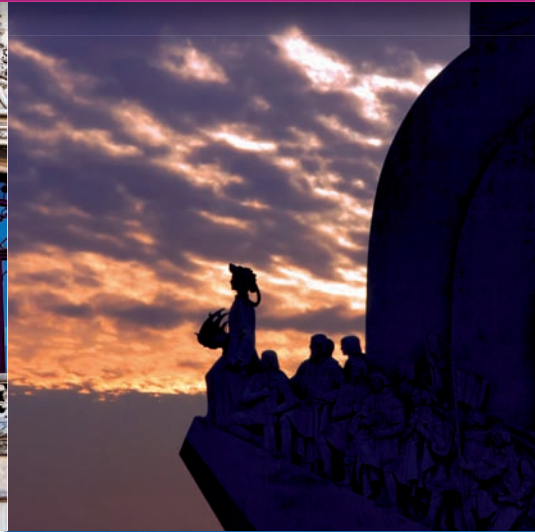
The worldwide journal for the companion animal veterinarian

A detailed 3D rendering of a cell, showing its nucleus, mitochondria, and other organelles. The cell is surrounded by other cells and structures, creating a complex, multi-layered appearance. The colors are primarily gold, white, and purple, with some red and blue accents.

Canine and Feline Nutrition

Nutritional considerations for the aging cat • Canine feeding behavior • The “BARF” trend – advantages, drawbacks and risks • Co-morbidity of overweight and obesity in dogs and cats • Cats and dietary fiber • The psychology of managing the owner • Pets and pet foods – questions and answers • Cut-out and keep guide...Calculating the energy content of pet food


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The 21st century aphorism that states “you are what you eat” can be traced back a long way. Some lexicographers attribute it to Jean Anthelme Brillat-Savarin, a French lawyer and politician, who wrote “Dis-moi ce que tu manges, je te dirai qui tu es” [tell me what you eat and I will tell you what you are]. He was not alone in his views – Ludwig Andreas Feuerbach, the 19th century German philosopher, concurred, declaring “Der Mensch ist, was er ißt”, which translates as “man is what he eats”. In fact many will suggest that neither intended their words to be taken literally; rather, they may have meant that the food one eats has a bearing on one’s state of mind and health, and that disease can be a product of diet and lifestyle as well as environmental factors – something that is perhaps all too obvious to the medical and veterinary professions today.

Interestingly, Brillat-Savarin, who became a famous epicure and gastronome and had both a cheese and a gateau named after him, was ahead of his time. He is sometimes claimed to be the father of low-carbohydrate diets, as he considered sugar and white flour to be the cause of obesity and suggested protein-rich ingredients were to be preferred, claiming “carnivorous animals never grow fat”; however he did not foresee the incredible diversity of diets that would develop over the next 200 years.

Indeed few things in the world of companion animals are currently more controversial than what does or does not constitute a good diet; this issue of *Veterinary Focus* tackles the topic with enthusiasm and does not shy away from controversy and discussion. Indeed, it may be apt to conclude with another aphorism, that of Hippocrates, who said, “Let food be your medicine and medicine your food”. Therefore one may find in the pages ahead a diet of knowledge and wisdom that will allow clinicians to both nourish and heal their patients. Enjoy!

Ewan McNeill – Editor-in-chief

Veterinary Focus – Vol 24 n°3 – 2014

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Printed in the European Union

ISSN 1354-0157
Circulation: 70,000 copies
Legal deposit: November 2014
Cover: Shutterstock

Veterinary Focus is also published in French, German, Chinese, Italian, Polish, Spanish, Japanese & Russian.

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Nutritional considerations for the aging cat



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KEY POINTS

- **Nutrition and appropriate nutritional management have been shown to alleviate, postpone, slow down and even prevent diseases commonly associated with the process of aging.**
- **The nutritional recommendations for older healthy cats must take into account the specific requirements of the feline species and the impact of aging on physiology and metabolism, as well as dietary strategies that could help to prevent or slow down disease processes.**
- **Longevity requires a healthy start from an early age; nutrient deficiencies as well as excesses will significantly affect lifespan.**
- **It is important to maintain optimal body condition for a cat's entire life. Veterinary practitioners should thus assess the diets and dietary management of the aging pet and make recommendations based on the latest scientific knowledge.**

■ Introduction

Improved veterinary care, nutrition and lifestyle have collectively improved the life expectancy of dogs and cats over the last 20 years (1,2). Nutrition and appropriate nutritional management have been shown to alleviate, postpone, slow down and even prevent diseases commonly associated to the process of aging, allowing a better quality of life in older pets (3-6). Veterinary practitioners should thus assess the diets and dietary management of the aging pet and make recommendations based on the latest scientific knowledge.

Many age-related feline diseases (*e.g.*, chronic kidney disease, osteoarthritis, diabetes mellitus, hyperthyroidism) are more frequently observed after ten years of age, and with most of these diseases (and especially in cats) obvious clinical signs occur rather late in the pathophysiological process. Diets for "healthy" senior cats should therefore integrate aspects that will help prevent diseases associated with aging in their formulation. Cats tend to live longer than dogs and it is not uncommon for veterinarians to see cats that are more than 15 years of age. However, as with humans, the

Table 1. Major goals of nutritional support for senior cats (7,8).

<ul style="list-style-type: none"> • To provide a palatable, easy-to-ingest diet
<ul style="list-style-type: none"> • To provide a complete and balanced diet for cats
<ul style="list-style-type: none"> • To maintain optimal body condition <ul style="list-style-type: none"> + Level of energy based on the body condition and sexual status of the cat + Moderate increase of a balanced blend (fermentable/non fermentable) of dietary fibers
<ul style="list-style-type: none"> • To slow down or prevent disease processes associated with aging <ul style="list-style-type: none"> + Renal disease <ul style="list-style-type: none"> - Decreased levels of dietary phosphorus - Increased levels of long chain omega-3 fatty acids (EPA+DHA) + Diabetes mellitus <ul style="list-style-type: none"> - Maintain the cat in optimal body condition to prevent insulin resistance - If the cat is at risk of insulin resistance (e.g., some breeds (such as Burmese) or overweight (especially neutered males)), reduce the levels of carbohydrate and fat, and increase the level of protein and dietary fiber + Osteoarthritis <ul style="list-style-type: none"> - Green-lipped mussel, chondroitin sulphate/ glucosamine, increased levels of EPA/DHA + Chronic inflammatory diseases <ul style="list-style-type: none"> - Increased level of dietary antioxidants (e.g., vitamin E, vitamin C, taurine, lutein, carotenes, polyphenols).

genetic and environmental background of each animal means that the chronological and physiological ages do not always match. The nutritional recommendations for the older healthy cat must therefore take into account the specific requirements of the feline species and the impact of aging on physiology and metabolism, and include dietary strategies that could help prevent or slow down disease processes commonly associated with aging (**Table 1**) (1,7).

Although this paper will focus on the nutritional needs of the healthy aging cat, longevity requires a healthy start from an early age. Both nutritional deficiencies and

excesses will significantly affect lifespan, and it is important to maintain optimal body condition in cats for their entire life (9,10). This might be a challenge, especially following neutering, but feeding diets formulated for neutered cats (e.g., less energy-dense) and adjusting the ration for the body condition have clearly been shown to contribute to achieving life-long optimal body condition (**Figure 1**) (11).

The most precisely formulated diet will only help an aged cat if it is willing to eat it. Special care should thus be taken to ensure maximum palatability by a combination of quality ingredients, and careful selection of aroma, kibble size and the texture of the diet. Note that older cats are at increased risk of suffering from diseases that cause polyuria/polydipsia and are more likely to suffer from lameness, and it is therefore essential to provide them with easy access to fresh water (**Figure 2**).

■ Consequences of aging on dietary requirements

Energy

As with other species, aging in cats is associated with a decrease in lean body mass and an increase in fat mass (1,12). Since lean mass is the metabolically active tissue, energy expenditure and energy needs should thus decrease with age, but this is not true in all cats, especially those above 12 years of age. There is evidence that as many as one-third of older cats have a decreased ability to digest food, especially fat and protein (1). This is supported by a lower prevalence of obesity in cats above 10 years of age (**Figure 3**) (9,13). Therefore not all senior diets should have reduced energy content; energy density and calorie allowance should be adjusted to maintain optimal body condition. As a starting point recommendations are available (**Figure 1**) (7,9) as follows;

- Adult cat (moderate activity – all cats, whether neutered or entire) = $77,6 \times BW^{0,711}$ KcalME/kg
- Adult intact cat and mature cat (high activity) = $93 \times BW^{0,711}$ KcalME/kg
- Overweight cat = $62 \times BW^{0,711}$ KcalME/kg

As individual and seasonal variability can be high in cats, calorie allowance should then be adapted to the body condition of each patient. Life expectancy is lower in cats that are below or above optimal body condition (10). Poor body condition can be an early indicator of a clinical problem that will not allow compensating episodes of fasting commonly associated with disease. As well as promoting lameness and encouraging skin

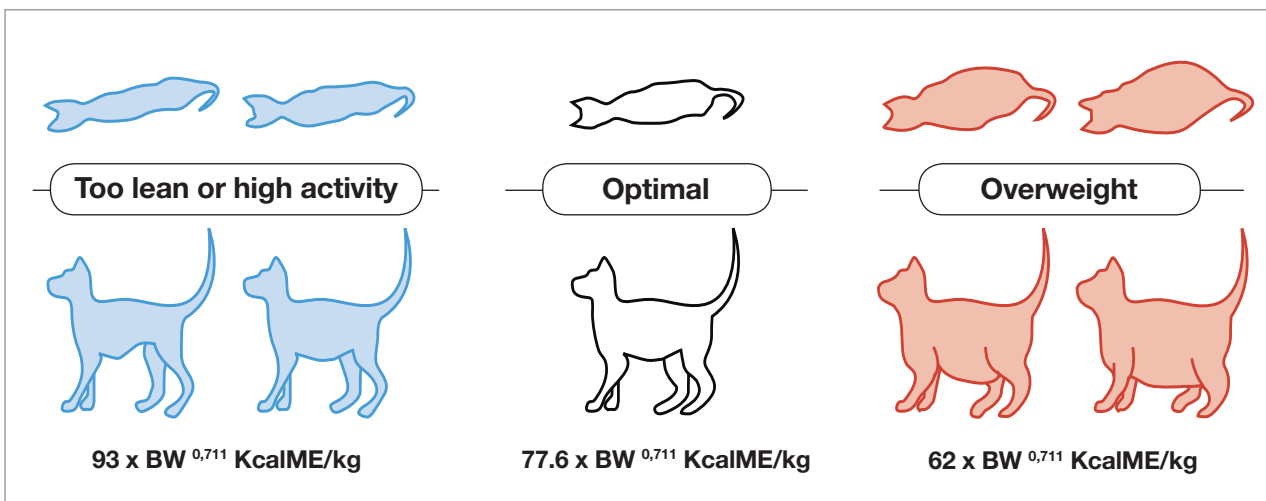


Figure 1. Energy requirements (in Kcal ME/kg bodyweight) and lifelong optimal body condition (modified from (7), (8) & (9)).

problems (because the cat does not groom) obesity promotes insulin resistance (**Figure 4**) (9) and consequently diabetes mellitus is a frequent complication of feline obesity. There are some controversies regarding the use of carbohydrates as an energy source in feline diets; cats have evolved as true carnivores and as such, when compared to dogs or humans, have a lower ability to digest and metabolize carbohydrates (14,15). However, cats are very good at using large amounts of well-cooked carbohydrates in their diet and obesity, rather than high carbohydrate consumption *per se*, promotes insulin resistance (14-17). In cats that are overweight and/or have diabetes mellitus, reduction of dietary carbohydrates, reduction of energy intake and increased dietary protein can collectively improve both the body condition and rate of remission, and allow reduction in the insulin dose (17).

In addition to being an energy source, fats also provide essential fatty acids (7). There are two families of essential fatty acids, omega-6 (vegetable oil) and omega-3 (soybean, flaxseed and fish oils) and it is important to balance them. Early signs of essential fatty acid deficiencies are a dry, unkempt, dull hair coat. There is good evidence in other species (and some suggestions in cats) that long-chain omega-3 fatty acids (EPA and DHA) from fish oil contribute to a healthy immune system and cognitive function (*e.g.*, learning, memory); they may also reduce inflammatory processes (such as those observed in osteoarthritis and dermatitis), slow the progression of renal disease, and could be beneficial in preventing diabetes mellitus and cancer (6,15,18).

Shorter-chain omega-3 fatty acids (α -linolenic acid) such as found in flaxseed oil, cannot be converted to EPA and DHA in cats (and there is a very poor conversion efficiency in dogs) (7). Gamma-linolenic acid (borage oil, primrose oil), although an omega-6 fatty acid, will also have anti-inflammatory benefits through the prostaglandin-1 pathway.

Protein

In the past, it has been commonly recommended to restrict protein in older cats based on the (false) belief that this would help to protect kidney function. However



Figure 2. It is essential to provide senior cats with easy access to fresh water.

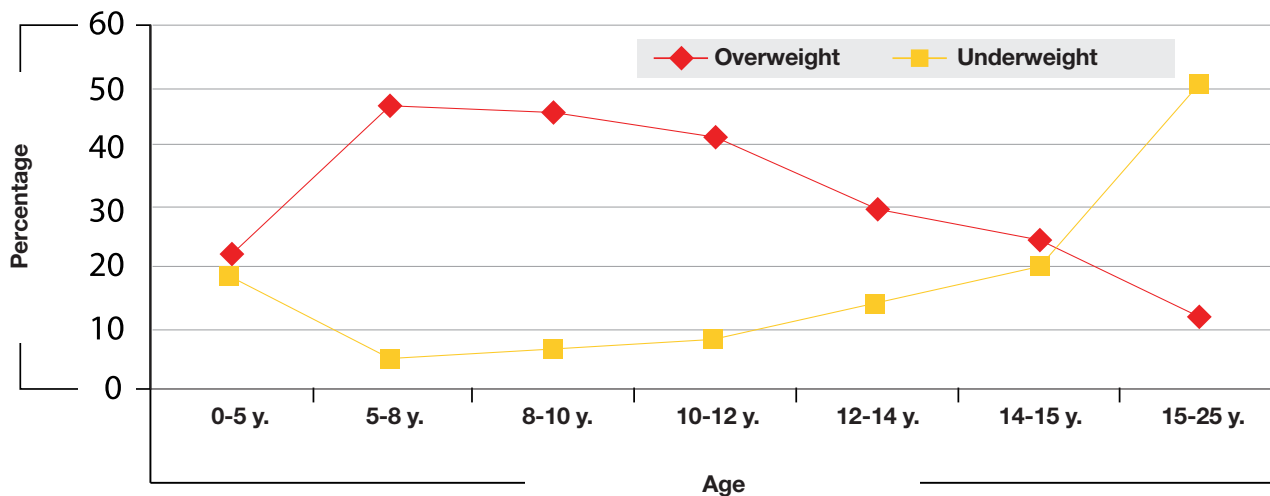


Figure 3. Influence of age on body condition in cats (9,13).

research shows that protein restriction is unnecessary in older cats, even with early renal disease (18,19), and restriction in dietary phosphorus and supplementation with EPA/DHA have been shown to be the most important factors in slowing the progression of renal disease (18). In dogs, protein requirements have been found to increase with age (1); similar data are missing in cats but because of their true carnivorous nature, dietary protein requirements are much higher in cats of all ages (7). Protein quality must also be taken into account. Poor protein digestibility will promote proteolytic colonic flora (the so-called “bad” flora, *Clostridium perfringens* etc.), softer feces and fecal odor. Contrary to common belief, some vegetable proteins, such as wheat gluten, corn gluten, soy protein isolate and hydrolysate, are very digestible, and their amino-acid composition is

easily balanced by careful choice of ingredients; they are also low in phosphorus, and are therefore the proteins of choice in diets for senior cats.

Dietary fiber

Dietary fibers are essential for the health of the gastrointestinal tract (7). They contribute to the regulation of transit, although excessive amounts (> 25%) of insoluble (non-fermentable) fibers may promote constipation in the aged cat. Dietary fibers will contribute to satiety and reduce energy intake in those cats that tend to be overweight (**Figure 5** and see paper on page 26) (20). Fermentable fibers, also called prebiotics, such as beet pulp, chicory pulp, and fructo-oligosaccharides promote a healthy flora and the production of short-chain fatty acids, especially butyrate, an important energy

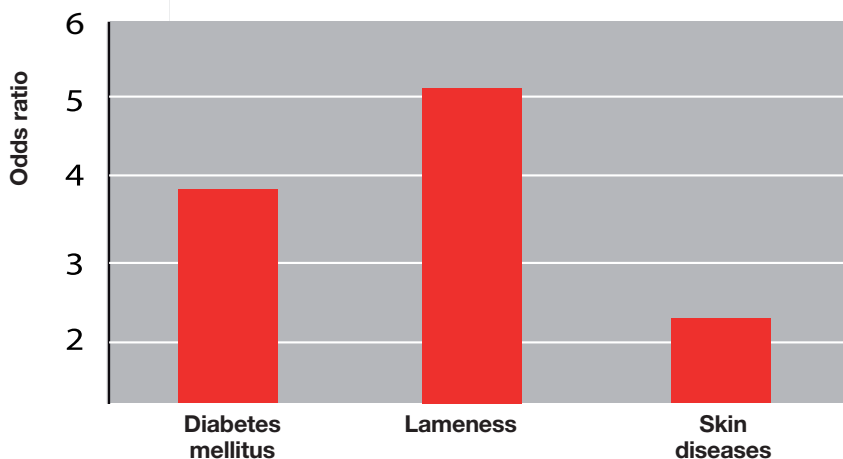


Figure 4. Overweight and obese cats are much more likely to suffer from diabetes mellitus, lameness and/or skin diseases than cats in optimal body condition (approximately four, five and two times respectively over a four-year period) (9).

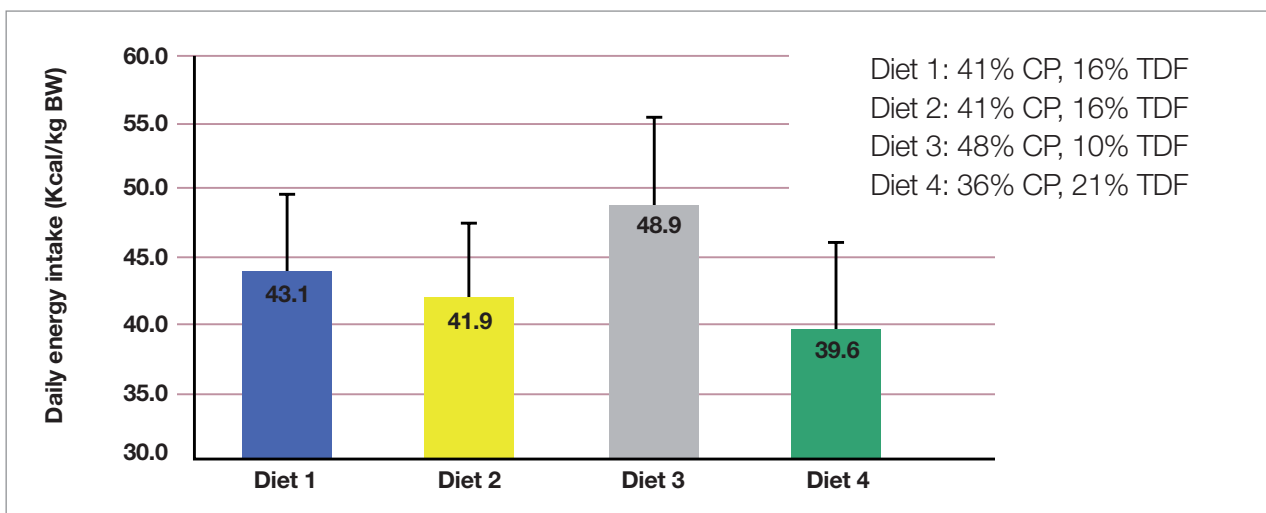


Figure 5. Level and source of fibers can affect energy intake in cats when fed *ad libitum*. Diet 2 contained a fiber with a high water binding property which rapidly binds water in the stomach and thus increases satiety, therefore lowering the energy intake (20). CP = crude protein TDF = total dietary fiber

source for the colonocytes. A recent study indicated that a combination of prebiotic fiber, linoleic acid, EPA/DHA and antioxidants could promote longevity in aging cats by better preserving their body weight, lean body mass, red blood cell count and skin thickness (6). Note that the level of dietary fiber will vary considerably depending on the target energy density of the diet (15-90 g/1000 Kcal ME).

Minerals

As phosphorus restriction has been shown to slow the progression of renal disease, and the prevalence of renal disease is very high in older cats, it is often recommended to reduce the level of phosphorus to the minimum recommended levels (1.25-2.0 g/1000 Kcal) in diets for senior cats (1,18). The calcium/phosphorus ratio should be balanced accordingly. It has been suggested that levels of dietary sodium (2.5-3.0 g Na/1000 Kcal) that stimulate diuresis will promote the progression of renal disease (21) but literature published in peer-reviewed journals does not support this claim; of five scientific papers looking at the association between sodium intake and progression of renal disease in cats and dogs, four failed to find any association (21-25) and the claim that foods high in NaCl are associated with a progressive decline in renal function (26) has been disputed. Hypokalemia is common in older cats, especially in those with renal disease, and dietary levels of potassium should therefore not be too near the minimum recommendations, especially if the diet is acidifying. Calcium oxalate (CaOx) stones are more

common in older cats, but the pathophysiology of CaOx is still poorly understood (27). Urinary pH is a poor predictor of CaOx urine saturation (27,28), but promoting urine dilution by feeding moist food and/or increasing dietary sodium (2.5-3.0 g/1000 Kcal) is an efficient way to reduce CaOx saturation (27).

Vitamins

Oxidative damage plays an important role in many diseases associated with aging such as arthritis, cancers, cardiovascular and neurological diseases. Considerable evidence in humans and animals suggest antioxidants may offer some protection against oxidative stress and normal aging processes (1,6). Studies on antioxidants in cats have reported beneficial effects on markers of oxidative status (29) and it is thus reasonable to recommend increased amounts of antioxidant nutrients. Supplementation with a combination of antioxidants (e.g., Vitamins C and E, taurine, lutein, polyphenols) is preferred, as they act in different areas of the cell and have a synergistic action. As they are necessary for the synthesis of key enzymes and substrates in the antioxidant pathways, it would seem prudent to provide adequate protein and trace-element intakes in diets for aged cats.

Other nutrients

Several non-essential nutrients have been recommended in the diets of aged cats, for example L-carnitine for its role in fat oxidation. Osteoarthritis is very common in older cats, but the clinical signs are poorly

recognized by owners (30), and whilst the owner may not seek veterinary advice, dietary supplementation may well be beneficial for the cat – a recent double-blind randomized clinical study showed the efficacy of a combination of green-lipped mussel, glucosamine, chondroitin sulphate plus EPA/DHA on the perceived and objective activity of cats with osteoarthritis (31).

■ Summary

The nutritional recommendations of the aged healthy cat must therefore take into account the specific requirements of the feline species, to promote maintenance of an optimal body condition and adjust and/or provide nutrients as necessary that will help prevent or slow down the progression of diseases associated with aging.

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Canine feeding behavior



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■ Introduction

Two trends appear to have become fashionable amongst dog owners in recent years:

- **Natural feeding:** Feeding of diets that are based on the composition of wild wolf diets, often including raw ingredients.
- **Dominance-based training methods:** The use of gestures of dominance, such as feeding order or restriction of privileges, to establish control based on increased owner status as a pack leader rather than through reinforcement of desirable behaviors using food rewards.

KEY POINTS

- The diet of modern wolves should not be used as an absolute template for the composition of domestic dog diets, but instead their feeding behavior provides an indication of the needs of domestic dogs.
- Dogs are highly motivated to forage and work to get food, but these needs are rarely met in a domestic setting, which can lead to behavioral problems.
- The relationship between dogs and people should be established using feeding and training with food rewards rather than traditional methods based on concepts of dominance.
- Prevention of behavioral problems is closely associated with the use of food rewards during training.

Both trends are rooted in a popular return to a naturalistic view of dogs, but share the common weakness that they do not take into account the impact that the presence of humans has had on domestic dogs and wolves. This article will provide an overview of the feeding behavior and preferences of wolves and dogs, and provide an indication of how a better understanding of this subject can lead to fewer health and behavioral problems in domestic dogs.

■ The relationship between people and dogs

The history of the relationship between people and dogs is a long one. *Homo sapiens* is thought to have emerged in Africa approximately 250,000 years ago, after a period of increasing skull expansion in early hominid species which began 150,000 years earlier. Although there is evidence of gradual development of tool use and cultural advancement in our species throughout its history, there appears to have been a surge in cultural development which culminated in “behavioral modernity” approximately 50,000 years ago; namely the presence of symbolic culture, language and specialized technology, which contain all of the elements recognizable in subsequent civilizations, including the keeping of animals (**Figure 1**).

The ancestor of the domestic dog is *Canis lupus* (the grey wolf), which became a species separate from the coyote approximately 1-2 million years ago. The geographic origin of the domestic dog remains controversial. Genetic studies have pointed to an origin in South-East Asia, the Middle East or South-East China (1-3), with a possibility of genetic divergence from the wolf beginning up to 100,000 years ago. However, the most recently published analysis of the mitochondrial DNA of

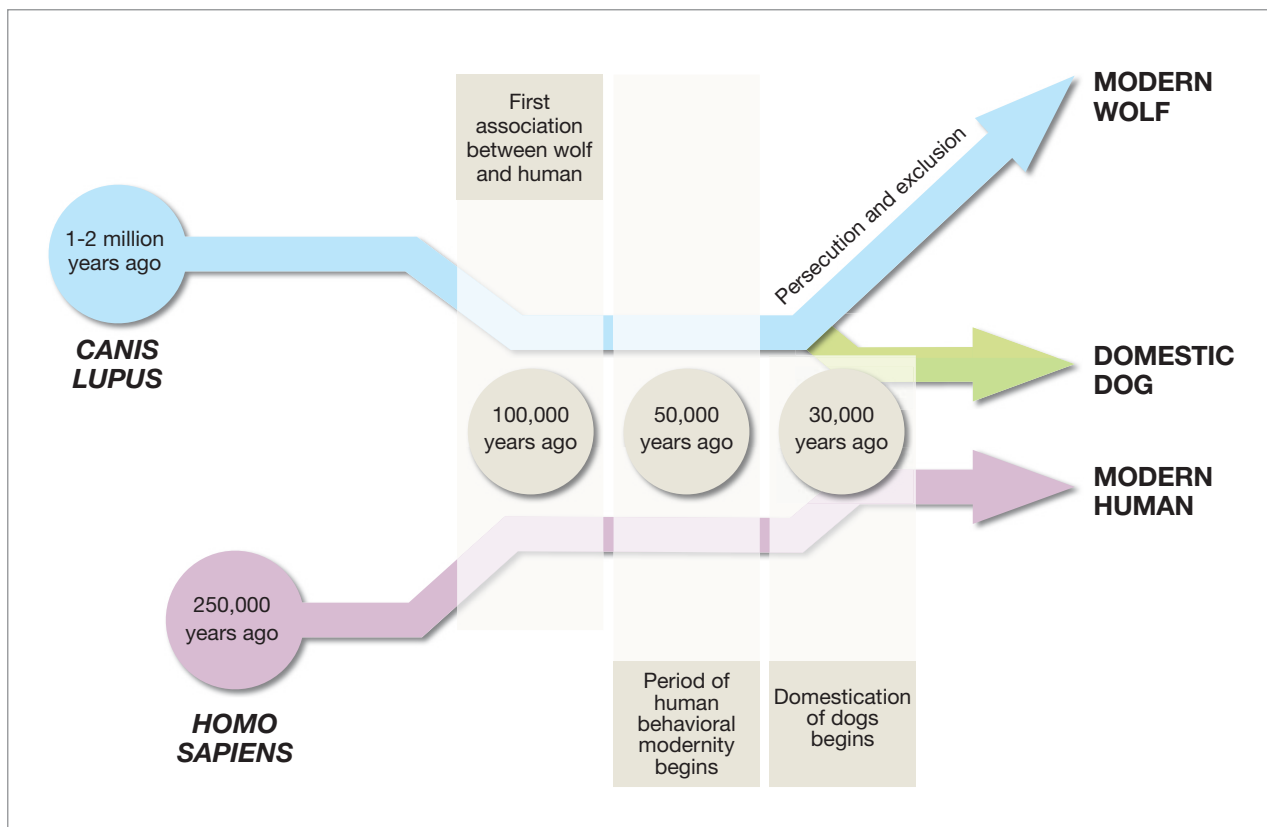


Figure 1. A brief summary of human association with the domestic dog.

prehistoric canids and modern dogs suggests that domestication began 18,800-32,100 years ago (4). The earliest accepted archaeological evidence of canine domestication is the 33,000-year-old remains of a dog found in Siberia in 2010 (5), which was subsequently found to be more closely related genetically to the modern domestic dog than the wolf (6).

In general, the genetic and archaeological evidence indicates that while there may have been some association between our species early in the history of *Homo sapiens*, dogs only began to undergo the process of domestication in the era of human behavioral modernity (Figure 2). This is significant, because it means that the dog would have been present prior to, and throughout, the development of agriculture. It would therefore have been part of human communities during the development of the most fundamental aspects of human culture relating to the preparation and consumption of food. From the very beginning of its association with humans, the domestic dog's diet and feeding habits would have been heavily influenced by the practices and expectations of people.

■ The wolf (*Canis lupus*)

Diet

The behavior of modern wolves is often referred to as the basis for understanding the behavior of domestic dogs. While there is a lot to be gained from this, the modern wolf is in fact as much the product of the influence of humans as the domestic dog is, and this may be particularly true with respect to diet. The wolf was once one of the most widely distributed mammals, living throughout the northern hemisphere. In the areas where it continues to survive, its dietary range includes other mammals (ranging in size from small mammals to large ungulates), snakes, reptiles, birds and their eggs, fish, primates, carrion, berries, vegetables and fruit.

Having such a wide range of potential food sources, wolves have a number of food-competitors, including coyotes, jackals, foxes and bears. Being bigger and better organized group hunters than many of their competitors, wolves are more successful predators of large ungulates, and hence we see a predomination of moose, deer, bison and caribou in the diet of modern wolves. This has given rise to a perception that this is the natural



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Figure 2. A 7,000-year-old rock painting from Tassili N'Ajjer, Algeria, depicting humans hunting with dogs that show physical traits that differentiate them from wolves and other wild canids.

diet of wolves, and that they and domestic dogs are almost pure carnivores.

With the development of agriculture, humans began to enclose and cultivate land, keep animals and drive away predators and pests. The expansion of agriculture, human settlements and trading routes would have had a progressively limiting effect on the range of habitats available to wolves, thereby also restricting their diet (7). This change was relatively rapid, within less than 2% of the history of the species (**Figure 3**). Now confined to a range that is less than half the size it once was, and to areas are generally less supportive of human habitation, the modern wolf is presented with a very different range of foraging opportunities which may not be representative of its past. So although modern wolves predominantly hunt large ungulates, this may be the result of choice restriction and competition with other species. This idea is supported by aspects of the wolf's anatomy; for example, its dentition is similar to that of that jackal, which is omnivorous (7,8).

The current dietary range and dentition of wolves suggest that they may be best classified as facultative carnivores; the bulk of their preferred diet is animal flesh, supplemented with plant material, but they can subsist on an entirely non-animal diet. However, prior to human

Figure 3. Modern wolves share a common ancestry with the domestic dog, but their hunting range and behavior may have been significantly altered by the threat from humans.



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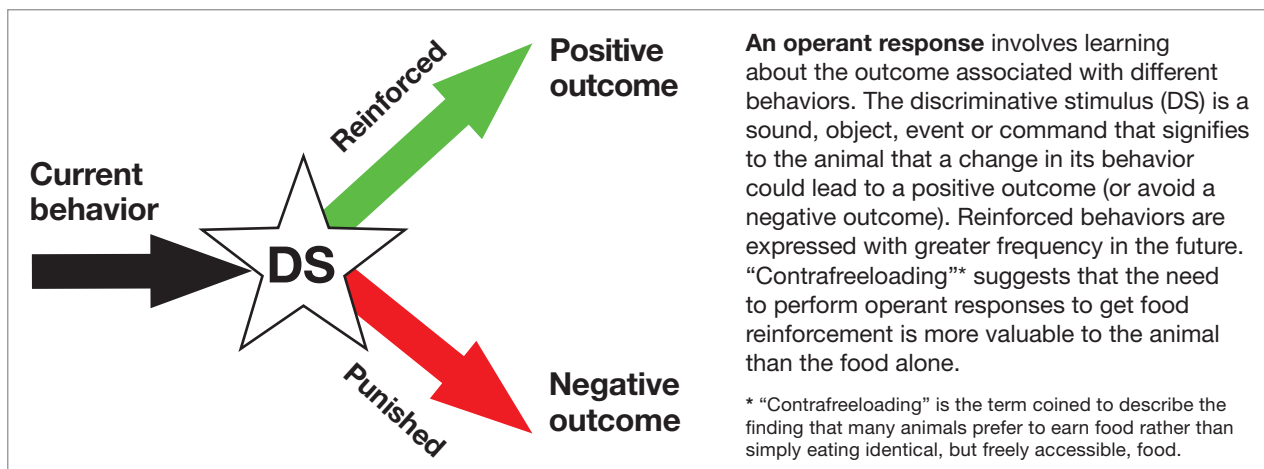


Figure 4. Operant response.

persecution, their dietary habits may have been more varied and omnivorous. The intrinsic flexibility of this omnivorous nature would have been an advantage during and after domestication, when the dog’s diet would have contained little protein, ultimately leading to the permanent adaptation to a carbohydrate-rich diet which has been observed in genomic studies of the domestic dog (9).

Hunting and feeding

When hunting large ungulates, wolves operate as a cooperative group with only two or three wolves actually participating in the killing (10). The rest will be involved in a variety of roles including breaking a selected individual away from its herd, running it down, or keeping other members of the herd away whilst it is being hunted. In areas where wolves currently depend on elk as a food source, each wolf typically catches one or two elk per month, depending on season, but they have been observed to survive on scavenged food alone for periods of up to 10 weeks (10). Wolves are therefore adapted to a “feast or famine” foraging pattern, in which there may be long periods without a successful hunt.

If a hunt is successful, all members of the group seek to gain a share of the carcass. It is important that the sharing of the carcass does not result in injury to group members, for two reasons. Firstly, the ability of the group to continue hunting depends on the fitness of all of its members. Secondly, the members of wolf groups are often related, so there is a genetic basis for altruism; sharing food with close relatives increases the probability of a proportion of an individual’s own genes being passed to future generations. Feeding order is not only

affected by the relative status and role of individuals in the group, but also an individual’s need for food. Juvenile animals are not involved in the process for competing on a hierarchical basis for food.

Wolves have therefore evolved systems of communication and competitor evaluation that enable them to deal with very difficult situations of competition between group members that prevent serious injury.

Foraging in itself is a highly motivated behavior, independent of the need to obtain food. This has been confirmed by the phenomenon of “contrafreeloading” which has been observed in a wide range of wild and laboratory animal species, including wild canids (11,12). “Contrafreeloading” occurs when an individual chooses to work to gain access to food that is also available for free – it appears that in most species it is preferable to perform an operant response in order to gain food reinforcement, rather than simply to consume the food (**Figure 4**).

Domestication

The ability of wolves to subsist on scavenged food and a non-animal diet may have been crucial to their suitability for domestication. It is not clear how this started, but two of the main theories for canine domestication are that either wolf cubs were trapped and reared, or that wolves were partially “self-domesticated” when they were attracted into human settlements by the opportunity to scavenge food. Voluntary phases of domestication may have occurred during periods of reduced prey availability, with a subsequent selective pressure in favor of animals that were bold, sociable and



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Figure 5. “Contrafreeloading” is the basis for training, as dogs prefer to work for food even when food is otherwise available for free.

attracted to a diet that was composed of non-animal food. It is suggested that the main trait passed on by successful animals to their offspring was a reduction in flight threshold (the distance at which an avoidance-escape response is triggered), so that successive generations became increasingly tolerant of human proximity.

The urge to contrafreeload may have provided the basis for initial interactions with people and the earliest responses to training (**Figure 5**); the motivation to perform an operant response for reinforcement is at the heart of dog training. Evidence from studies comparing the effectiveness of training methods based on dominance, punishment and positive reinforcement strongly suggest that positive reinforcement with food produces superior outcomes and is less stressful for the dog (13,14). It is likely that food-based training formed the basis for early human-dog interactions, because even rudimentary knowledge of wolf social behavior would have been unavailable to our early ancestors.

Even with improving agricultural methods, meat or fish-based dietary protein would have been of high value to people. Trapped wolf cubs, and early domestic dogs, would have been maintained on a diet that contained only a small quantity of lower quality protein, together with scraps of human food that was mostly fat and carbohydrate. However, they would have received food on a more regular basis than wild wolves, reducing the need for competition and establishing a relationship with people based on feeding.

The conflict-limiting behavior of wolves is also important for their ability to fit into human communities; domestic dogs would be intolerable as companions or working animals if they were always violently competitive over food.

As domestication proceeded, and dogs started to become a part of human communities, new selection pressures would have become important. Sociability, tolerance of handling and an ability to respond to human communication would all have become increasingly important, with those animals which did not show early promise being removed from the breeding population. This selection process favored the retention of juvenile physical and behavioral characteristics into adulthood (neotenisation); for example, floppy ears, heavy loose jowls, increased playfulness, behavioral plasticity, and reduced competitiveness and aggressiveness.

In a series of experiments lasting more than 50 years, it has been shown that selective breeding for friendliness in silver foxes leads to heritable changes in sociability and dependence on people, together with changes in coat color and markings that are similar to those thought to have occurred during the domestication of the dog (15,16). Selective breeding for traits that made dogs sociable and workable has had far reaching effects on their ability to relate to humans. For example, domestic dogs and human children exhibit comparable abilities to attend to and process information from human facial expressions (17). This ability is not observed in wolves when they are reared in the same manner as domestic pets.

Further artificial selection has seen the enhancement of breed-specific behavior, with dogs being more specialized in certain parts of the hunting behavioral sequence, e.g., dogs that favor pointing or herding behavior. Some of these behaviors have become so enhanced that they would have a negative impact on survival and fitness if present in a wild animal. Evidence for this distortion in

hunting behavior comes from studies of feral dogs, which appear incapable of co-operative hunting in the manner of wolves, and instead depend on scavenging (18). Therefore, in terms of diet and feeding behavior, the end result of a host of natural and artificial selection pressures was that domestic dogs were able to thrive on a diet that was less meat-based, be less fussy about the kind of food they would eat, accept a shift from “feast and famine” to regularly fed meals, and be less competitive over food. They traded the ability to hunt effectively as a group for being able to read and respond to emotional and communicative signals in people, and thereby develop a relationship with people that was based on feeding and reinforcement.

Satiety and food preference

In herbivorous and omnivorous species diet selection has been linked to mechanisms for establishing an optimal macronutrient balance. It was thought that these mechanisms were unnecessary in carnivores, as their diet was assumed to be innately balanced and invariant (19). However, the diversity of the wolf diet implies that some mechanisms for food selection do exist in this species. A recent study has shown that domestic dogs select a diet that favors an overall balance of 30% protein, 63% fat and 7% carbohydrate (with respect to metabolizable energy) (19). This is very different from the diet selected by domestic cats, which is more heavily biased toward protein (52% protein, 36% fat, 12% carbohydrate) (20), which relates to the obligate carnivorous nature of the domestic cat and the relatively higher protein:fat ratio in the small mammals (e.g., mice) that form the basis of its natural diet.

In a number of studies, dogs have shown a tendency to consume food in excess of their energy requirements. When fed *ad libitum* and given a choice of dietary components, dogs did regulate their protein and overall energy intake, but the regulated energy level was around twice the mean daily requirement (19). This implies that dogs have inherited satiety mechanisms that are the result of adaptation to a “feast or famine” food availability in wolves.

Wolves have been observed to consume as much as 10 kg of meat during the initial feeding bout after killing a large ungulate (10). It is also suggested that rapid eating may have been favored during domestication, when competition for food would have been high (7) but intraspecific and interspecific violence would not have been tolerated by humans. This has implications for weight control in dogs. Satiety is the result of a combination of hormonal and

physical signals from the gastrointestinal tract that indicate that sufficient food has been consumed. In many mammals, including man, a range of hormones including ghrelin, cholecystokinin, peptide YY (PYY), oxyntomodulin, and adipokines play a role in satiation. Evidence from trials of the weight-controlling drug dirlotapide, which is thought to act through PYY, indicates that manipulation of the satiety mechanism in the dog can be effective in the treatment of obesity (21).

However, it is clear that in many situations wolves continue to feed until gastric distension limits further intake. It appears that the same is true, at least in part, with dogs. High fiber levels in the diet, which lead to increased stomach distension, have been shown to increase satiety and decrease voluntary intake in the short and medium term after a meal, with an even greater effect when the diet was both high in protein and fiber (22). Such a diet has been shown to have a beneficial role in weight loss in dogs (23).

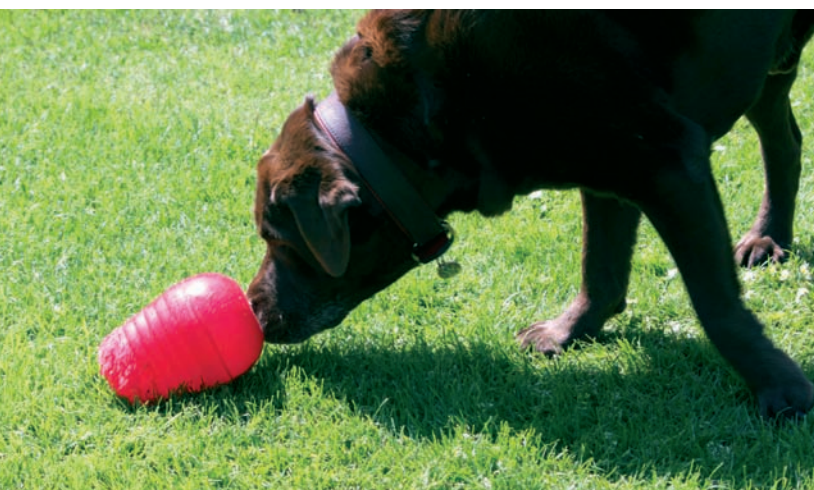
■ Implications for domestic dogs as pets

Problem prevention

Proper socialization and habituation during the sensitive period (3-12 weeks of age) are generally regarded as the key to healthy behavioral development. However, knowledge of the “contrafreeloading” nature of dogs and the retention of juvenile behavior in the domestic dog indicates that the use of food rewards, and feeding in general, to train and develop a bond with puppies is the method most likely to be effective. From the known ethology of wolves and dogs, dominance-based methods will be meaningless, or even intimidating, to puppies.

This is supported by evidence for a reduced rate of aggression in dogs trained using positive reinforcement with food, and an increased attentiveness toward owners who employed positive reinforcement (24). Training has also been shown to have generally beneficial effects such as an increase in problem-solving ability in dogs (25); an ability to solve problems reduces frustration and an individual’s need to act instinctively when faced with challenge or conflict.

The commonest owner-directed aggression problems in dogs involve resource guarding, and many owners will be shocked when they first encounter food guarding in their young dogs. Knowledge of the competitive behavior of wolves around food, and their use of signaling to avoid fights, shows us that to some degree food guarding



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Figure 6. Activity feeding provides an outlet for normal foraging behavior.

is normal in this species. As a result dogs should generally not be challenged over food but should be left to eat in peace. This goes against the traditional view that an owner should repeatedly challenge a dog over its food until it is willing to relinquish the food bowl. The reason is that the traditional method teaches the dog that the owner is a potential competitor, in the manner of another member of a wolf pack. It may learn to relinquish food that is of modest palatability and which is freely available, but the fact that the owner is now regarded as a competitor means that the dog may guard far more ferociously scavenged or stolen food that has not been gifted by the owner, and which is high in fat or protein. This food is not only more palatable but also important for the dog's diet selection in favor of fat and protein. It is better to establish an association between the presence of the owner and the availability of high value food; for example, by adding small amounts of highly palatable items to the bowl while a puppy is feeding (the food offered should not exceed 10% of the daily calorie requirements).

Problems with eating

Such problems can include gluttony, scavenging, begging and pickiness. We should expect dogs to be gluttonous, and we can also use an understanding of their normal feeding behavior to explain problems such as pickiness. Feeding behavior often involves the rapid consumption of large amounts of food at one meal, with the main limitation being gastric distension. Scavenging is driven by a need to find supplementary sources of food in anticipation of famine periods, and begging and

stealing are an extension of “contrafreeloading”. Once a dog has learned that by climbing onto a kitchen worktop it can steal and eat an entire roast dinner, it is very unlikely that this behavior can be extinguished. This general tendency toward food overconsumption by most dogs means that owners are forced to control their dog's food intake, and to accept and take responsibility for preventing food stealing and begging.

Picky eating is influenced by the same underlying mechanisms. Often, when the diet of picky eating puppies is analyzed, the animals are in fact getting more than sufficient calories, but mostly through begging for human food that is often high in fat. They refuse to eat from a bowl. This problem can therefore be viewed in terms of normal diet selection in dogs, and the effect of “contrafreeloading”; these dogs may be motivated to perform operant behaviors such as begging in order to get food. For picky eaters, scavengers and food thieves, a very successful solution is therefore to provide all food through puzzle or activity feeders and training, which enhances the “contrafreeloading” and foraging aspects of feeding behavior (**Figure 6**). Having a range of different feeders increases the complexity and diversity of problem solving and foraging behavior available to dogs, which is more important to them than the palatability and range of food flavors.

Conclusions

The trend toward “natural feeding” has focused on the composition of the diet, and has increased owner awareness regarding the quality of the ingredients in their pet's food. However, the composition of the recommended diets is often based on dietary patterns observed in modern day wolves. For all the reasons discussed previously, these diets may not be representative of what the wolf ancestors of domestic dogs ate before humans restricted their range, and they do not take into account changes that have occurred in food selection and nutritional requirements during domestication of dogs.

This approach to natural feeding also overlooks aspects of feeding that may be much more important to the dog's psychological wellbeing and the way in which they relate to us. Despite the fact that we see the same foraging behaviors in dogs as we do in wolves, most dogs are expected to take all their food from a bowl and are generally unable to forage. Many are trained using methods that exclude the use of food treats, which not only frustrates a dog's natural drive to obtain food reinforcement through operant behaviors, but also removes one of the key aspects of the development of a trusting

and non-competitive relationship between dog and owner. The subsequent obedience and behavioral problems that owners experience often lead them to use dominance and punishment-based methods that further conflict with the motivations of dogs. It is therefore

important that we, as veterinarians, begin to overturn common misunderstandings of the central role that feeding had during the process of domestication, and continues to have in the forging of a relationship between a dog and its owner.

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The “BARF” trend – advantages, drawbacks and risks



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■ Background

The trend of feeding raw foods to dogs and cats was apparently started in the early 1990's by an Australian veterinarian who wrote a book promoting the virtues of feeding raw food to dogs (1), and the abbreviation “BARF” (usually taken to mean either “Biologically Appropriate Raw Food” or “Bones and Raw Food”) is now a widely used acronym in this context. There are several other concepts and philosophies for “correct raw feeding”, such as the “Prey Model” or the “Ultimate Diet” (2), but these are much less well known, and the

BARF acronym is now generally accepted as a synonym for feeding raw foodstuffs.

BARF rations are oriented towards adapting the predator-prey system for domestic dogs and cats, giving them food consisting essentially of raw meat, with a high proportion of “meaty bones” and organs (**Figure 1**). On top of this fruit and vegetables, nuts, oils and herbs are also fed, with eggs and dairy products in lesser amounts. The feeding of grain products is generally not recommended, although other carbohydrates such as potatoes or pulses are sometimes allowed. Despite the fact that “artificial ingredients” (such as mineral or vitamin preparations) are proscribed, there is already a large selection of products on the market specially aimed at supplementing BARF rations.

The most important motive for an owner in choosing a BARF diet for their pet is the desire for a “more natural, healthier food” (**Figure 2**) (3,4). Other reasons include a chronic illness (such as skin disease, gastrointestinal disorders and allergies) which the owner hopes will improve on the new diet, and various claims that commercial ready-to-serve foods contain only “waste materials and chemical ingredients” and are responsible for various diseases. These stories make many pet owners feel insecure and cause them to search for “healthier” alternatives.

The information sources for BARF are primarily internet sites and books (**Figure 3**) (3,4). Unfortunately, these sources are normally written by lay people and contain misleading or even inaccurate information, although they may be presented in a very scientific style. BARF is frequently propagated in a very emotional manner and

KEY POINTS

- BARF rations are oriented towards adapting the predator-prey system for domestic dogs and cats, giving them food consisting essentially of raw meat, with a high proportion of “meaty bones” and viscera.
- No scientific studies exist on the long-term effects of raw diets, so discussions on the advantages and drawbacks can therefore only be conducted on the basis of inferences from knowledge of food science and nutritional physiology.
- Various risks can arise when raw diets are fed, including nutritional imbalances, transmission of disease, and the use of unsuitable and harmful ingredients; problems may also occur if an animal is fed bones.
- Animals fed meat containing thyroid tissue can develop hyperthyroidism or thyrotoxicosis.



Figure 1. BARF rations are oriented towards adapting the predator-prey system for domestic dogs and cats, giving them food consisting essentially of raw meat, with a high proportion of “meaty bones” and organs.

portrayed as a cure-all for diseases, problems and behavioral abnormalities. This can result in some owners, who would not normally consider feeding their pet raw food, being convinced that they will injure their pet by feeding them commercial diets.

■ Claims and facts

It must be said firstly that no scientific studies exist on the long-term effects of raw diets. Discussions on the advantages and drawbacks can therefore only be conducted on the basis of inferences from knowledge of food science and nutritional physiology. Various advantages are often cited for feeding BARF compared to ready-to-eat diets, and these are listed below, with comments as appropriate.

- **Knowing the origin and composition of the food**
 - poorly tolerated or unpopular foods and allergens can be easily avoided.
- **Avoidance of additives**
 - pet owners often view additives as having a bad reputation and to be “unnecessary chemicals”. The use of flavorings in commercial diets is frequently overestimated by owners, and many believe that some manufacturers add so-called “attractants” to their foods which supposedly fool the animal into accepting lower-quality nutrition and even make it “addicted” to the food. Many pet owners are unaware that essential vitamins and trace elements fall under the “additives” term and that all additives must go through the relevant country’s regulatory approval procedures.
- **Avoidance of grain products**
 - the idea that gluten and cereals in general are

damaging to dogs and cats is another popular rumor with no scientific basis. One can assume that many domestic dogs received lots of grain-based products (e.g., bread, dog biscuits) before the introduction of commercial dry diets. Current research suggests that dogs have genetically adapted to carbohydrate foods throughout their evolution (5). Cats can also metabolize carbohydrates, albeit in lower amounts than dogs. Gluten-containing products must only be avoided if the animal has gluten intolerance, but this is rare.

- **The effect of heat destroys nutrients**
 - it is undoubtedly true that some nutrients, especially the B vitamins and vitamin A, are not heat-stable, but this is easily managed through the addition of nutrients in sufficient quantity to compensate for heat treatment during the manufacturing process. In addition, the availability of some amino acids, especially lysine, is reduced by heat treatment, but in practice a lack of essential amino acids is not usually an issue for dogs and cats as long as they are fed a diet containing good quality animal protein.
 - The destruction of enzymes in meat by heating is also cited as an argument for raw feeding, claiming that feeding with heat-treated meat leads to an “enzyme deficiency”. It may be that owners mistakenly equate this with the idea that enzymes within the food are necessary for the digestion process.
- **Lower stool quantity, better stool consistency**
 - BARF diets are normally highly digestible, and certainly more digestible than low-quality commercial feeds. However, household cooking does not negatively influence the digestibility of meat, and highly

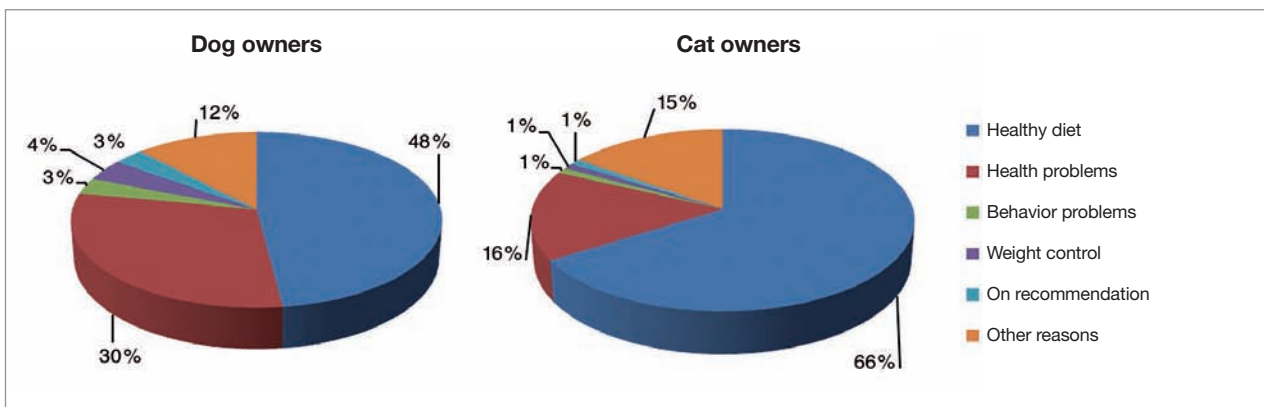


Figure 2. An internet survey carried out in Austria and Germany in 2011 demonstrated that the most important motive for an owner in choosing a BARF diet for their pet is the desire for a “more natural, healthier food”, although other reasons (such as skin disease, gastrointestinal disorders and allergies) may also be cited (3,4).

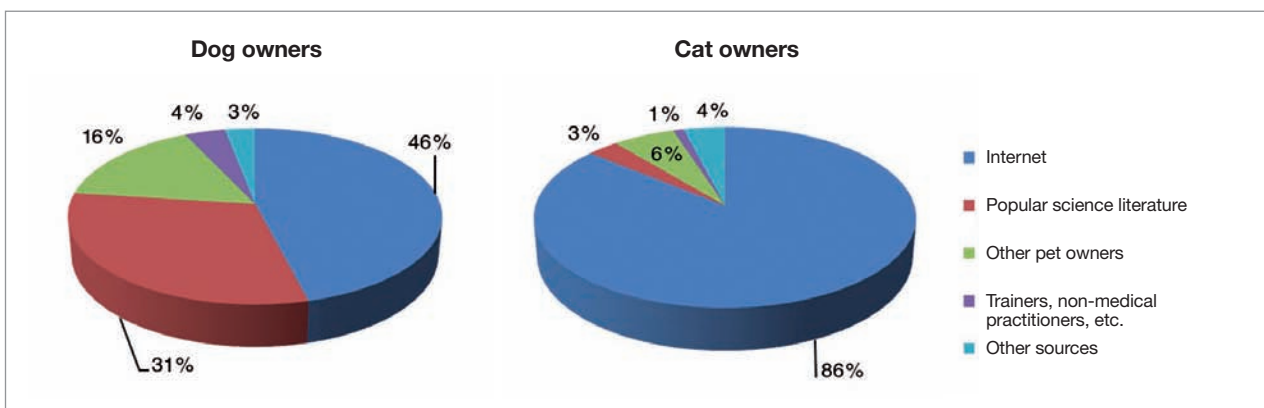


Figure 3. An internet survey carried out in Austria and Germany in 2011 demonstrated that information sources for BARF are primarily the internet and non-scientific books (3,4).

digestible homemade diets can be constructed from cooked ingredients.

- **Improved dental health due to increased chewing** - chewing tough pieces of meat and gnawing on bones strengthen the periodontium and clean the tooth surface. This seems plausible, although it must be pointed out that injuries can occur from eating bones (**Figure 4**).

Most of the frequently-cited positive effects, such as “shiny coat”, “lively behavior” and “better constitution” are subjective impressions and are difficult to prove objectively in a clinical setting. Whilst there is no doubt that nutritional deficiencies or feeding a specific diet that is unsuitable for an individual animal can cause issues such as poor appetite, digestive disturbances and skin problems, many diseases can also result in such signs. It seems that pet owners are currently very sensitive to

the idea of “food intolerance from commercial diets” and if their pet is unwell they may quickly switch to a raw diet without considering other, more plausible causes such as parasites or infection.

■ Risks of raw feeding

The following risks must be considered with feeding raw diets:

1. Nutritional imbalances
2. Hygiene risk from raw meat
3. Problems caused by eating bones
4. Unsuitable and harmful ingredients

1. Nutritional imbalances

It is frequently asserted that a “food close to nature” will automatically cover all nutritional needs and that “artificial” supplementation is unnecessary and could even be harmful. Certainly, whatever diet is fed, the body can only absorb nutrients that are actually contained within

the food. Knowing about the nutritional content of ingredients and how they can be combined in sensible proportions is necessary in order to create a ration that covers the body's needs. There are numerous books and websites that offer complete BARF recipes, but unfortunately the majority of these are incorrect in various aspects. The following errors are frequently encountered in such recipes:

- **Very high protein content**
 - currently thought to be harmless for healthy dogs, but diets high in protein are not recommended for older animals especially those suffering from liver or kidney disease.
- **Low protein content**
 - e.g., if meat with a high fat content is employed exclusively.
- **Very high fat content (> 30% in dry matter)**
 - increased risk of pancreatitis in dogs (6).
- **Calcium over- or under-supplementation and incorrect calcium-phosphorus ratio**
 - especially dangerous for growing pups (**Figure 5**).
- **Vitamin A deficiency or over-supplementation**
 - cats cannot convert carotenoids into vitamin A and must eat animal products that contain vitamin A.
- **Vitamin E deficiency**
- **Vitamin D deficiency**
 - it is sometimes asserted that dogs and cats do not need vitamin D supplementation because it can be produced endogenously – this is erroneous!
- **Deficiency in trace elements (zinc, copper, iodine, manganese)**
- **Use of unnecessary or harmful supplements**

For more on these nutritional deficiencies, the clinician is directed to the plethora of scientific literature on basic nutrition and physiology. It must be stressed that an animal with specific deficiencies in vitamins and trace elements can be free of clinical signs for months or even years until the body has exhausted its reserves or until an increased need arises due to illness. Because an animal can appear to be well, a pet owner will frequently argue “my dog/cat seems healthy, so there cannot be a nutrient deficiency” or “the blood tests were normal, therefore what I feed my animal must be right”.

It is worth pointing out to an owner that an optimal nutrient supply cannot be determined through such tests; blood values give a momentary picture, while long-term changes do not appear until massive deficiencies or over-supplementation accumulate. In the case of calcium



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Figure 4. Gnawing on bones may help clean the surface of the teeth but can also cause injuries in the mouth area and tooth fractures.



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Figure 5. Dorsoventral radiograph of the caudal trunk and hind legs of a young dog with nutritional secondary hyperparathyroidism. Note the thin cortices and pathological fractures of both femurs.

and phosphorus, blood levels are constantly held within a tight range – changes indicate a pathological process that seldom has anything to do with food. In order to evaluate what an animal is receiving in terms of nutrient supply, its diet must always be assessed!

Conventionally, the nutritional requirements of animals are calculated using figures based on the recommendations of the research council or the regulatory bodies* (7).

* Depending on the country of manufacture and/or sale, commercial pet foods are invariably produced following stringent guidelines from either the National Research Council (NRC), the European Pet Food Industry Federation (FEDIAF) and the Association of American Feed Control Officials (AAFCO). Strict adherence to these guidelines ensures that manufactured pet foods should be balanced and safe for pets to eat. Guidelines (including full nutritional guidelines) are available to view or purchase from each organization's website.



Figure 6. Hunting dogs may be fed raw meats which can predispose them to various diseases including Aujeszky's disease and endoparasites.



Figure 7. A major concern with BARF diets is the possible danger to human health when handling raw meat.

BARF adherents criticize these estimates, since the figures have been determined based on feeding trials using purified diets and therefore cannot be applied when raw food is offered. However, all the recommended figures include a margin of safety that takes into account digestibility for ready-to-eat foods, and although there are no figures available for raw foods at present, the NRC's information is the best that is available. It is improbable that a dangerous over-supply may arise when BARF rations are calculated following NRC data, but in any case the minimum requirement or safe upper limit for supply as given by NRC can be used to evaluate BARF rations.

Some pet owners reject any food supplementation, such as extra minerals, as being “artificial”, and want to cover their pet's requirements using exclusively “natural sources” such as fruit, vegetables, nuts and herbs. Note that the vitamin and trace element content in these products are usually broadly overestimated and the levels are too low to deliver an adequate supplement when using realistic doses. Much of the “science” behind the use of herbs has been carried over from traditional medicine practices and suggested beneficial effects are seldom tested in dogs and cats, with most of the claims being unproven in animals.

To formulate a BARF ration that covers all nutrient requirements based on single components and without

the use of mineral and vitamin supplements is possible but complex, and should only be done with professional nutritional advice.

Various nutritional supplements based on herbs, algae, German medicinal clays (the so-called *Heilerde* or “healing earth”) and similar components are especially popular among dog owners and are viewed as natural sources of nutrients which contain unspecified “vital elements”. Normally any product statement for these products is inadequate or incomplete. Sometimes the composition is not given at all, and a nutritional analysis is almost always absent; such products cannot be recommended. The variety of available trace elements can vary widely; for example, although marine algae (brown sea kelp, *Ascophyllum nodosum*) is actually quite suitable as an iodine supplement, freshwater algae (*Spirulina* and *Chlorella*) contain no iodine. Lastly, the possibility of side effects and unwanted interactions from using these supplements cannot be excluded.

2. Hygiene risk from raw meat

Meat can contain viruses, bacteria and parasites. Aujeszky's virus (pseudorabies) is the foremost risk and is deadly for both dogs and cats. Many pet owners know that raw pork should not be fed to their animals, as there are recent reports of hunting dogs dying from Aujeszky's disease after contact with wild boar carcasses (8) (**Figure 6**), but all raw meat is potentially dangerous,

especially when it has been prepared without observing basic food safety rules.

Possible bacterial pathogens include intestinal microorganisms such as *E. coli*, *Salmonella*, *Campylobacter* and *Yersinia*, and endoparasites (e.g., tapeworms such as *Echinococcus spp.*) can of course infect dogs or cats. The human health risk must also be considered; as well as potentially pathogenic intestinal bacteria, raw meats can also (depending on their origin) carry zoonotic diseases such as tuberculosis or tularemia, and both farmed food animals and wild-living animals can be carriers of *Toxoplasma*.

BARF proponents will frequently counter these concerns with the argument that dogs and cats should be “immune” to such pathogens. Although it seems to be true that dogs and cats seldom suffer as much as humans from gastroenteritis related to *Salmonella* or *E. coli* bacteria, pet animals can indeed contract serious disease and even septicemia, with immune-compromised animals especially being at risk.

The bigger danger however is to human health, and it is not just that the handling of raw meat represents a risk (**Figure 7**). Dogs and cats that ingest contaminated meat can become symptom-free carriers and can shed human pathogens such as *Salmonella* in their feces for many weeks, allowing the bacteria to spread to the animal’s skin, its sleeping area, and finally throughout the household.

The hygiene risk due to raw meat is played down in almost all BARF publications. It may be that nowadays our food is generally so safe that potential dangers are almost eliminated and the awareness of risks is low. BARF products however are often not sourced from the human food industry. In addition, there is now a market whereby raw meat and meat by-products can be ordered online for use in BARF diets; such products are usually shipped frozen but are not subject to the same hygiene guidelines as food industry items, so there is no guarantee that the transport containers are always disinfected and that the cold chain is maintained. Furthermore, various raw commercial diets are currently available, and several reports have noted that these products are of poor quality in terms of microbiological contamination (9, 10). It is of course worth noting that bacteria such as *Salmonella* are a risk in pet food factories too and that the pet food industry must maintain high standards to ensure quality and food safety are not compromised during the production process.



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Figure 8. Ingestion of bones can lead to obstruction of the throat, esophagus or gastrointestinal tract and necessitate surgical intervention.

3. Problems caused by eating bones

Possible damage from ingestion of bones can include injuries in the mouth area and tooth fractures, bones lodging in the throat or esophagus, constipation, ileus, and even gastrointestinal perforation (**Figure 8**). There are no data on whether these problems have increased in recent years with the rise in the popularity of BARF diets, but some small animal practitioners and animal clinics have a subjective impression that these cases are being seen much more frequently nowadays compared to even five years ago, when they seemed comparatively rare.

4. Unsuitable and harmful ingredients

There is always the risk that an owner preparing a homemade diet may, through ignorance, employ ingredients that are poorly digestible or even poisonous. Although most dog and cat owners know that items such as chocolate, grapes and onions are poisonous, other products are often discussed, recommended and sold as being suitable for inclusion in BARF diets. A good example is garlic, which is often considered to have both

health-promoting properties and a repellent effect against ectoparasites. Not only is there no scientific proof for this, garlic actually damages red blood cells. The same goes for broad-leaved garlic or chives, which are sometimes fed as "healthy herbal side-dishes". Proponents will often respond to warnings by saying that such products are fed at well under the toxic dose, but it is not known if long-term intake of small amounts of such products are actually harmless or not, and therefore feeding all onion-type plants to dogs and cats must be advised against. Furthermore, it should be pointed out that some products are definitely not suitable for raw feeding, as follows:

- **Eggs**

- Raw eggs contain avidin, which binds biotin and leads to a biotin deficiency.
- Egg white contains a trypsin inhibitor which impairs protein digestion.

- **Fish**

- Many fish in raw form contain thiaminase, which destroys thiamin.
- Fish contain trimethylamine, an organic compound which binds iron and (if fed long-term) can cause anemia.

- **Beans (*Phaseolus genus*)**

- Contain lectins and tannins (which damages the gastrointestinal mucosa), trypsin inhibitors (which impair protein digestion) and cyanogenic glycosides (which can cause cyanide poisoning). However cooking or heat-treating such products renders them safe to use.

- **Cassava/Manioc**

- Uncooked contains cyanogenic glycosides. Again cooking or heat-treating such products renders them safe to use.

Specific concerns

It is worthwhile mentioning two specific problems attributable to BARF diets.

- **Thyrotoxicosis;** Studies have already shown (11,12) that dogs fed meat containing thyroid tissue can develop hyperthyroidism or thyrotoxicosis. In fact this is a problem which is not potentially unique to raw feeding, since thyroid hormones are heat stable, but BARF diets frequently contain meat sourced from the head and neck. In addition, the trachea and larynx are often sold as chew treats and may even be purchased as a

canned product in some countries. Since no safe dose is known, such products must be regarded as unsuitable for feeding. To date, there are no reports of thyrotoxicosis on cats, perhaps because these products are rarely fed to cats.

- **Detoxification;** Some BARF promotional material may state that after changing from a ready-to-eat diet to raw food an animal may show digestive disturbances and skin problems. These are declared to be the animal undergoing "detoxification", a process which must occur to eliminate "harmful chemicals" that have been ingested from ready-to-eat foodstuffs. This detoxification idea is a concept that comes from alternative medicine and has no scientific basis. However, digestive disturbances and skin problems can be signs of dietary intolerance, and the phenomenon perhaps exemplifies how convinced pet owners are of BARF, since they perceive these signs as positive, while the same reaction to a commercial ready-to-eat diet only confirms their negative opinion.

■ BARF for disease

If a sick animal is fed a raw diet it is important to consider if the characteristics of this feeding method (higher protein and fat content, high calcium and phosphorus levels, potential hygiene risk) are compatible with the nutritional demands imposed by a given disease.

- For gastrointestinal diseases, if the intestinal flora is disturbed and the intestinal mucosa can be assumed to have increased permeability, raw meat should not be given (especially if there is hematemesis and/or bloody diarrhea) in order to avoid any risk of infection. Raw feeding may be suitable for animals that need to lose weight or for diabetic individuals, and the raw fiber content can be increased if necessary with bran or cellulose.
- For kidney failure, BARF rations are contraindicated, as they are too rich in protein and phosphorus.
- In cases of neoplasia, pet owners often search in despair for a "miracle cure" and may consider feeding a "special" diet. If the patient is immunosuppressed, raw meat presents an avoidable infection risk and at least some carbohydrate is recommended in order to support the liver and supply the body with readily-available energy.

Vitamin and trace element levels should not be ignored either when choosing a diet for an ill animal, as they are necessary for optimal functioning of the immune system.

It must also be recognized that a change in diet represents an additional stress factor, and should not be imposed on tumor patients who frequently have little or no appetite anyway.

■ Summary

Whilst BARF is one possible form of feeding dogs and cats, it is associated with various risks. The veterinarian should explain these risks, but the ideological convictions and circumstances of the pet owner must also be taken into account. Owners like to make the “best” decision for their pet, but this is often not according to objective criteria, and is instead influenced by the internet, advertisements or other people. It is essential to

advise careful selection and control of the foodstuffs chosen, since the recipes and recommendations found on the internet and in popular books are seldom correct. All food ingredients must be subject to strict hygiene criteria and owners must be aware of the specific risk of bacterial contamination when using meat sourced via mail-order companies; head or neck meat should not be used if thyroid tissue is present. In particular raw feeding must be advised against when at-risk individuals (small children, pregnant women, senior or chronically ill persons) live in the household, and for animals that are in frequent contact with such people, for example pets employed with animal-assisted therapy and education.

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Co-morbidity of overweight and obesity in dogs and cats



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■ Introduction

Obesity is a nutritional disease of concern in both canine and feline pets, with up to 35% of adult dogs and cats in the United States reported to be either overweight or obese (1-4). Several chronic diseases have been associated with overweight and obesity in both dogs and cats, including osteoarthritis, heart disease, and diabetes mellitus, as well as hypothyroidism in dogs (5, 6). This population analysis was conducted in order to provide a recent assessment of select chronic conditions as co-morbidities in the US pet population.

■ Methods of analysis

Medical records of all canine and feline in-patients seen in 2013 at over 850 Banfield Pet Hospitals were used to extract information regarding body condition score (using a 5-point scale, with 1 = cachexia, 3 = ideal, 5 = obese), reproductive status and diagnoses of select chronic diseases hypothesized to be linked to overweight or obesity: diabetes mellitus, heart disease (cardiomyopathy, heart failure, valvular insufficiency), osteoarthritis and hypothyroidism (dogs only). Relative risk (calculated as a prevalence ratio, *i.e.*, the probability of being overweight if an animal has a chronic disease vs. not having the disease) and 95% confidence intervals were calculated for each chronic disease, and adjusted for spay/neuter status.

■ Results

In 2013, more than 463,000 cats and 2,281,000 dogs visited a Banfield hospital. The distribution of sex and neuter status for the cat population was as follows: 6.5% intact females, 5.5% intact males, 43.6% spayed females and 44.4% neutered males. The distribution in the dog population was 10.7% intact females, 14.3% intact males, 37.4% spayed females, and 37.6% neutered males.

Among the cats, 23.1% were juveniles (< 12 months of age), 20.9% young adults (1-3 years old), 37.2% mature adults (3-10 years of age), and 18.8% geriatric adults (10 years and older). Among the dogs, 22.0% were juveniles, 23.3% young adults, 44.6% mature adults, and 10.1% geriatric adults.

Overall, 30.3% of cats and 26.3% of dogs were recorded as being either overweight or obese (BCS of 4 or 5). Those diagnosed with the chronic conditions of interest were commonly overweight or obese, with the prevalence of overweight/obesity greater in animals with the chronic disease than those without the disease (**Table 1**). Neutered pets were more likely to be diagnosed with all conditions than intact pets ($P < 0.0001$ for each comparison; **Table 2**), with prevalence ratios in cats noticeably greater than in dogs. The relative risk of overweight or obesity in pets diagnosed with chronic disease vs. no chronic disease for osteoarthritis, heart disease and diabetes mellitus in cats are 1.39, 1.05, and 1.79 (respectively) and in dogs 1.97, 1.55, and 2.09 (respectively); the relative risk for canine hypothyroidism is 2.73. Because neuter status is associated with being overweight/obesity, the calculations were adjusted for neuter status; in brief, this involved calculating the relative risk of being overweight/obese with a given condition for the neutered population, and for the intact population, then combining the two calculations to establish the adjusted relative risk. This weighted average of the two risk groups resulted in a decrease in the magnitude of the relative risk of overweight/obesity associated with each chronic disease. With the exception of feline heart disease ($p = 0.75$), pets with the chronic conditions were significantly more likely to be reported as overweight or obese ($P < 0.0001$).

Discussion

Overweight and obese pets are at greater risk for specific chronic diseases that impact on the quality of life for the pets and their owners. The proportion of patients seen at Banfield Pet Hospital that are diagnosed with the selected chronic diseases is small; although a high proportion of patients seen at Banfield are young, the low prevalence of these chronic diseases reported here are similar to those previously reported (1-3,7).

Multivariate analyses are needed to more fully characterize the associations between these conditions and

overweight/obesity, controlling for potential confounders and other identified risk factors such as gender, age, and breed (1,2,5,6). Because of the cross-sectional nature of this study, it is not possible to determine whether the chronic conditions preceded, co-developed with, or followed an overweight or obese body condition. However, the significant associations found suggests that diagnosis of certain chronic conditions is an excellent opportunity to educate clients of the importance of nutrition and weight control in order to reduce the other risks associated with overweight and obesity.

Table 1. Proportion of pets with chronic disease that were overweight or obese.

Condition	Overall prevalence of disease in cat population	% of cats with the specified disease that were overweight/obese	% of cats without the specified disease that were overweight/obese	Overall prevalence of disease in dog population	% of dogs with the specified disease that were overweight/obese	% of dogs without the specified disease that were overweight/obese
Osteoarthritis	0.7%	41.9%	30.2%	3.0%	50.2%	25.5%
Heart disease	0.1%	31.8%	30.3%	0.3%	40.6%	26.3%
Diabetes mellitus	0.9%	54.0%	30.0%	0.3%	54.7%	26.2%
Hypothyroidism	---	---	---	0.6%	71.0%	26.0%

Table 2. Relative risk (95% confidence interval).

Condition	Cats (n = 463,802)		Dogs (n = 2,281,039)	
	RR of diagnosis of chronic condition by neuter status (neutered vs. intact)	RR of overweight/obesity when also diagnosed with chronic disease, adjusted for neuter status	RR of diagnosis of chronic condition by neuter status (neutered vs. intact)	RR of overweight/obesity when also diagnosed with chronic disease, adjusted for neuter status
Overweight/obese	5.60 (5.42, 5.79)	---	3.11 (3.09, 3.14)	---
Osteoarthritis	8.60 (6.45, 11.47)	1.26 (1.21, 1.32)	4.00 (3.89, 4.11)	1.72 (1.70, 1.73)
Heart disease	3.10 (2.10, 4.60)	0.98 (0.87, 1.10)	1.72 (1.62, 1.83)	1.44 (1.40, 1.48)
Diabetes mellitus	5.03 (4.18, 6.05)	1.65 (1.61, 1.70)	3.50 (3.22, 3.81)	1.84 (1.80, 1.88)
Hypothyroidism	---	---	4.32 (4.05, 4.60)	2.38 (2.36, 2.41)

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Cats and dietary fiber



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KEY POINTS

- Fiber is surprisingly difficult to define but is often classified by its properties, such as solubility in water, viscosity, and fermentability in the gastrointestinal tract. Many commercial cat foods contain two or more fiber-containing ingredients.
- Dietary fiber, and in particular slowly fermentable fibers such as cellulose and peanut hulls, have been shown to be an effective means of increasing dietary bulk in the gastrointestinal tract without supplying additional calories.
- Recent reviews suggest that the effect of fiber in cats with diabetes mellitus is unknown but that low-carbohydrate, low-fiber diets may be indicated.
- Recommendations for nutritional therapy of constipation vary widely; some authors suggest highly digestible, low-fiber diets while others prefer high-fiber diets or fiber supplementation.

■ Introduction

Nutritionists and veterinarians have been interested in dietary fiber as a component of pet foods or as a supplement for many years. Fiber has traditionally been used to modify stool quality and as an aid in weight management, but more recently fiber has been shown to have effects on the gastrointestinal microbiome and may play a role in the management of various disorders. This article offers a brief overview of dietary fiber and a discussion of the potential benefits for several common feline medical conditions.

■ Definition

Fiber is surprisingly difficult to define. The current human food standard refers to dietary fiber as "...carbohydrate polymers with 10 or more monomeric units, which are not hydrolyzed by the endogenous enzymes in the small intestine..."(1) while the current petfood definition in the U.S. is "any of a large class of plant carbohydrates that resist digestion hydrolysis"(2). There are many other descriptions of fiber depending on source, composition, methods of analysis, physiological effects, and food labeling regulations.

Dietary fiber is often classified by its properties, such as solubility in water, viscosity, and fermentability in the gastrointestinal tract. **Table 1** summarizes the characteristics of common fiber sources used in pet food. It can be difficult to predict the health effects of any one fiber source, and many commercial cat foods include two or more fiber-containing ingredients. For example, fermentable fibers can act as energy substrates for bacteria in the lower intestinal tract which results in the production of short-chain fatty acids (3). These in turn are absorbed and can modify the structure and function of intestinal cells. Nonfermentable fibers tend to increase fecal weight and volume and may decrease intestinal transit time (3). Fiber sources with high viscosity often have an increased water-binding capacity that can result in softer, moister feces. It is likely that varying the amounts and types of fiber will affect a cat's gastrointestinal microbial population, although research into the microbiome is in its early stages (4). **Figure 1** illustrates the solubility and viscosity of different fiber sources.

■ Fiber and its role in disease

Obesity

In North America, obesity is the most common form of malnutrition in veterinary patients; it is estimated that 35.1% of adult cats are either overweight or obese (5) (**Figure 2**). Obesity predisposes cats to a variety of diseases such as diabetes mellitus, hepatic lipidosis, urinary tract disease, orthopedic disease, and dermatopathies.

Dietary fiber has been used to help manage obesity in both dogs and cats. In particular, slowly fermentable fibers such as cellulose and peanut hulls have been shown to be an effective means of increasing dietary bulk in the gastrointestinal (GI) tract without supplying additional calories. Sources of dietary fiber in commercial

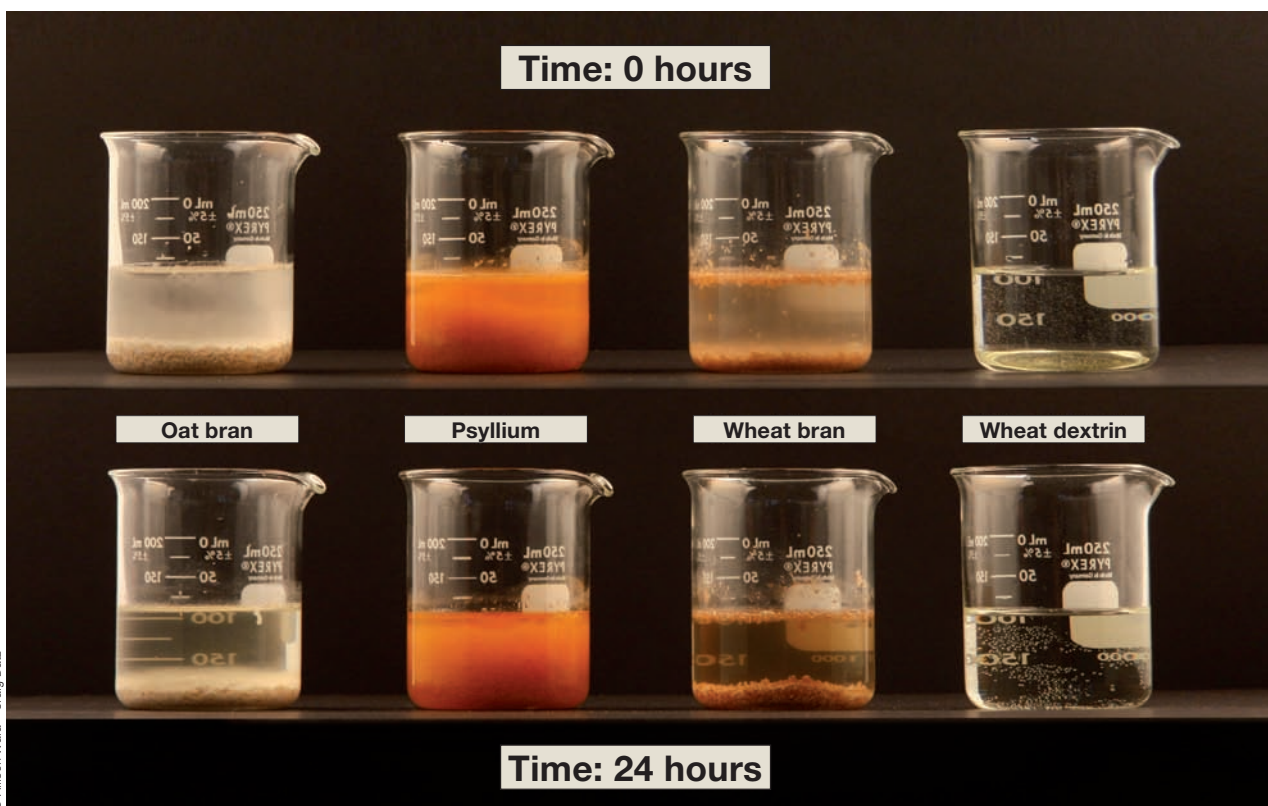
pet foods can thus be beneficial, as they are likely to result in the consumption of less food energy. Mixed dietary fibers are also thought to promote the attenuation of glucose absorption from the GI tract, induce gastric distention which stimulates the cholecystokinin-satiety signaling pathway, delay gastric emptying, and stimulate longer ileal transit time (6). While the effects of fiber on food consumption in cats are not well described in the literature, there is speculation that fiber-enhanced diets might reduce overeating and thus play a protective role against the development of feline obesity (7).

Hunger-driven begging behaviors often compromise client compliance and can result in failure to achieve weight loss in obese-prone individuals. The inclusion of fiber in commercial diets is thought to induce satiety to the extent that it decreases these unwanted behaviors. A study evaluating weight-loss strategies in overweight cats found reduced begging scores (less vocalization and owner-seeking behavior) with a diet containing high-water-binding capacity fiber compared with a diet containing primarily insoluble fiber (8). Therefore, not only the amount but the type of fiber may have an effect on satiety.

Despite the potential therapeutic properties of fiber on obesity, it should be noted that its inclusion can also result in decreased protein digestibility; weight loss diets must compensate for this by increasing dietary protein concentrations. Moreover, the ratio of slowly to rapidly fermentable fibers is important because research has shown that when rapidly fermentable fibers are included in high concentrations sufficient to promote satiety, GI side effects such as flatulence and diarrhea may be seen (9). Overall, despite the paucity of information available on fiber in feline patients and conflicting results on its efficacy,

Table 1. Properties of fiber sources commonly used in pet food.

Source	Solubility	Viscosity	Fermentability
Beet pulp	Low	Low	Moderate
Bran	Low	Low	Moderate
Cellulose	Low	Low	Low
Guar gum	High	High	High
Pectin	High	High	High
Psyllium	Moderate	High	Moderate
Soybean hulls	Low	Low	Low



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Figure 1. A demonstration of the solubility and viscosity of different fiber sources where equal amounts are added to 100 mL water. The oat and wheat bran do not absorb water and no changes are seen after 24 hours, whilst the wheat dextrin powder dissolves immediately and stays in solution. Psyllium powder absorbs water and forms a thick gel after 24 hours.

its inclusion in commercial diets may prove useful for weight loss in obese-prone patients.

Diabetes mellitus

Previous veterinary literature suggested that dietary fiber improves glycemic control in dogs and cats and aids in the management of diabetes mellitus (DM) (10). More recent reviews state that the effect of fiber in diabetic cats is unknown and that perhaps low-carbohydrate, low-fiber diets are indicated (11). Nutritional studies of cats with DM are difficult to interpret because of differences not only in fiber content but also protein, fat, carbohydrate, and actual ingredients in the diets.

In one randomized controlled crossover study (12), 16 diabetic cats were fed a high-fiber (HF) diet containing 12% cellulose (dry matter basis) or a low-fiber (LF) diet (added cornstarch). Pre- and post-prandial blood glucose measurements were lower when the cats ate the HF diet. Insulin doses and glycated hemoglobin concentrations were not significantly different and 4 cats

did not show improvement in blood glucose on the HF diet. The authors concluded that the results supported feeding a diet with added cellulose to cats with DM. These data were consistent with an unpublished study conducted by the same authors, in which 9 of 13 diabetic cats had improved glycemic control on a HF diet. However, there were other differences between the two study diets that may have influenced the results; the LF diet was lower in protein and higher in carbohydrates than the HF diet, and caloric intake was reduced on the HF diet. The four cats that did not respond to the HF diet had a lower average body weight (4.7 kg vs. 5.5 kg), so the amount of body fat may be a significant variable (12).

Another randomized study (13) evaluated two wet (canned) diets in cats with DM that were also being treated with insulin. The moderate-carbohydrate, high-fiber (MC-HF) diet contained approximately 11% crude fiber and 26% carbohydrate (on a dry matter basis) while the low-carbohydrate, low-fiber diet (LC-LF) contained approximately 1% crude fiber and 15%

carbohydrate. Most, but not all, cats showed improvement in blood glucose and fructosamine in both diet groups. By week 16, insulin was able to be discontinued in 68% of cats on the LC-LF diet and 41% of cats on the MC-HF fiber. The authors concluded that cats were more likely to be well-regulated or revert to a non-insulin-dependent state when fed a LC-LF diet. However, the two diets differed in ingredients (ground corn in MC-HF vs. soybean meal and corn gluten meal in LC-LF) and in fat content (41% in MC-HF vs. 51% in LC-LF, metabolizable energy basis). Therefore it is difficult to determine if the fiber, carbohydrate, or fat content or particular combination of ingredients in the two diets were responsible for the results (13).

Current guidelines for humans with diabetes include medical nutrition therapy (14). While dietary fiber consumption is associated with lower all-cause mortality in people with DM, there is little evidence that glycemic control is improved with increased intake of fiber or whole grains. Several dietary fiber studies in dogs with DM have yielded mixed results, and decreased caloric intake with high-fiber diets may be responsible for improvement in glycemic control (11). At present, there is little evidence to support a direct effect of dietary fiber on DM in cats, but weight loss strategies that may include higher fiber can play a role in the management of these cases.

Diarrhea

Various enteropathies in cats can result in chronic diarrhea, a frequent and often frustrating clinical condition which commonly results in presentation to a veterinarian. The finding of diarrhea is often associated with an increase in frequency, volume, and fluidity of stools, which can also contribute to inappropriate elimination. In adult cats, the most common causes of chronic diarrhea are inflammatory (inflammatory bowel disease) or dietary (food sensitivity or intolerance); a less common etiology is neoplasia. Dietary intervention can play a beneficial role in the management of diarrhea and can control its occurrence and severity. Physical characteristics of fiber can both increase or decrease stool passage time; for example, research has shown that beet pulp promotes a shorter intestinal transit time in dogs, while cellulose increases it (15). There is substantially less information available with respect to the effects of fiber on the rate of stool passage in cats, but the combined knowledge from research in humans, dogs, and the clinical experience of veterinarians suggests that fiber may have the same effects in this species.



Figure 2. Obesity is the most common form of malnutrition in veterinary patients; it is estimated that 35.1% of adult cats in the USA are either overweight or obese.

Soluble fiber absorbs water from the GI tract to form a viscous gel which can reduce free fecal water and aid in the normalization of stool consistency. The viscous gel also prolongs intestinal transit time and may be useful in treating cases of secretory or osmotic diarrhea as it absorbs luminal toxins. When increased motility is the cause of diarrhea, insoluble fiber can be helpful in decreasing certain types of colonic myoelectrical activity (16).

While randomized, controlled studies are lacking, some veterinarians advocate the use of fiber supplementation for dogs and cats with IBD if diarrhea is a clinical feature. When food hypersensitivities are suspected as the underlying etiology, novel or hydrolyzed protein diets are the typical recommendation. Adjunctive fiber supplementation may be administered to these therapeutic diets to improve intestinal motility and water balance and normalize microflora (6); psyllium husks and wheat bran have been used effectively in such cases. In other instances, patients with IBD respond best to highly digestible, low fiber diets, therefore fiber supplementation may be contraindicated for some individuals. Assessing each pet on an individual basis is critical in optimizing the clinical outcome.



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Figure 3. This cat had chronic constipation as a result of a previous traumatic incident which had damaged his coccygeal vertebrae, making defecation painful. Such cases may benefit from a fiber-modified diet.

Constipation

The prevalence of constipation in the feline population is unknown but most veterinary practitioners have treated cats with varying degrees of difficulty in passing feces (**Figure 3**). Frequent or recurrent episodes of constipation may lead to obstipation, which is refractory to routine treatment. If constipation/obstipation continues to progress, the cat may develop megacolon, an (often idiopathic) end-stage condition characterized by colonic dilation, loss of smooth muscle motor function, and inability to pass feces. Treatment depends on the underlying cause, severity, and chronicity. Early or mild cases of constipation often respond to removal of any impacted feces and laxatives; moderately affected cats may need colonic prokinetic drug therapy, while severe cases of obstipation and megacolon may require surgery in the form of subtotal colectomy.

Recommendations for nutritional therapy of constipation vary widely. Some authors suggest highly digestible, low-fiber diets, while others prefer high-fiber diets or fiber supplementation (17). Different types and amounts

of dietary fiber have different effects on large intestinal function. Certain poorly fermentable fibers such as cellulose act as bulk-forming laxatives and can help distend the lumen of the colon and increase the rate of fecal passage (17). However, cellulose has different effects on fecal dry matter and quality in dogs depending on type and fiber length (18). Other fibers such as psyllium can form a viscous gel (because of its high water-binding capacity) which helps ease the passage of feces. Diets that are low in fiber and highly digestible can reduce the amount of feces produced but do not stimulate motility or fecal passage (17). As dehydration is one of the underlying causes of constipation, wet (canned) diets are often suggested to increase water intake along with parenteral fluid therapy when necessary. However, wet diets vary in fiber types and amounts and may not be appropriate for all cats with constipation.

Only one study has been published looking at the effects of a commercial diet in constipated cats (19). In this uncontrolled clinical trial, a moderate-fiber dry commercial diet containing psyllium as the predominant

fiber (along with other fiber sources including chicory, fructo-oligosaccharides, mannan-oligosaccharides, rice and corn) was fed to 66 constipated cats. Assessments of fecal consistency and subjective improvement in clinical signs were evaluated by both veterinarians and owners. The results indicated that 56 cats completed the trial and all ate the diet and had improvements in fecal scores. Most cats that were on current medications for constipation were able to decrease or stop the drugs completely. While there was no control group or diet in this study, the positive results support the use of this psyllium-enriched diet as a primary or adjunctive therapy in managing cats with constipation and obstipation (19).

Hypercalcemia

Hypercalcemia is a relatively uncommon disorder in cats, with the most common underlying etiologies being idiopathic hypercalcemia, hypercalcemia of malignancy, chronic kidney disease, and primary hyperparathyroidism. Clinical signs are often lacking early in the disease process, which is usually diagnosed as an incidental finding on routine blood work. As the condition progresses, clinical signs become more apparent and can include vomiting, anorexia, weight loss, dysuria, and inappropriate urination. Medical therapy is typically targeted towards the underlying cause.

Dietary interventions are often ineffective because hypercalcemia tends to develop from increased bone resorption and renal tubular reabsorption of calcium. A dietary change to a product low in calcium will only benefit the subset of patients with increased intestinal absorption of calcium such as with hypervitaminosis D. High-fiber diets have been reported to decrease the risk of hypercalcemia and calcium oxalate urolithiasis in humans by increased binding of intestinal calcium, prevention of calcium absorption from the GI tract, and a decrease in GI transit time (20). There are very few studies in the veterinary literature to support this finding. Fiber-enhanced diets were associated with resolution of hypercalcemia in 5 cats with idiopathic hypercalcemia and calcium oxalate urolithiasis (21) but no effect was observed in another study (22). Further evaluation of the role of nutritional therapy in cats with hypercalcemia is required before conclusive recommendations can be made.

Hairballs

Hairball vomiting or regurgitation in cats is fairly common but not well-studied (**Figure 4**). A recent review of the topic (23) classified causes as either excessive hair

ingestion or altered upper gastrointestinal motility. Hair ingestion can be seen in cats with pruritic skin disease or that over-groom because of pain or anxiety. Chronic stomach or intestinal problems such as inflammatory bowel disease may alter motility and lead to hair accumulation. When hairballs cannot be eliminated by vomiting, they may cause partial or complete intestinal obstruction, entrapment in the esophagus, or they may enter the nasopharynx.

Commercial hairball control diets are available that include various types and amounts of fiber. A survey of dry and wet feline diets with hairball claims available in the U.S. found that the fiber sources listed among the ingredients varied widely, and included powdered cellulose, dried beet pulp, soybean hulls, dried chicory root, rice hulls, rice bran, pea bran meal, pea fiber, oat fiber, inulin, and psyllium. Published studies are lacking. A crossover trial comparing a maintenance diet with one with added fiber in 102 cats over 2 months showed an average of 21.5% fewer hairballs and 21.8% reduction in vomiting frequency (24). Another research study in 16 healthy cats compared the effect of two dry diets, one moderate fiber (6.9% as fed) and one high fiber (14.2%), on fecal hair excretion (25); after 3 weeks, cats on the high fiber diet excreted an average of twice as much hair as cats on the moderate fiber diet. The results indicated either the amount or the type (psyllium and cellulose) of fibers in the high-fiber diet increased hair passage through the intestinal tract and may reduce the incidence of hairball regurgitation or vomiting.

Figure 4. Hairball vomiting or regurgitation in cats is fairly common. However hairballs can cause various problems including obstruction of the esophagus or intestines.



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■ Conclusion

Both the amount and type of dietary fiber in the diet can impact on intestinal health and function, and have been shown to play a beneficial role in the treatment of

various clinical conditions. Further studies are needed to determine the effects of specific diets and fiber supplementation in cats.

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The psychology of managing the owner



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Dr. Adamelli graduated from the University of Padua in 2001 with a thesis on the evaluation of the quality of life for companion animals in relation with the owner. She followed this with a PhD and then post-doctorate work as a research associate, and at the same time attended foreign universities (including Cambridge School of Veterinary Medicine, the Veterinary Faculty at Barcelona and the Faculty of Veterinary Medicine in Helsinki) to develop her knowledge of Ethology and Behavioral Medicine along with animal welfare and human-animal relationships. Her activities include tutoring and teaching as Adjunct Professor at the Universities of Bologna and Turin, and she has contributed to various scientific journals and conferences as a recognized behavioral expert. She continues to carry out research in this area and currently works for the CSC, where her main role is behavioral counseling and training.

KEY POINTS

- **Good sense, logical reasoning and sound instructions from a professional are not always enough to change an owner's behavior patterns towards their pet. Only a minority of owners will follow treatment instructions properly, and compliance becomes worse with the passage of time.**
- **The owner-clinician relationship is both an integral and a critical aspect for dietary instructions to be successful; the clinician does not need to be a psychologist, but it is essential to understand communication management and the mechanisms that govern human relations.**
- **Knowing some of the main "social rules" that help persuade people to do something can make it easier for the clinician to convince an owner that instructions should be implemented.**

■ Introduction

A person will often adopt a domestic animal as a response to a psychological need, such as the desire for a companion, but more often than not a future owner will focus on acquiring an animal that best meets their own needs without always considering the animal's requirements. In an ideal world an owner might seek advice from a veterinarian on the best method of raising a pet and how to optimize the animal-human relationship before adopting an animal, but this rarely happens. This failure to consider the compatibility between the owner's lifestyle, the reasons for acquiring the animal, and the animal's needs can all impact on whether or not the type of management adopted is appropriate, putting both the animal's well-being and the success of the relationship at risk.

One of the aspects where the owner's conduct is often insufficient to meet an animal's basic requirements is feeding. Most domestic animals rely almost exclusively on their owners for their dietary needs to be met, yet clinicians often note that many clients seem unaware



Figure 1. An owner may offer their pet extra food, for example during the preparation of human food.

that the dietary requirements of animals can differ widely, and that even the differences between canine and feline nutrition are not appreciated. An owner who is misinformed, careless or ignorant will tend to treat their animal in an unplanned and simplistic manner, offering and imposing anthropomorphic behavior in various situations including feeding. The animal thus becomes the victim of the owner's inappropriate behavior, with consequences that can sometimes be critical and/or pathological, as when it becomes overweight or obese.

■ Professional intervention

Where this situation cannot be prevented by the provision of adequate information, then intervention by a professional is essential to correct the animal's diet. However, this is not simply a case of selecting the appropriate food to encourage weight loss or maintenance of a correct weight. Nutritionists have noted that a weight-control diet alone will not in itself always achieve the required outcome in a domestic situation which is often quite different from the environment where the product was successfully developed and tested (1). The reason for this is the relationship that has been

established between the animal and the owner; when considering the intervention required to correct the way in which meals are provided, and to avoid food being used inappropriately, it is essential that neither the human-animal bond nor the way in which the owner is handled should be underestimated.

Correctly managing food makes it easier to manage the animal in general, because the owner can communicate clearly and consistently with their pet so that the animal is more motivated and obedient. It is therefore vital to clearly explain even trivial instructions – such as the number and times for meals – so that the amount fed at each meal is controlled and to avoid food being given “out of hours”. The owner may otherwise offer the pet extra food, perhaps during their own meals (**Figure 1**) or in an attempt to prevent unwanted behavior on the part of the animal (e.g., to stop incessant barking by a dog or meowing by a cat).

In addition to the actual feeding of the animal, physical exercise has an important role to play. This is easy to achieve with dogs with their daily walk, although the amount of exercise must be based on the dog's size. For cats, physical exercise can be encouraged by providing toys that release food if they are moved by the animal (**Figure 2**), or by hiding food in places that the cat must reach by climbing. These factors also link with an animal's ethological requirements (which include displaying exploratory and/or predatory behavior, and intra- and inter-specific social contact) and allows the owner to share pleasant activities with their pet.

Figure 2. Cats can be encouraged to partake in physical exercise by providing toys that release food if they are moved by the animal.



■ Clinician/owner relationship

However, for the veterinarian's instructions to achieve the desired result it is important to establish that whoever feeds the animal has not only understood the information correctly, but that the instructions are faithfully adhered to. There is no guarantee that either oral or written instructions will be effectively applied; as with the human situation, only a minority of owners follow treatment instructions properly, with compliance gradually becoming less strict as time passes.

Perhaps more than any other medical discipline, it is essential for the veterinary clinician to establish a good relationship with the owner to ensure that instructions issued are effective. The owner is the animal's "tutor"; the instructions will therefore only have a good outcome if the correct behavior is adopted by the owner. The veterinarian must therefore understand that the relationship between the clinician and the owner is both an integral and a critical aspect for the dietary instructions to be successful. It is not necessary to transform the clinician into a psychologist, but it is essential to understand the mechanisms that govern human relations and communication management.

It is vital to pay close attention to the initial contact between the owner and the clinic, or rather the owner and the first member of staff who meets him or her. Remember that it is not only animals that display an "instinct for survival"; people do so as well. Primitive behavior patterns, such as territory marking, are commonly seen in dogs and cats, but advanced social and cultural codes developed over thousands of years means that humans do not necessarily exhibit their own primitive behavior characteristics, at least not overtly; the signs are now usually masked. But put simply, the basic element of any living species is the principle of survival, and when two people meet for the first time, there are certain questions that are asked on a subconscious level: will the other person be a friend or an enemy, will they support me or fight me, will they be able to answer to my needs or will the threat remain?

An immediate response is required, and what is commonly referred to as the "4 x 20" principle is applied. These are four critical elements (with a common factor of 20) that are initiated – mainly on a subconscious level – when two people meet for the first time to quickly assess if the speaker is a "friend or enemy"; this process allows the individual to adopt the necessary behavior for survival.



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Figure 3. The person responsible for the initial contact with every new client should be aware of the "4 x 20" phenomenon and must ensure that they adopt the most welcoming attitude possible.

The elements are as follows:

- Everything that happens in the first 20 seconds
- The first 20 words spoken
- The first 20 movements by the speaker
- The expressions shown within the 20 cm diameter of the other person's face

Therefore the person responsible for the initial contact with every new client must be aware of this phenomenon and must ensure that they adopt the most welcoming attitude possible (**Figure 3**); this will help convince the owner that every member of the staff is a friend able to respond to their needs. The required characteristics are an attentive, welcoming manner with a pleasant attitude and an ability to listen; in other words, behavior that will establish a climate of respect and trust. People will assess the environment and equipment available in a veterinary clinic but also assess its trust and professional credibility. It should be remembered that even if the clinic



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Figure 4. With an assertive communication method, the veterinarian should use a clear, friendly, balanced voice with open gestures and direct eye contact.

has a highly professional image, all that is needed is a couple of incorrect behavioral patterns to change the client's concept from friend to enemy and lose the loyalty that has been established with time and effort.

Once the first stage has been completed, certain factors which govern interactions between people need to be kept in mind; this is especially true with the relationship between the clinician and the owner. As in all relationships, where the roles are not equal, whoever has the main role (in this case the clinician) must manage the relationship with the other party (the owner), by using dialog almost as if it were an instrument. The main communication method should therefore be assertive, using a clear, friendly, calm voice with open gestures and direct eye contact (**Figure 4**); the speaker should have an upright, relaxed and receptive posture with a facial expression that shows involvement and compassion. Only in critical situations should a passive and/or managerial communication style be employed; these two methods may be useful in dealing with a difficult individual, such as an owner who is aggressive, nervous, inattentive,

presumptuous, skeptical or uncooperative, but it is essential to understand and master these communication styles in order to make them actual tools of persuasion or guidance. If one has not fully mastered all the communication styles, it is better to maintain an assertive relationship and involve the other party with prompting questions to establish co-operation by proposing alternatives. Owners usually have the information that will allow a clinician to gather a proper case history, but for reasons that may not be evident, this is not always provided; rather the owners tend to give details that are tainted by their perspective on reality.

Dealing with overweight pets

It is also important to note that it is not unusual to find that an overweight or obese animal has an owner (or family members) who are also overweight, reflecting the consequences of their own incorrect eating habits (**Figure 5**). Obviously these poor eating habits on the part of the owner can also have consequences for the animal; in fact, the sharing of specific circumstances can provide an element of satisfaction for humans in a positive situation, but in negative situations sharing specific circumstances brings less sense of responsibility, guilt and shame. Therefore if both pet and owner are overweight or obese, then the human may actually perceive the situation as positive, or at least to be less negative or critical than others might see it. Interestingly, it is very easy to find media or internet pictures of overweight and/or obese owners with their animals which often convey a positive, sympathetic image, despite the fact that society recognizes that obesity can lead to serious health issues.

When dealing with an owner who is feeding their animal incorrectly (and especially when the owner or family members are also overweight), effective communication is essential, both as a tool for diagnosis and to convince the owner to apply the relevant treatment. Dialog should not be based on asking open questions (e.g., "when and what do you feed your dog?"), but rather by using paired alternatives to restrict the field and identify the owner's behavior (e.g., "do you feed your dog at set times, or is there always food in the bowl?" "Does the animal always eat alone, or with you and the family?"). By communicating in this way the clinician can make the owner understand that there are different feeding behaviors, some of which can then be emphasized as negative. The objective of this form of communication is to allow the owners to discover the way in which they conduct themselves in relation to the animal; they can understand that they themselves are the ones generating

incorrect circumstances which may create the problem and/or not support the solution.

Once the owner has provided answers, it is worthwhile checking the exact situation by using phrases such as: "Did I understand correctly that ..., can I confirm then that you feed your..., given what you've told me, it would seem that..., etc." Reviewing the information has certain advantages, as it can create an alliance with the owner and make them the instigator in understanding the problem, as well as giving them the opportunity to analyze it from a different perspective (via the suggested alternatives). It also consolidates the relationship between the clinician and the owner, because the summary communicates the intention of checking that the problem has been understood, and consequently the clinician's wish to have a full understanding of the situation; in other words, it reinforces the concept of professionalism and that the clinician is a friend taking care of the problem.

If an owner, realizing that their overweight or obese pet has a severe problem, approaches a clinician to request help, they will probably follow the instructions given. On the other hand, if the owner does not appreciate that their pet has a potentially dangerous condition, and it is the clinician who points out the problem and advises on what should be done, the instructions will not always be willingly adhered to.

Figure 5. Owners may have habits that encourage their dog to eat inappropriately.



Devices such as metaphors, anecdotes and homilies can be employed to help a listener perceive that certain behavior patterns are favorable or unfavorable. For example, to explain the consequences of excessive feeding, both in terms of quantity and procedures, the following metaphor could be useful:

"Imagine you are a young boy walking along a mountain path with your parents and some friends. You are carrying a knapsack on your back, and just after setting off, one of your parents shows you a beautiful stone with a shiny appearance. They like it so much that they put the stone into your knapsack. Continuing along the path, they find other stones they like, and again place these in your knapsack. They do not allow you to empty it out. How would you feel after a few hours of walking and at the end of the day? Giving an animal too much to eat, and at the wrong times, is just like loading up the boy's knapsack!"

■ Strategic language

It is in these situations that language takes on a strategic significance for the dietary instructions to be successful. Like human behavior, managing the feeding of animals is triggered by motivation, by wanting to achieve objectives, by trying to find a sense of well-being, by principles, by the wish to experience pleasure, etc. Good sense, logical reasoning and sound instructions from a professional are not always enough to change behavior. Very often it is necessary to arouse feelings, emotions and sentiments in people to generate the motivation required to implement changes in their behavior; sometimes the "subconscious" needs to be triggered to promote change. The subconscious may be defined as that part of a person which is not rational and cognizant, but generates "feelings" that often guide our actions (e.g., when faced with a certain situation, someone may say: "I don't know why but I just felt like acting in this way..., I acted instinctively but it seemed for the best..."). It may be necessary to facilitate these subconscious choices when dealing with the owner of an obese animal; for example the use of metaphors, anecdotes and homilies (*i.e.*, language that generates feelings) can be an effective way of prompting these sensations and will allow the listener to perceive certain behavior patterns as either favorable or unfavorable (see box above).



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Figure 6. Social confirmation can be used to encourage compliance – for example, showing a client that certain facts have been proven scientifically can underline the instructions given.

■ Social rules

To make the instructions effective, the owner therefore needs to be convinced. It is worth knowing some of the main social rules that can persuade people to do something; if used correctly, they make it easier for the clinician to convince the owner that a set of instructions should be implemented for the animal's well-being.

- **Liking.** People actually prefer saying yes to someone they know and appreciate. We will like a certain person for various reasons – for example, they may have a pleasing appearance, we may have a shared affinity with them (e.g., how they do certain things, how they dress, etc.), they may pay us compliments, or we may belong to a common group (e.g., a sports club or community). It is therefore important to pay careful attention to the “4 x 20 mechanism” in order to establish a positive and likable relationship; this includes trying to identify the other party's interests and complimenting them on this when necessary.
- **Reciprocity.** This rule states that one person tries to repay what another person has offered them. A tactic that is often used is to do someone a favor or give them something, even if it is not asked for, and then request that it be reciprocated at a later stage. For example, the clinician could apply this rule by simply offering a small item for the animal to play with, while asking that the instructions are followed (“I have made a “gift” of this toy because it will get your animal to exercise more”), thus committing the owner to complying with the rule of reciprocity.
- **Concessions.** Another way of offering something to the owner can be to “increase” the level of the request,

and then agreeing on a concession; for example, one could ask the owner to exercise their pet for at least an hour three times a day, and then allow them an initial period whereby they only have to exercise the pet for perhaps 45 minutes twice a day.

- **Social confirmation.** Most people think it is important to see what others say or do when deciding how they themselves should believe or behave; in other words, it is difficult to avoid the “power of others”. So when communicating with the owner the clinician can use phrases such as “these things I've just mentioned have been proven scientifically” or “people who have implemented this method have always had good results” (**Figure 6**).
- **Commitment and consistency.** People are more open to accepting further requests – even if these are more onerous than the original instructions – as long as any new request is consistent with the initial objective. So in this case, once the clinician has proposed a course of action and the client has committed to it, additional requests can be made at follow-up consultations, with the veterinarian emphasizing that these new tasks are still consistent with the original goal.
- **Authority.** People have a strong tendency to obey authority. Remember that aspects which influence obedience to authority include titles, clothing and status symbols that correspond to the type of authority being exercised. It is important therefore for the owner to immediately perceive that both their chosen clinic and clinician have all the necessary elements that convey

Figure 7. The clinician should have all the necessary elements that convey authority – for example, being dressed neatly and appropriately.



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authority – for example, the veterinary surgeon should be dressed neatly and appropriately (**Figure 7**), the reception area should have a neat appearance, and the staff's professional qualifications should be displayed prominently.

■ Conclusion

When dealing with an animal that is overweight or critically obese, the clinician must manage the relationship with the client carefully to ensure effective intervention, since the outcome for the patient will essentially depend on how the owner responds. The clinician may need to help the client recognize that obesity is a major problem, especially if the owner and/or family members have the same problem. To do this, the clinician must remember the importance of initiating a positive impression within the first few seconds of meeting each and every owner;

if done carefully, this will generate the empathy needed to create a genial relationship whilst still allowing the clinician to maintain authority. Both verbal and non-verbal communication must be used carefully; the clinician should ask prompting questions and offer alternative answers which will allow the owner to recognize if they are feeding their animal incorrectly, and encourage them to find the solution to the problem. To persuade the owner, social rules and professional authority can be useful, and the clinician must always be aware that communication takes on special importance when it comes to compliance; if the owner is not persuaded, the instructions may not be correctly applied. Even though this may seem difficult at times, it is worth remembering the words of Seneca, the ancient Roman philosopher; "We do not confront adversities because they are difficult, instead they are difficult when we do not confront them".

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Pets and pet foods – questions and answers



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■ Introduction

Veterinarians and practice support staff encounter questions and comments on a daily basis from clients regarding various aspects of petfoods, many of which are based on hearsay, popular belief and even falsehoods. In this paper Dr. Heinze considers some of the more frequently posed questions and offers both some background to the issues and reasoned science-based answers.

Q. Are home-cooked diets healthier for my pet than commercial diets?

In some countries, home-prepared diets have always been popular, while in other countries (such as the U.S.), home-cooking for pets has become much more popular in the past ten years. Many pet owners who cook for their pets cite a distrust of commercial pet foods, the perception that home-prepared foods are healthier, or the desire to include or exclude certain ingredients. They may also believe that making food for their pets at home allows for increased palatability or decreased costs.

In theory, home-prepared pet foods, if done correctly, can be nutritionally balanced and healthy, although whether they are healthier than commercial diets remains debatable due to the lack of evidence for or against this idea. Unfortunately, most home-cooked diets either put together empirically by pet owners (or even veterinarians), or made from recipes obtained from books or the internet, have serious nutritional concerns. Several recent studies have investigated recipes for home-prepared diets for dogs and cats in books and on websites and have found that the vast majority of them contain lower than recommended amounts of essential nutrients (1-3).

While a detailed analysis of a home-cooked recipe requires either laboratory or computer analysis using diet formulation software, some basic components should always be included in a home-prepared diet recipe. Recipes without the following components are more likely than not to be unbalanced; however, even recipes that contain all these components can have serious nutritional imbalances.

1) An animal protein source – home-cooked recipes that do not contain

animal protein are often inadequate in protein or amino acids.

- 2) A calcium source – either as calcium carbonate, calcium phosphate or bone meal. Typically inorganic calcium sources are best, as bone meal has variable digestibility in the author's experience.
- 3) A source of linoleic acid – typically this is corn, canola, or safflower oils or meals, although chicken fat or oats can sometimes provide adequate levels.
- 4) A source of vitamins and minerals – this typically needs to be a complete vitamin/mineral human supplement designed to be taken once daily. Pet supplements usually do not contain adequate amounts of nutrients to balance home-prepared diets. However, there are some supplements available designed specifically (and only) for balancing home-prepared pet diets and they may fulfill this purpose.
- 5) A taurine source (for cats) – cooking meat reduces the concentration of taurine, so it should always be supplemented.

Because of the significant risk of inadequate nutrients, home-cooked diets should never be used in growing, gestating or lactating animals.

These life stages are very demanding nutritionally and inappropriate nutrient levels can have dire consequences.

Pet owners interested in feeding home-cooked diets should be referred to board-certified veterinary nutritionists or individuals with an advanced degree (e.g., a PhD) in animal nutrition to ensure that they have the best recipe possible. All recipes should be followed exactly and re-evaluated yearly to ensure that the recipe still meets appropriate nutritional guidelines as well as the needs of the pet.

Bottom Line: There is no evidence that home-prepared diets are healthier than commercial diets. In fact, the majority of home-prepared diets used by pet owners are deficient in some essential nutrients and contain levels of other essential nutrients below those required for commercial pet foods. Conversely, some recipes may deliver an excess of nutrients, e.g., toxic levels of vitamin D may be provided if large quantities of fish are used.

Q. Does my dog or cat need any extra vitamins or supplements?

If a pet is fed a diet that meets minimal nutrition guidelines [such as the Association of American Feed Control Officials (AAFCO) nutrient profiles (4)], then it is unlikely to benefit from added vitamin and mineral supplements unless it has a specific health problem. Most vitamin and mineral supplements marketed for pets assume that the pet is getting the nutrients that it needs from a balanced diet and therefore include only small amounts of vitamins and

minerals which are unlikely to have much benefit in a healthy animal.

On the other hand, if the supplement manufacturer is not knowledgeable or careful, it is possible to end up with excessive, potentially toxic, amounts of nutrients when fed alongside a balanced diet. Examples that the author has found are supplements marketed for large breed puppies that contain added calcium (excessive calcium is a major risk factor for developmental orthopedic disease), fish oil supplements that contain high concentrations of vitamins A and D3, and numerous vitamin supplements containing excessive concentrations of vitamin D3.

In general, all pets that are fed home-prepared diets (with the possible exception of those fed whole prey) will require a vitamin and mineral supplement to provide essential nutrients. As noted above, most supplements marketed for general use in pets will not contain adequate nutrient concentrations to balance a home-prepared diet, especially if the labeling suggests that they can be used “for pets of all ages, on all types of diets”. Special products are required for balancing home-prepared diets and these diets often require multiple supplements; for example, the author will commonly use perhaps five or even seven different human supplements to achieve the desired vitamin/mineral balance when designing a home-cooked recipe.

Bottom Line: Most pets fed a balanced commercial diet are unlikely to benefit from additional vitamin and mineral supplements, and these products can cause harm if the levels of nutrients in the supplement fed alongside the diet are too high.

Q. Are carbohydrates bad for cats?

There are few controversies more heated in feline medicine than the role of carbohydrates in the diet of cats in health and disease. As the cat's historic diet consists of small rodents, birds, and reptiles that are typically low in carbohydrate, it has been argued that cats should not be fed substantial amounts of carbohydrates in their diet. Despite the cat's adaption to low carbohydrate intake (e.g., up-regulated gluconeogenic pathways, low activity of hepatic glucokinase), cats have maintained the ability to process carbohydrates and properly cooked carbohydrates can have a digestibility of 93% or above (5). Cats do have an upper threshold for dietary carbohydrate that is considerably lower than that of dogs, pigs and humans, but most cats do very well on the carbohydrate concentrations typically present in commercial cat foods (5-40% of calories on a metabolizable energy (ME) basis).

Proponents of limiting carbohydrate in cat diets often blame the carbohydrates for various problems including obesity and the development of diabetes (**Figure 1**). Low carbohydrate diets are often described as “magic bullets” for weight loss – because they are more “natural”, cats will supposedly limit their intake to appropriate amounts. Other sources suggest that high carbohydrate diets lead to direct fat deposition, regardless of the calories consumed. Interestingly, diets low in carbohydrates are typically higher in fat and thus caloric density, which is a risk factor for obesity.

In fact, many dry low-carbohydrate diets (carbohydrate < 20% ME) are



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Figure 1. Caloric density is much more of a concern than carbohydrate content when it comes to feline obesity.

extremely high in calories (495-592 kcal/cup or 3960-4366 kcal/kg, as fed), which can make them very difficult to feed in appropriate amounts to cats with lower energy needs. One notable study compared diets with variable concentrations of fat and carbohydrates (using simple carbohydrates) and found that dietary fat (and thus dietary calories) were much stronger predictors of weight gain than dietary carbohydrate; cats fed the high fat/low carbohydrate diets gained considerably more weight after spaying and neutering than cats fed the high carbohydrate diets (6). It has also been the author's experience that caloric density is much more of a concern than carbohydrate content when it comes to feline obesity, as many cat owners are very bad at limiting the amount of food that their cats are allowed to consume (**Figure 2**).

While many people also believe that higher carbohydrate diets (particularly dry diets) cause diabetes mellitus in cats, there is no data at this

time to support a link. A known risk factor for feline diabetes is obesity, so feeding a diet that will help maintain the cat at an appropriate weight before diabetes develops is paramount. Indeed, one study did not find a link between dry food consumption and the development of diabetes, but did find physical inactivity was

associated with the development of diabetes when the analysis was controlled for body weight (7).

Once a cat develops diabetes, there is data to support a potential benefit of feeding lower carbohydrate diets in some cats (8-10). However, these studies have a number of limitations and should not be interpreted as meaning that all cats with diabetes require a low carbohydrate diet for best management. Additionally, there is little data available to address the "ideal" carbohydrate concentration (*i.e.*, no well-designed dose-response studies) or source (*e.g.*, simple *versus* complex carbohydrates) for cats with diabetes. The practice of focusing on individual carbohydrate-containing ingredients and their potential effect on blood glucose (typically by extrapolating human glycemic index data) may not appropriately estimate the effect of the ingredient in the complex pet food matrix when fed to an actual cat.

For normal or underweight diabetic cats, the author typically looks for

Figure 2. Many cat owners do not limit the amount of food that their cats are allowed to consume.



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the lowest carbohydrate diet that meets the cat's other needs. However, for obese cats, it may not be possible to find a low carbohydrate diet with appropriate caloric and nutrient density for weight loss, particularly if the cat is unwilling to eat canned diets. In these cases, the emphasis is on weight loss as a method to mitigate diabetic signs.

Bottom Line: There is no evidence that higher carbohydrate diets cause diabetes in cats, and while some evidence suggests that cats with diabetes may do better on low carbohydrate diets, such diets are not ideal for every cat and further research is strongly needed.

Q. Are grain-free diets healthier for my pet?

In recent years, there has been an explosion of pet foods marketed as “grain-free” or “cereal-free”. These diets, available in both extruded and canned forms, use potato, tapioca, peas, or other legumes (pulses) as carbohydrate sources instead of corn, wheat, rice or other grains. These diets are frequently marketed to the pet owner as being healthier, less likely to cause allergies, etc. However, despite the widespread popularity of these diets, there are no known health benefits to substituting non-grain carbohydrates for grains in commercial pet foods. Contrarily to popular belief, often fed by internet rumor, grains are less likely to cause food allergies in pets than meats, so switching to a grain-free diet whilst maintaining the same meat proteins fed previously is unlikely to benefit the pet with a true food allergy.

Many people equate grain-free diets with low carbohydrate diets, but this correlation is frequently inaccurate. Many grain-free diets have similar carbohydrate levels to grain-containing diets and the carbohydrates used may be simpler carbohydrates compared to the whole grains. At this time, unless a pet has a specific known allergy to a specific grain (which is quite rare), there is no health benefit to feeding a grain-free diet. Likewise, gluten-free diets are unlikely to be of any benefit, even to pets with gastrointestinal disease. The only reported cases of gluten-sensitive enteropathy in dogs or cats have been in several closely related Irish Setters and there is no evidence that any other dog breeds or cats are affected (11).

Bottom Line: “Grain-free” and “gluten-free” diets are largely marketing terms that confer no health benefits to pets.

Q. My dog is often itchy and a friend suggested he might have a food allergy, but his signs didn't improve when I fed a grain-free diet. Could his itchiness still be from a food allergy?

Despite what most pet owners believe, food allergies are actually pretty uncommon causes of dermatologic or gastrointestinal symptoms in dogs and cats (**Figure 3**). “Adverse food reaction” is a term that encompasses all negative responses to food that one might see in a pet; the most common types of adverse food reactions are allergies (immune-mediated) and intolerances (not involving the immune system). Intolerances typically manifest as gastrointestinal symptoms such as vomiting,

poor stool quality or flatulence, whereas allergies can present as dermatological or gastrointestinal signs or both.

Allergies to environmental antigens such as pollens, molds, dust mites, and fleas are the most common causes of allergic skin disease in dogs and cats. For gastrointestinal signs, food is often a factor; however, other properties of a food – e.g., its digestibility, fat, or fiber content – are more likely to cause digestive upsets than an immunogenic response to specific food ingredients.

Diagnosis of specific food allergies is difficult as it involves laborious dietary elimination trials followed by provocative testing of individual ingredients. As a result, food allergies are rarely definitively diagnosed in dogs and cats and it can be hard to find much information in the literature on the most common confirmed food allergens. However, it has been reported that beef, dairy, wheat, egg and chicken are the most common food allergens in dogs, while beef, dairy, and fish are the most common in cats (12). However it is likely that these lists merely reflect the most common ingredients in pet diets over the past two decades, rather than enhanced antigenicity of any specific pet food ingredients.

If a food allergy or intolerance is suspected, dietary elimination trials should be conducted using veterinary therapeutic diets containing limited, novel antigens (*i.e.*, one protein plus one carbohydrate that the pet has never previously been fed). For pets with extensive ingredient exposure, particularly those with exposure to white potato (dog) or green pea (cat), it may not be possible to find an appropriate novel therapeutic diet. For these cases, a diet consisting

of hydrolyzed protein plus a simple carbohydrate (*i.e.*, no protein component) should be utilized.

Only when an animal has signs that do not improve on one or more strict trials with a novel or hydrolyzed therapeutic diet (but an allergic cause is still suspected) should a home-cooked diet be tried. While many resources recommend an unbalanced combination of one protein and one carbohydrate, it is the author's experience that when these diets are successful, they tend to be fed long-term by the client, typically without regard for the fact that they are deficient in essential nutrients. For this reason, the author always ensures that recipes for trial diets include appropriate supplements to provide essential nutrients for long-term feeding, utilizing sources that do not introduce additional antigens.

Bottom Line: Food allergies are uncommon in pets, but when they occur, they are more likely to be to animal products in the diet rather than plant ingredients.

Q: I always check the ingredient list when I am considering buying a new pet food so I can determine the quality of the food. What ingredients should I look for or avoid?

Unfortunately, the ingredient list of a pet food is not a good way to assess either the quality of individual ingredients or the diet as a whole. While in most countries ingredients are regulated in that they have very specific definitions which must be followed, these definitions typically do not contain any detail on the quality



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Figure 3. Despite what most pet owners believe, food allergies are actually an uncommon cause of dermatological signs in dogs.

or nutritional composition of those ingredients. A company could use either top quality or poor quality chicken meal and the label will still say "chicken meal".

Likewise, there is no requirement for companies to prove that certain ingredients improve health or are even bioavailable to the pet. Manufacturers may use exotic meats (*e.g.*, bison, rabbit, salmon, venison, duck) or fruits, vegetables, or herbs in diets in amounts that are unlikely to have any nutritional benefit, solely for marketing purposes as the pet-owning population is increasingly looking for ingredient lists that are more similar to the foods that they themselves are eating or that reflect their perception of what their pets "should" eat. This explains the presence of expensive diets that contain foods such as smoked salmon and goji berries that may confer no additional nutrients or benefits than a traditional corn and chicken-based diet.

Many pet owners strive to avoid artificial colors and preservatives, and these compounds have largely been

removed from commercial pet foods due to consumer pressure. It is important to keep in mind, however, that natural preservatives may actually have less safety and efficacy data available for them than the artificial preservatives that were traditionally used. Thus the use of natural preservatives puts a lot of onus on the manufacturer to assure that the amounts and types of preservatives used are appropriate to protect the nutritional quality of the food throughout its entire shelf life.

Bottom Line: The ingredient list provides little to no information about the quality or healthfulness of a pet food, and manufacturers may choose ingredients that appeal to pet owners rather than because they are better for pets.

Q: My veterinarian has recommended that I feed an expensive veterinary therapeutic diet rather than a diet available at the pet store or discount store.

Are these diets really any different from the diets I can buy without a veterinarian's approval?

In most countries, pet foods sold to consumers for healthy pets must meet minimum nutrient concentrations that are thought to be appropriate for the specific life stage of the pet (adults, pregnant or lactating bitches or queens, or growing kittens or puppies). These diets have variable nutrient levels and are designed to provide adequate nutrition for healthy dogs, and they may not contain ideal nutrient composition and other properties (e.g., fiber, digestibility) needed for some pets with health problems. Some health issues that may necessitate a special diet include obesity, gastrointestinal disease, kidney disease, or pets suspected of having an adverse food reaction.

Many obese pets have low energy needs and their caloric intake must be heavily restricted compared to that of a lean animal to allow for weight loss. In order to ensure that they are not restricted in essential nutrients along with calories, diets that contain higher nutrient levels per calorie are required. While there are dozens of diets sold in pet stores and supermarkets that are marketed for overweight or obese-prone pets, there is a huge amount of variation in these diets in both calories and nutrient concentrations (13) and many of them may be reduced in calories without necessarily being higher in nutrients. For instance, many lower calorie dry maintenance diets for dogs are rather low in protein even before the calories are restricted, and maintaining adequate dietary protein intake is thought to be important for maintenance of lean body mass during weight loss.

Veterinary therapeutic diets for weight loss are often lower in calories than maintenance diets while having higher concentrations of nutrients such as protein. These diets may also have higher concentrations of fiber or other compounds that may enhance weight loss, maintenance of lean body mass, or satiety. These products often result in healthier, more successful weight loss, particularly in pets with very low energy needs, compared with lower calorie maintenance diets (Figure 4).

For pets with moderate to severe kidney disease (as classified by the International Renal Interest Society, Stages 2-4), appropriate concentrations of protein, phosphorus and other nutrients will not be available in maintenance diets, as these concentrations are typically below regulatory minimums for healthy dogs. Several studies have shown improved clinical signs and longer survival times in dogs and cats fed specially designed veterinary therapeutic diets compared to typical maintenance diets (14, 15). In these pets, an appropriate diet can potentially double lifespan and improve quality of life during the disease progression.

Pets with signs of gastrointestinal disease that do not improve on maintenance diets may respond better to the higher digestibility and fiber complexes available in veterinary therapeutic diets designed for pets with gastrointestinal disorders. There are also a number of diets designed for pets with potential food allergies or intolerances that contain very limited, less common ingredients as well as diets made with hydrolyzed proteins. While many over-the-counter diets market themselves as being for pets with "sensitive stomachs" or containing few

ingredients, there are no regulations that guide these claims and these products may be no different in digestibility or ingredients than diets marketed for "normal" pets.

Veterinary therapeutic diets should be used exclusively when possible to rule in or out food allergy/intolerance. Although it often appears that similar diets are available in pet supply stores, many readily available "limited antigen" diets contain common ingredients in addition to potentially novel ones (e.g., a "venison" diet may also contain chicken or egg) or more ingredients than the name would suggest (e.g., "Venison

Figure 4. It is important that veterinarians and veterinary staff clearly explain to owners the differences between the therapeutic diet and the foods they may have easier access to, so the pet owner can better perceive the value of therapeutic diets.



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and Potato” that also includes chicken, egg, peas, and barley). Additionally, at least one study suggests that these diets are frequently contaminated with other ingredients not listed on the label (16). Thus the results of a feeding trial are likely to be confused by the use of these diets, leading to incorrect diagnoses.

When a veterinary therapeutic diet is important for a pet’s health, it is important that veterinarians and veterinary staff clearly explain to owners the differences between the therapeutic diet and the foods they may have easier access to, so the pet owner can better perceive the value of therapeutic diets.

Bottom Line: For some health problems, diet may play a critical role in treatment; for these conditions, veterinary therapeutic diets may provide significant benefits over traditional maintenance diets.

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CUT-OUT AND KEEP GUIDE...

Calculating the energy content of pet food

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■ Introduction

Why is it important to know the energy content of pet foods? Because if the energy content of the food(s) and the quantity of food(s) consumed is known, it is possible to determine how much energy a pet is being fed. This in turn will enable the clinician to provide more precise feeding recommendations to an owner, advice which is particularly important for clients who are in the process of changing their pet's diet or are feeding multiple diets. Owners may not appreciate that feeding guides can vary between pet food manufacturers, and that different manufacturers may have different approaches to estimating a food's energy content.

Knowing the energy content of a pet food also means that different diets can be accurately compared. By normalizing to a fixed energy content it is possible to compare nutrient content, or other factors such as cost, across a range of quite different foods, *e.g.*, one can accurately evaluate the difference between a wet and a dry diet. Some pet food manufacturers provide information on the energy content of their diets, but mandatory legislation varies from country to country and there is no standard method as to how the energy content should be calculated. The approach outlined in **Table 1** provides a consistent way to estimate the energy content across a range of foods for both dogs and cats.

Foods differ in the amount of energy they contain, and this is primarily a function of the amount of moisture, protein, fat and carbohydrate present, and (in the case of the macronutrients) their respective digestibilities. Typically dry foods are more energy-dense per unit weight than wet foods; the energy content of wet foods can vary from 70-130 kcal/100 g of food, compared with dry foods that can vary from 280-480 kcal /100 g of food.

Table 1. Factors influencing the amount of energy in food.

Forms of energy in food

Food energy is expressed in units of kilocalories (kcal) or kilojoules (kJ), where 1 kcal is equivalent to 4.182 kJ. Energy in food is usually considered at 3 different levels.

- **Gross energy (GE);** this is the total (thermic) energy in the food released by complete oxidation. However, although a food may have a high GE content, it may be indigestible and therefore unavailable to the animal.
- **Digestible energy (DE);** this is the amount of energy which is digested and absorbed by the animal, and is equivalent to the GE minus fecal losses. However not all of the DE is available to the animal; some is lost in the urine as energy is metabolized by tissues and cells.
- **Metabolizable energy (ME);** this is the food energy that is utilized by the tissues, and is calculated from DE minus urinary energy losses. This is the most meaningful measure of food energy as it represents energy that is truly available to the animal to use.

■ Measurement of metabolizable energy (ME) content of pet food

The gold standard for measuring ME is to perform a feeding (digestibility) study, but this is time-consuming and expensive to conduct, and many pet food manufacturers do not have the capability or resources to conduct such studies. Predictive equations are an alternative method to feeding studies and can provide a good estimate of a diet's ME content. There are a number of different predictive equations, but they all use a similar



Table 2. Calculation of energy content (1).

Step 1: calculate carbohydrate (NFE) content of the food	Carbohydrate (g/100g) = 100 – (Moisture + Protein + Fat + Ash + CF)
Step 2: calculate GE content	GE (kcal/100g) = (5.7 x protein) + (9.4 x fat) + (4.1 x [NFE + CF])
Step 3: calculate the percentage digestibility (note there are different equations for cat and dog foods)	Cat; % energy digestibility = $87.9 - \left[\frac{(0.88 \times CF \times 100)}{(100 - \% \text{ moisture})} \right]$
	Dog; % energy digestibility = $91.2 - \left[\frac{(1.43 \times CF \times 100)}{(100 - \% \text{ moisture})} \right]$
Step 4: calculate DE content	DE = GE (from step 2) x % energy digestibility (from step 3)/100
Step 5: calculate ME content (note there are different equations for cat and dog foods)	Cat; ME (kcal/100g) = DE (from step 4) – (0.77 x Protein)
	Dog; ME (kcal/100g) = DE (from step 4) – (1.04 x Protein)
Key: GE = gross energy - DE = digestible energy - ME = metabolizable energy - CF = crude fiber - NFE = nitrogen free extract	

approach based on the amount of protein, fat and carbohydrate in the food, and employ coefficients (and in some cases other factors) to adjust for the digestibility of the food.

■ Interpreting nutritional information on pet food labels

Some, but not all, of this information may be provided on the pet food label. It is important to check that nutrient values are expressed in % units, or g/100g of food. It is also essential to verify that the given values represent typical or average values for the nutrient in question; sometimes different values (such as guaranteed minimum or maximum levels) are declared and these should not be used. If it is not clear on the label as to what the values refer to, it is advisable to check with the manufacturer.

The following nutritional values must be known to use a predictive equation; as noted above, values must be expressed as percentages or as g/100g. Also note that the carbohydrate (“Nitrogen Free Extract” or NFE) fraction may not be measured directly but can be calculated by difference (**Table 2**).

- Moisture
- Protein
- Fat
- Carbohydrate* (NFE)
- Ash **
- Crude Fiber

*if not provided this can be calculated from the other nutrients.

** sometimes referred to as “inorganic matter”.

Royal Canin is pleased to announce the launch of an app that will assist calculation of the estimated metabolizable energy density of dog or cat food from its approximate analysis. Download the app using the relevant link below.

- **iTunes, iPhone and iPad:** <https://apps.apple.com/zw/app/energy-calculator-cat-dog/id917317961>
- **Android:** <https://appstore.infostrates.fr/projects/energy-calc/production/android>

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