

# Novel Trends in Small Animal Nutrition

## A Practical Guide

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**N**utritional assessment is a cornerstone of veterinary wellness care, with recent guidelines encouraging a complete and thorough dietary evaluation for every patient.<sup>1</sup>

Practitioners now encounter a number of new trends and controversies in small animal nutrition. A recent market analysis suggests that natural and organic pet foods will exhibit significant growth in coming years.<sup>2</sup> Major pet food manufacturers have responded by launching new products or redesigning entire lines of pet food.

Therefore, a clinician's nutritional assessment requires:

- Examination of owner choices
- Review of the evidence for novel interventions
- Specific recommendations for ensuring dietary adequacy.

### OVERVIEW: CONCERNS & CONTROVERSIES

Much of the controversy in veterinary nutrition centers on suitability of particular ingredients used in commercial pet foods. The 2 primary concerns are:

1. Artificial flavors or preservatives
2. Vagueness inherent in certain ingredient terms found on product labels.

The Association of American Feed Control Officials (AAFCO), the organization that establishes nutritional standards for pet foods used by industry and state regulatory agencies, clearly defines some foods. Visit [todaysveterinarypractice.com](http://todaysveterinarypractice.com) (Resources) to view a list of AAFCO definitions for common dietary ingredients in pet foods.

### Preservative Changes

The synthetic preservatives—ethoxyquin, BHA, and BHT—were commonly added to commercial pet foods to prevent oxidative damage to polyunsaturated fatty acids and fat-soluble vitamins.<sup>4</sup>

However, the Food and Drug Administration (FDA) received a number of adverse event reports concerning these synthetic compounds, although such effects could not be replicated in laboratory studies at similar concentrations.

Nevertheless, the increasing preference for natural diets has prompted the replacement of such compounds with natural alternatives, such as tocopherols, rosemary extract, and other antioxidants.

### By-Product Clarification

A primary owner concern is lack of specificity concerning the definitions of:

#### WHAT ARE NATURAL PET FOODS?

Natural diets are defined as *not having been produced by or subject to a chemically synthetic process and not containing any additives or processing aids that are chemically synthetic.*<sup>3</sup>

Vitamins and minerals are generally excluded from *natural* requirements when the packaging label reads: *with added vitamins and minerals.*

- **Meat**, which is derived from undefined mammalian tissue
- **By-products**, which fails to identify the particular tissues used in the final product.

These vague terms led to concerns that euthanized dogs and cats from animal shelters sent to rendering plants were used in commercial pet food formulations. The FDA investigated and failed to identify dog or cat DNA in pet food samples, although trace amounts of pentobarbital, likely administered to other species, were documented.<sup>5</sup>

The pet food industry relies on by-products from human food production given the large amount of leftover, nutrient-containing material.

- The use of such foods allows for a less expensive product and readily available source of raw material.
- For example, canned specialty foods (≈ 1 cent/calorie or more) may include cuts of meat commonly consumed by humans, but dry kibble (≈ 0.15 cent/calorie or less) is unlikely to contain similar ingredients.
- Moreover, some cuts of meat, such as chicken breast, may be rich in protein and amino acids but poor in other essential nutrients.
- Consequently, pet food manufacturers often include by-products, including organ meats, to provide digestible sources of vitamins and minerals.

Many natural foods incorporate similar ingredients but include specific descriptors, such as heart, kidney, or liver, to allay consumer fears regarding unknown ingredients.

**Concerned owners can avoid foods containing generic descriptors of meats or animal by-products in favor of diets with specific meats listed.**

### Packaging Terms

Pet food packaging often contains additional terms designed to specify a specific nutritional philosophy or processing method.

- **Human-grade pet food** has no legal definition, although the FDA has implied that such foods should voluntarily comply with human safety and sanitation standards.
- **Organic pet foods** should carry an organic seal from a U.S. Department of Agriculture (USDA)-approved third-party auditor until additional AAFCO recommendations are available.
- **Holistic foods** imply a philosophy of treating or nourishing the whole animal rather than any specific part; considerable overlap exists between owner interpretations of natural and holistic diets.

### Influence of Recalls

The debate over biological requirements for nutrients versus perceived quality of dietary ingredients was magnified following the extensive pet food recalls for melamine and cyanuric acid contamination.<sup>6</sup> Chinese suppliers intentionally added these compounds to wheat gluten to increase the food's nitrogen content. Nitrogen is measured to approximate dietary protein content, often the most expensive part of any food.

The large number of confirmed and suspected cases of renal failure in pets fed contaminated food resulted in:

- Owner distrust of pet food assessment based on nutritional adequacy alone
- Pet food manufacturers improving transparency of ingredient sources *or* obtaining local suppliers.

**Many owners remain wary of mainstream commercial products; veterinarians must be prepared to objectively evaluate the nutrient composition of many different commercial diets.**

### DEFINING NUTRIENT REQUIREMENTS

Nutrient requirements are based on the best available, although often incomplete, scientific literature. The requisite daily dose may be affected by the concentration of other dietary nutrients. For example, the selenium allowance for adult dogs is based on requirements for growth when the needed amount is likely much higher and the requirement may be less in diets with high vitamin E levels.<sup>9</sup>



### AGAINST THE GRAIN: SHIFTING ATTITUDES ABOUT DIETARY STAPLES

#### Owner Concerns

Many pet foods rely on grains and grain products as a source of carbohydrate and protein. However, owners commonly regard these ingredients as *fillers* despite their nutritional composition.

In addition, some clients believe grains cause or worsen allergic disease.

- A limited number of food-allergic dogs have displayed sensitivity to various grains.<sup>7</sup>
- Storage mites, a potential allergen, have been identified in dry dog foods,<sup>8</sup> but it remains unclear whether storage mites are unique to grain-containing dry kibble.
- High total fat and polyunsaturated fatty acid content of some foods may explain nonspecific effects on atopic or contact dermatitis through stabilization of the epidermal barrier or through modulation of the immune response.<sup>9</sup> Such properties may explain anecdotal reports of improvement in coat quality/sheen—a known benefit of diets high in linoleic acid.<sup>9</sup>

#### Digestibility Factors

Pet food digestibility, regardless of ingredient source, is influenced by processing, the source of raw materials, and nutrient composition. Laboratory measurement of actual digestibility requires invasive ileal catheterization.

- **Grain gluten meals**, for example, contain most of their protein within the grain and are obtained after extraction of the germ (oil), fiber, and starch. Their digestibility often exceeds 70%, a value comparable to many meat meals.<sup>9,10</sup>

TABLE 1. A SELECTION OF THE NUTRIENT PROFILES OF 3 COMMERCIAL GRAIN-FREE DIETS

Dry Diet	Major Ingredients	Protein (g/1000 kcal)	Fat (g/1000 kcal)	Carbohydrate (g/1000 kcal)
A	Deboned turkey, potato, peas	74	45	83
B	Turkey, chicken, potato	111	58	29
C	Chicken, turkey, lamb, potato	93	48	71

- **Meat meals**, generally, are slightly more digestible than grain meals; however, some rendered lamb meal provides poor amino acid digestibility—far less than that of many processed grain sources.<sup>9</sup>
- **Insoluble fiber**—found in some plant material—is the dietary ingredient with the lowest digestibility. However, grain products are not necessarily high-fiber ingredients.
- **Supplemental fiber** is often included in pet foods to alter intestinal transit, fecal moisture, or colonic motility.<sup>9</sup>
- Ingredients, such as **cellulose, beet pulp, oat fiber, and wheat bran**, reduce the digestibility of a diet, increase fecal volume, and are more likely responsible for the moniker *fillers*.

**Pros & Cons**

There are no definitive studies on advantages of grain-free foods, and no known disadvantages when compared to grain-containing foods of similar composition.

Carbohydrates, protein, and fat composition can vary greatly among grain-free foods (Table 1).

- **Carbohydrates** are not necessarily low in grain-free foods.
  - » Kibble generally requires carbohydrates for extrusion.
  - » Potato and tapioca are common replacements for grains in these foods; improper cooking of either ingredient may decrease digestibility.<sup>9</sup>
  - » After appropriate processing, though, cooked potato and tapioca are highly digestible but may cause a more immediate post-prandial glucose spike compared to other carbohydrate sources, which could affect insulin response in diabetic patients.<sup>9,11</sup>
- **Protein** provided by gluten meals in grain-containing diets is replaced in grain-free foods, in part, by protein within potato or tapioca.
  - » Additional sources of animal protein may be required to achieve adequate protein concentrations.
- **Fat** content is high in many grain-free foods.
  - » This may predispose pets to obesity (due to increased caloric density) and may also be inappropriate for dogs with chronic pancreatitis.
- **Fiber** is low in many grain-free foods, making them highly digestible.

Cost per pound is likely higher due to increased reliance on animal ingredients, but an increased caloric

density may decrease total daily cost compared to grain-containing foods.

**Further study is necessary to understand the effects of grain-free foods; consideration of the macronutrient profile should allow clinicians to better evaluate nutritional adequacy for maintenance or therapeutic purposes.**

**HOME-COOKED HEALTH?: OWNER-PREPARED PET FOOD**  
**Owner Concerns**

Some pet owners cook food for their pets due to concerns about pet food ingredient sourcing and quality; these home-cooked diets may be viewed as an alternative to raw foods. A *hybrid* home-cooked diet of commercial pet food and prepared ingredients may be fed to overcome perceived dietary deficiencies.

Advantages of home-cooked feeding cited by owners include ability to:

- Treat multiple conditions
- Provide ingredient control
- Ensure ingredient freshness
- Offer dietary variety.



The prevalence of such diets is unknown, but anecdotal information suggests they are common in oncologic practice and integrative medicine clinics.<sup>12</sup>

**Pros & Cons**

Surveys of diets designed for cancer patients and other conditions have revealed nutritional deficiencies in home-cooked diets; in particular, calcium, trace elements, vitamin D, and essential fatty acids.<sup>12</sup>

- These deficiencies are most problematic during growth and can lead to lifelong disability: nutritional secondary hyperparathyroidism and secondary osteopenia have been reported in both puppies and kittens fed unbalanced home-prepared diets.
- Clinically-significant hypocalcemia in adult dogs is less common but occurred with concurrent taurine deficiency in a recent case report.<sup>13</sup>

Home-cooked diets may be required when the patient has multiple nutrition-responsive diseases and no appropriate commercially-produced alternative exists. Some dermatologists also advocate home-cooked diets for short-term elimination trials.<sup>7</sup>

**A consultation with a board-certified veterinary nutritionist who can assess the diet provides the**

most complete dietary analysis. However, several simple strategies for improving such diets can be employed if referral is declined (Table 2).

### RAW DIETS: FIT FOR CONSUMPTION?

#### Owner Concerns

Raw diets have grown in popularity over the last decade; both home-prepared recipes and commercial options are now encountered in practice. Proponents point to improved coat quality, reduced fecal volume, reduction in allergic signs, and decreased dental calculus as well as assert that wild animals suffer less chronic disease.

#### Pros & Cons

- **High fat:** Raw diets are generally high-fat with similar potential benefits on the epidermal barrier and allergic response as those described for high-fat, grain-free foods.
- **High digestibility/low fiber:** High digestibility and low fiber content explains owner-reported reductions in fecal volume.
- **Novel proteins:** Many raw diets contain single protein sources and may be appropriate novel protein diets in select patients.
- **Food antigens:** The allergenicity of food antigens is also altered by different processing methods. A pet could conceivably react to a cooked protein and not a raw counterpart.<sup>14</sup>
- **Dental health:** Large raw or cooked bones do engage the occlusal surface of teeth, resulting in less visible calculus and perceived benefits on dental health.
  - » Benefits to bone supplementation have been shown in large felids, but low rates of calculus were tempered by high rates of periodontal disease and dental fractures in a large, isolated population of feral cats eating a diet of native birds.<sup>15,16</sup>
  - » Bones may also penetrate the oral or esophageal mucosa causing mild or significant trauma (**Figure**).
- **Disease prevalence:** A comparison of disease prevalence in wild versus domestic populations is problematic as the lifespan of wild animals is generally much shorter than captive or domesticated animals.



Figure. Right lateral radiograph of a dog with a bone foreign body (inset) in the cervical esophagus

Low-grade evidence exists for both proponents and opponents of raw diets.

Further information and trials are necessary to compare raw diets to canned or dry diets of similar nutrient composition.

• **All diets should be evaluated for nutritional adequacy** and the guaranteed analysis should be examined (see **Beyond the Guaranteed Analysis: Comparing Pet Foods**, page 43).

• **Owners should be encouraged to follow sanitary practices**, as with dry foods, and should be counseled about the risks to immunosuppressed animals or human family members.

Further information and trials are necessary to compare raw diets to canned or dry diets of similar nutrient composition.

### CARBS & CARNIVORES: CONTROVERSIES IN FELINE NUTRITION

#### Owner Concerns

Cats are carnivores (versus dogs, which are omnivores) and display a number of metabolic adaptations consistent with an evolutionary history of obligatory prey consumption.

TABLE 2. FIVE TIPS FOR IMPROVING OWNERS' HOME-COOKED DIETS

1.	<b>Offer referral for nutritional consultation;</b> a list of specialists is available at <a href="http://acvn.org">acvn.org</a> .
2.	<b>Encourage feeding of high-protein, high-fat diets</b> unless otherwise contraindicated. Dietary sources of protein and fat are required but there is no requirement for carbohydrate.
3.	<b>Encourage feeding of essential fatty acids</b> , using a fat source with both omega-3 and -6 fatty acids, such as canola oil. <ul style="list-style-type: none"> <li>• Poultry with skin attached can provide linoleic acid, an omega-6 fatty acid.</li> <li>• Plant sources of linoleic acid include sunflower and safflower oils.</li> <li>• Fish oil can provide the essential omega-3 fatty acids, EPA and DHA. A maintenance dose of 1 standard fish oil capsule per 50 lb of body weight should meet the National Research Council (NRC) recommended allowance for adult dogs.<sup>9</sup></li> </ul>
4.	<b>Encourage feeding of a human daily multivitamin</b> , feeding ¼ tablet per 25 lb of body weight. Products vary widely in composition so warn owners that excess/deficiency cannot be anticipated with any given product.
5.	<b>Encourage feeding of supplemental calcium</b> , using calcium carbonate powder or tablets or, in the case of low-protein diets, bone meal or dicalcium phosphate.

Many owners maintain that common medical conditions in cats, such as obesity, diabetes mellitus, and feline lower urinary tract disease (FLUTD), are all sequelae of feeding a diet high in carbohydrates.

### Unique Nutritional Needs

Felids do have a higher protein requirement than dogs and humans, and require taurine as an essential amino acid.<sup>9</sup> Cats also have:<sup>9</sup>

- Limited ability to downregulate gluconeogenesis compared to other species
- Greater insulin response to amino acids
- Inability to convert tryptophan to niacin or to produce arachidonic acid from linoleic acid
- Genetic mutations inactivating sweet taste receptors
- Requirement for pre-formed vitamin A.

Cats utilize glucose as a metabolic fuel either after absorption of carbohydrates or through the conversion of amino acids to glucose via gluconeogenesis. The metabolic fate of many excess amino acids from protein is ultimately glucose, a carbohydrate.

Several publications describe the dietary composition of prey-based diets.

- A white-footed mouse—a prey species of feral cats—contains approximately 70% moisture, 135 g protein, 45 g fat, and 14 g of carbohydrate per 1000 kcal.<sup>20</sup>
- This value is similar to the estimated nutrient composition of feral cat diets, which is approximately 130 g protein, 51 g fat, and 5 g of carbohydrate per 1000 kcal.<sup>21</sup>
- A recent study demonstrated that domestic cats preferentially selected a diet approximating 131 g protein, 39 g fat, and 31 g of carbohydrate per 1000 kcal when able to choose among canned diets; they reduced food intake when forced to choose

higher carbohydrate diets.<sup>22</sup>

- The NRC's recommended allowance published for cats, by contrast, is about 50 g of protein per 1000 kcal.<sup>9</sup>

### Pros & Cons

The evidence suggests that feral cats consume, and domestic cats select, a high-protein, moderate-fat, and low-carbohydrate diet.

**Carbohydrates.** The implications of feeding dry diets with higher carbohydrate concentrations are presently unknown due to conflicting evidence. Cats are known to absorb and utilize dietary carbohydrates, but some authors suggest that hepatic glucose uptake and glycogen storage may be limited.<sup>23</sup>

Noninsulin dependent diabetes mellitus in cats is primarily the result of obesity,<sup>23</sup> and no conclusive studies link high carbohydrate intake to obesity. Most cats fed energy-dense diets in liberal quantities, regardless of composition, easily exceed their average metabolic needs of approximately 200 calories per day, predisposing them to weight gain.

**Moisture.** In addition to low-carbohydrate strategies for feline diets, many veterinarians and owners advocate high-moisture diets. Some studies have shown dry diets to increase the risk of urinary obstruction or FLUTD in cats; therapeutic canned diets better prevented recurrence of urinary obstruction compared to similarly formulated kibble.<sup>9,24</sup>

Canned diets for cats contain about 80% moisture and result in relative diuresis as the water requirement for most cats is about 0.6 mL/kcal.<sup>9</sup> Higher protein diets may exert a similar effect by increasing urine volume due to the effects of urea.<sup>9</sup>

**Protein.** The cat is adapted to high dietary protein intake and, therefore, such diets are metabolically appropriate and may offer some advantages in certain situations. Further work is necessary to determine the differences in long-term feeding of high-protein versus high-carbohydrate diets.

Commercial pet foods were designed for convenience and cost effectiveness, which led to the incorporation of plant-based ingredients. **Owners desiring to feed their cats foods similar to what wild or feral cats eat can select a food that approximates the nutrient compositions listed previously.**

### FRINGE TO MAINSTREAM: NOVEL DIETARY STRATEGIES ON THE RISE

The rise in novel diets is a result of public concerns about ingredients and safety.

- Historically, pet food manufacturers and veterinary nutritionists focused on nutrient composition given that animals have nutrient, rather than ingredient, requirements.
- However, it is increasingly clear that diets of varied composition can be used for purposes of maintaining and promoting health.
- Pet food companies have responded by examining

(Continued on page 45)



### RAW FOOD CONTROVERSY

Raw foods are the most controversial of feeding practices.

The AVMA issued a statement discouraging the feeding of *any animal source protein that has not first been subjected to a process to eliminate pathogens because of the risk of illness to cats and dogs as well as humans.* Multiple publications have cultured bacteria from samples of raw diets, and *Salmonella* isolates have been identified in 6% to 20% of sample diets in various studies, with some resistant to multiple antibiotics.<sup>17,18</sup>

However, many raw diets are processed using pasteurization, freeze-drying, or dehydration and none in a small sample of these diets contained *Salmonella*.<sup>18</sup> Conclusive, rather than theoretical, evidence for specific risk to human health is lacking.<sup>17</sup> Many human infections of *Salmonella* in children have been linked to dry dog and cat foods, and most of the recent recalls were centered on dry, rather than raw, products.<sup>19</sup>

# Beyond the Guaranteed Analysis COMPARING PET FOODS

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*The guaranteed analysis found on all pet foods sold under AAFCO guidelines cannot be used to compare one pet food to another.*

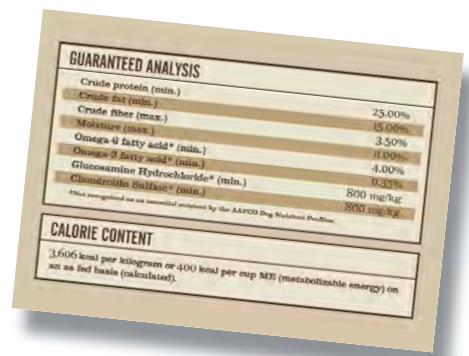
The macronutrients listed are reported as minima and maxima, instead of the actual amount typically found in the food, and values listed are a percentage of weight as-fed. Diets vary in moisture and fiber content, creating differences in the number of calories per unit of weight (caloric density).

Pets are fed by calorie, not by weight, so comparisons should ideally be expressed in the amount of a particular

nutrient per calorie.

- Typical content of protein and fat can be estimated by adding 1.5% to the protein minimum and 1% to the fat minimum.<sup>1</sup>
- This information can be subsequently used to determine grams of protein and fat per 1000 kcal—the preferred unit for pet food comparison.<sup>2</sup>

Any 2 pet foods can be accurately compared when the caloric basis is either calculated as described (Table 1) or:



- Obtained from manufacturers or via consultation services
  - Found online or in product guides.
- A general comparison tool for commercial pet foods is provided along with the suggested dietary concentrations established by a research panel (Table 2).<sup>2</sup> An example is provided that illustrates the method of comparison using the labels from 2 commercial products (Table 3).

**TABLE 1. STEP BY STEP: ESTIMATING NUTRIENT CONCENTRATION ON A CALORIC BASIS**

<b>Step 1</b>	<ul style="list-style-type: none"> <li>• Add 1.5% to protein percentage from pet food label</li> <li>• Add 1% to fat percentage from pet food label</li> </ul>
<b>Step 2</b>	Divide kcal/kg by 10,000
<b>Step 3</b>	Divide estimated protein % and fat % by number obtained in Step 2

**TABLE 2. COMPARISON OF PET FOODS BY CALORIC BASIS**

Canine Diets	NRC RA* (g/1000 kcal)	Low (g/1000 kcal)	Moderate (g/1000 kcal)	High (g/1000 kcal)
<b>Protein</b>	25	< 60	60–90	> 90
<b>Fat</b>	13.8	< 30	30–50	> 50
<b>Carbohydrate</b>	n/a	< 50	50–90	> 90
Feline Diets	NRC RA* (g/1000 kcal)	Low (g/1000 kcal)	Moderate (g/1000 kcal)	High (g/1000 kcal)
<b>Protein</b>	50	< 80	80–120	> 120
<b>Fat</b>	22.5	< 40	40–60	> 60
<b>Carbohydrate</b>	n/a	< 35	35–70	> 70

\*National Research Council recommended allowance<sup>2</sup>

**TABLE 3. CONVERSION OF GUARANTEED ANALYSES + COMPARISON OF TWO COMMERCIAL DOG FOODS**

Ingredient	PET FOOD 1 (DRY)	PET FOOD 2 (WET)
<b>GUARANTEED ANALYSIS</b>		
<b>Crude protein (min)</b>	25%	8%
<b>Crude fat (min)</b>	15%	5%
<b>CALORIE CONTENT</b>		
<b>kcal/kg</b>	3606	1198
<b>CONVERSION</b>		
<b>Protein</b>	<ol style="list-style-type: none"> <li>1. 25% + 1.5% = 26.5%</li> <li>2. 3606 kcal/kg / 10,000 = 0.3606</li> <li>3. 26.5 / 0.3606 = <b>74 g/1000 kcal</b></li> </ol>	<ol style="list-style-type: none"> <li>1. 8% + 1.5% = 9.5%</li> <li>2. 1198 kcal/kg / 10,000 = 0.1198</li> <li>3. 9.5 / 0.1198 = <b>79 g/1000 kcal</b></li> </ol>
<b>Fat</b>	<ol style="list-style-type: none"> <li>1. 15% + 1% = 16%</li> <li>2. 3606 kcal/kg / 10,000 = 0.3606</li> <li>3. 16 / 0.3606 = <b>44 g/1000 kcal</b></li> </ol>	<ol style="list-style-type: none"> <li>1. 5% + 1% = 6%</li> <li>2. 1198 kcal/kg / 10,000 = 0.1198</li> <li>3. 6 / 0.1198 = <b>50 g/1000 kcal</b></li> </ol>
<b>FINAL RESULT</b>	<b>Moderate protein / moderate fat</b>	<b>Moderate protein / high fat</b>

**References**

1. Hill RC, Choate CJ, Scott KC, et al. Comparison of the guaranteed analysis with the measured nutrient composition of commercial pet foods. *JAVMA* 2009; 234(3):347-351.
2. National Research Council Ad Hoc Committee on Dog and Cat Nutrition. *Nutrient Requirements of Dogs and Cats*. Washington, DC: National Academies Press, 2006.

This information can be downloaded and printed for use in your practice at [todaysveterinarypractice.com](http://todaysveterinarypractice.com).