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NUTRITIONAL MANAGEMENT OF CHRONIC ENTEROPATHIES: WHAT DIET IS BEST?

Valerie J. Parker, DVM, DACVIM (SAIM, Nutrition)

The Ohio State University

Columbus, OH, USA

Defining chronic enteropathies

An animal that presents with at least a 2-week history of vomiting and/or diarrhea may be diagnosed with a chronic enteropathy. By definition, the disease stems from a primary gastrointestinal disease. Other known primary gastrointestinal disorders as well as secondary causes of vomiting and diarrhea must be excluded (Table 1) prior to making this diagnosis. The diarrhea should be characterized as small bowel, large bowel, or mixed bowel in origin, as this may influence diagnostic and therapeutic options. A minimum database (CBC, biochemistry profile, urinalysis), fecal examination and abdominal imaging (e.g., radiographs, ultrasound) are typically recommended. Depending on these results, additional diagnostics may be warranted [e.g., cobalamin (vitamin B₁₂), folate, trypsin-like immunoreactivity (TLI), resting cortisol +/- ACTH stimulation test]. A review of laboratory tests for diagnosis of chronic canine and feline enteropathies is described elsewhere.¹

Table 1. Primary and secondary causes of vomiting and/or diarrhea.

Primary gastrointestinal disorders	Secondary gastrointestinal disorders
Inflammatory bowel disease	Pancreatitis
Lymphangiectasia	Exocrine pancreatic insufficiency
Food intolerance, food allergy	Hypoadrenocorticism (Addison's disease)
Foreign body obstruction	Hyperthyroidism
Dietary indiscretion	Hepatic disease
Infectious diarrhea	Kidney disease
Toxin	Neoplasia
Neoplasia	Neurologic disease

Inflammatory bowel disease

Inflammatory bowel disease (IBD) is a chronic enteropathy characterized by mucosal infiltration of inflammatory cells. It is typically classified by the predominant inflammatory cell(s); lymphocytic-plasmacytic inflammation is most commonly diagnosed. The etiology of IBD is multifactorial with genetic, dietary and immunologic factors potentially playing a role. IBD is an umbrella term that envelops a few chronic enteropathies, including food-responsive disease, antibiotic-responsive disease, and immunomodulatory-responsive disease. A histopathologic diagnosis of IBD does not necessarily dictate how an individual animal will respond to therapy. As such, with stable patients, a step-wise management approach is recommended in order to assess the animal's response to one therapy at a time.

Therapeutic options may include a diet trial, fiber supplementation, modification of the intestinal microbiome, and immunomodulatory medications (e.g., corticosteroids, cyclosporine, etc.). Nutritional management of IBD is discussed below. Fiber supplementation may prove useful, especially for animals that present with a component of large bowel diarrhea.² In some cases, only

the addition of soluble fiber (e.g., psyllium) is necessary to resolve the diarrhea. Similar to the effects of fermentable fiber in the intestine, prebiotics (e.g., inulin, fructooligosaccharides) may also be of benefit by increasing short chain fatty acid production and influencing intestinal flora. There is likely a role for probiotics in cases of chronic enteropathies; however, veterinary data is limited and we must rely for now upon empirical data. Caution must be exercised when recommending specific brands of probiotics as there is variable quality control among supplements. One study that evaluated labels and bacterial contents of 25 commercial probiotics marketed for use in animals revealed that only 2 of 25 products had acceptable labels that accurately described their contents.³

Lymphangiectasia

Lymphangiectasia is a common form of protein-losing enteropathy (PLE), characterized by intestinal villus lacteal dilation and subsequent luminal loss of chylous fluid. Lymphangiectasia may be classified as a primary idiopathic disease or secondary to inflammatory or neoplastic conditions. Definitive diagnosis requires intestinal biopsies; however many cases are diagnosed presumptively based on classic signalment (e.g., Yorkshire Terrier), physical examination findings (e.g., ascites), clinicopathologic findings (e.g., panhypoproteinemia, hypocalcemia, hypocholesterolemia) and diagnostic imaging (e.g., ultrasonographic intestinal mucosal striations).⁴

Animals with primary idiopathic lymphangiectasia may be successfully managed with nutritional modification as a sole therapy.⁵ The primary nutritional focus is to feed a low-fat diet. When comparing diets, it is most useful to assess nutrients per caloric concentration (i.e., grams fat per 100 kcal) versus the percent listed on the guaranteed analysis. This eliminates the effects of dry matter content and caloric concentration. In cases of lymphangiectasia secondary to inflammation, additional dietary and/or medical modifications may be necessary.

Food intolerance & food allergy

A food allergy is an immune-mediated reaction, whereas food intolerance is a non-immunologic reaction (Figure 1). Food allergy typically presents with dermatologic clinical signs (non-seasonal pruritus), gastrointestinal signs or both. The most commonly reported canine and feline food allergens are beef, dairy, chicken, and wheat, and beef, fish, and chicken respectively.^{6,7,8} Food intolerances may be due to a number of factors (e.g., food additive, Maillard reaction). Oftentimes no single, specific dietary component is identified.

A definitive diagnosis of food intolerance requires 1) feeding an elimination diet (e.g., novel protein diet, hydrolyzed diet) for several weeks (minimum 3 for gastrointestinal signs, longer for predominantly dermatologic signs); 2) seeing good improvement in clinical signs; and 3) rechallenging the animal with its original diet to see if there is a relapse. However, even this does not definitively diagnose food intolerance as the animal may be responding to a variety of dietary factors (e.g., increased digestibility, decreased fat concentration, fiber modification).

Diagnosing a true food allergy is even more challenging. There is no easy test to perform. Despite their appeal, serologic titers are fairly useless. After an elimination diet is fed and a response is noted, the animal should be challenged with one ingredient at a time in order to document the food(s) to which the animal reacts (e.g., intense pruritus). If there is no response to a diet trial, or only a partial response, a few factors must be considered: 1) the animal has atopic dermatitis (or concurrent allergies); 2) lack of owner (or pet) compliance; 3) the diet was not truly novel or it was contaminated.

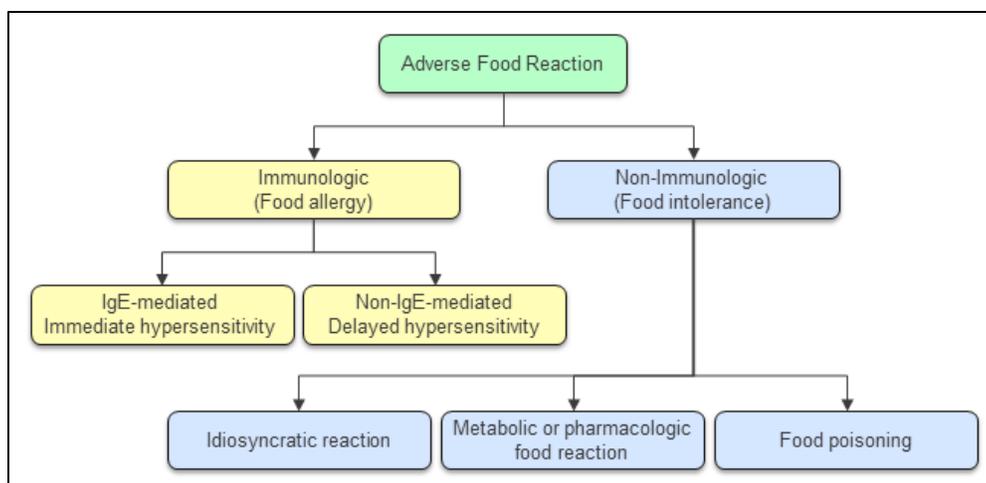


Figure 1. Characterization of adverse food reactions. Adapted from Roudebush, et al. 2010.

Nutritional Management

Various nutritional approaches may be taken in the management of chronic enteropathies.⁹ The underlying etiology may influence which approach is attempted first. It is important to let clients know that management of chronic enteropathies often entails a bit of trial and error as there is no single diet that will be best for every pet. Additionally, while dietary management may completely resolve the clinical signs, many animals will rely upon some combination of dietary and medical therapy.

Every animal with chronic enteropathy may respond a bit differently to dietary therapy. Various dietary approaches may be considered for pets with FRE including: 1) highly digestible diets; 2) limited antigen diets: either novel protein/limited ingredient diets or hydrolyzed diets; 3) low to ultra-low fat diets (dogs specifically), and 4) fiber-enriched diets. In some animals, a home-cooked diet may be recommended.

For dogs with lymphangiectasia, dietary management with a low-fat or ultra-low-fat diet is typically effective. If there is concurrent inflammation, a novel ingredient or hydrolyzed diet may be preferable. For others, sometimes simply addressing the fiber concentration of the diet may improve clinical signs. For animals with concurrent hypcobalaminemia, parenteral cobalamin (vitamin B₁₂) supplementation should be provided. Recommendations for cobalamin supplementation can be found elsewhere.¹⁰

Novel ingredient diet

By definition, a novel ingredient diet should provide both novel protein and novel carbohydrate food sources. These diets may also be known as “limited ingredient” diets, meaning they use only one protein and one carbohydrate source. These diets exist in both veterinary therapeutic and over-the-counter (OTC) forms. Studies have revealed that many limited ingredient canine diets were contaminated with proteins that were not listed in the ingredient list.^{11,12} For this reason, it may be recommended to feed a veterinary therapeutic diet for the initial diet trial. Pending the response to the diet trial, switching to an OTC diet may be attempted. Despite several diets having similar ingredients, their nutrient profiles may be quite variable (e.g., variable caloric, protein, fat concentrations). Thus, in choosing a novel ingredient diet, the veterinarian should consider the whole nutrient profile to determine which diet best suits the individual animal’s needs.

Prior to choosing a limited ingredient diet, it is important to get a complete diet history so that it is clear which ingredients (proteins and carbohydrates) the animal has eaten in the past. Given the fact that many OTC diets are now routinely using what were previously considered “novel” ingredients (e.g., potato, venison, fish), there may not be any truly novel ingredient commercial diets available. In those cases, another diet option may be preferable (e.g., hydrolyzed diet). Alternatively, reducing antigen delivery to the intestinal tract may still provide some benefit even if the diet is not truly novel.

Hydrolyzed diet

Hydrolyzed diets rely upon using proteins that have been broken into small polypeptides. By disrupting the protein structure, the goal is to prevent immune recognition of proteins by the intestinal tract, thus reducing allergenicity. These diets tend to be highly digestible and typically are low-moderate in fat concentration. Currently hydrolyzed diets are only available as veterinary therapeutic diet options. Some of these diets do provide intact carbohydrate sources (e.g., rice, potato); in rare cases, this may incite a reaction. One randomized, positively controlled study compared the efficacy of a hydrolyzed diet to a highly digestible diet in dogs with adverse food reactions. There was no difference in the initial response rate between groups; however long-term remission was better for the dogs fed the hydrolyzed diet.¹³

Highly digestible diet

Several veterinary therapeutic diets have been formulated to be specifically highly digestible (~90%). These diets typically have a low-moderate fat concentration and use highly digestible ingredients. They provide variable fiber concentrations, usually with mixed soluble & insoluble sources. These diets are not meant to be novel ingredient or hydrolyzed; however they may be a reasonable option for owners who cannot feed one diet exclusively. If fat is the primary nutrient of concern, there are specific diets with very low fat concentrations (1.7-2.3 grams fat per 100 kcal). It is important to remember that dry and canned formulations of the same diet may have different nutrient profiles. Dietary fat concentrations do not appear to be an important factor in management of cats with chronic diarrhea.¹⁴

Home-prepared diet

While there is no inherent benefit to feeding a home-prepared diet in most cases, some people may prefer to feed a home-prepared diet. Most recipes found online or in books do not provide complete and balanced nutrition;¹⁵ thus, a board-certified veterinary nutritionist should be consulted if an owner wants to feed a home-prepared diet. A home-prepared diet may be formulated to be a novel ingredient diet and most home-prepared diets have excellent digestibility. In some cases of profound fat intolerance (e.g., severe protein-losing enteropathy), a home-prepared diet may be required to control the animal’s clinical signs and maintain the serum albumin. There is anecdotal evidence that ultra-low-fat diets may be able to normalize blood proteins even when commercial low-fat diets cannot. If this is the route chosen for dietary management of a chronic enteropathy, the importance of consulting with a veterinary nutritionist cannot be overemphasized. Clients should be aware that feeding home-cooked diets may not provide financial benefit in most cases.¹⁶

So Which Diet Should I Choose?

This is the million dollar question! Unfortunately every animal is different and there is no best diet. Client and pet preferences should be taken into account in order to have the best compliance. Nutrient profiles of the various diets should be compared to see which option seems most appropriate. Good client communication is imperative so that owners do not get frustrated if they do not see immediate results. Animals should be reassessed regularly and therapy should be amended as needed. Most cases require tweaking of both nutritional and medical therapy to achieve the best results.

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NUTRITIONAL MANAGEMENT OF LIVER DISEASES IN DOGS AND CATS

Valerie J. Parker, DVM, DACVIM (SAIM, Nutrition)
Professor – Clinical
The Ohio State University

LIVER DISEASE

The liver is a complex organ that can be affected by a wide variety of disease processes. The World Small Animal Veterinary Association (WSAVA) has proposed that diseases be characterized into one of the following groups: 1) vascular disorder; 2) biliary tract disorder; 3) parenchymal disorder (including stellate and Kupffer cells); and 4) neoplasia.¹ An animal's history, clinical signs and physical examination will vary by its specific liver disease. While many clinical signs associated with liver disease are non-specific, certain breed predispositions may be the first clue pointing to disease. Some clinical syndromes are associated with liver disease including gastrointestinal ulceration, hepatic encephalopathy, icterus, coagulopathies and ascites.² Clinicopathology will vary by disease process. A review of a laboratory diagnostic approach to hepatobiliary disease can be found elsewhere.³ It is imperative to realize that elevated liver enzymes do not determine liver function. Values on a chemistry profile that may suggest liver dysfunction include hypoalbuminemia, decreased blood urea nitrogen (BUN), hypocholesterolemia and hypoglycemia. Liver function may be assessed by serum bile acids and blood ammonia.

Portosystemic shunt

Portosystemic shunts (PSS) would be an example of a vascular disorder affecting the liver. They can be either congenital or acquired, with acquired shunts more likely to develop secondary to portal hypertension. Shunts can be classified as either extrahepatic or intrahepatic. Congenital extrahepatic PSS are typically seen in small toy breed dogs (e.g., Yorkshire Terrier) while intrahepatic PSS are more commonly seen in large breed dogs (e.g., Irish Wolfhound). Clinical signs may range from mild (e.g., small stature) to severe (e.g., seizures). Clinicopathologic abnormalities typically associated with PSS include microcytosis and decreased BUN. Up to half of animals with PSS will exhibit hypoalbuminemia and mildly increased liver enzymes. Ammonium biurate crystalluria or urolithiasis may be observed. With severe cases, there will be additional evidence of liver dysfunction (e.g., hypocholesterolemia, hypoglycemia, prolonged clotting times). Serum bile acids and/or blood ammonia are typically abnormal. Definitive diagnosis of PSS is made either by visualizing an abnormal vessel on abdominal ultrasound, rectal scintigraphy, portal venography or computed tomography angiography. Whether or not specific nutritional management is necessary depends almost entirely on the presence or absence of hepatic encephalopathy (HE). The presence of a shunt without abnormal neurologic function does not necessarily warrant specific dietary modification. Additional information is presented below.

Copper-associated hepatopathy

Copper-associated hepatopathy (CAH) is a form of parenchymal disease characterized by excessive copper accumulation in hepatocytes. Several dog breeds are predisposed to developing CAH, including the Bedlington terrier, Doberman pinscher and Labrador retriever. The hepatic copper accumulation causes inflammation which leads to fibrosis and can ultimately result in cirrhosis. Although abnormal hepatic copper accumulation may begin by one year of age, it may

take several years to clinically manifest. Clinical signs may range from none to those consistent with hepatic dysfunction and HE. Mild-to-severe increased concentrations of alanine aminotransferase (ALT) may be noted on a chemistry profile. Diagnosis of CAH requires histopathologic evaluation of the liver. To be most exact, specific quantification of copper concentration should be made, as opposed to qualitative stain evaluation. The copper concentration observed in dogs with primary CAH is greater than the increased copper concentration typically associated with cholestasis. Based on the degree of copper accumulation, treatment of CAH may include the use of chelating agents (e.g., D-penicillamine). Dietary management of CAH entails feeding a reduced copper diet. There is likely a role for zinc, either as a primary chelating agent and/or as a dietary supplement.⁴

Hepatic lipidosis

Hepatic lipidosis (HL) is a form of parenchymal disease characterized by excessive accumulation of triglycerides in hepatocytes. This lipid accumulation, which develops as a consequence of anorexia and hormone-mediated lipolysis, typically induces cholestasis and can ultimately lead to liver failure. Obesity seems to be a predisposing factor to the development of HL. Anorexia is the most common clinical sign reported; icterus may be noted. A presumptive diagnosis may be made based on history, clinical signs, biochemical and diagnostic imaging findings. Definitive diagnosis requires either cytologic or histologic confirmation. A fine-needle aspirate may miss an underlying disease process (e.g., cholangiohepatitis, neoplasia).⁵ Medical therapy should address any underlying disease process when present. Supportive care may include fluid and electrolyte therapy, anti-emetics and hepatoprotectants. Nutritional management of HL is of the utmost importance to halt the animal's catabolic state and prevent further lipolysis. These animals are often anorectic and assisted enteral nutritional support is typically indicated. Detailed techniques for tube placement and dietary options for assisted enteral nutrition can be found elsewhere. Protein restriction should only be considered in cases when HE is present to avoid contributing to further loss of lean body mass.

Hepatic encephalopathy

Hepatic encephalopathy is defined as an abnormal mental state caused by liver dysfunction and accumulation of neurotoxins (e.g., ammonia, benzodiazepine-like substances, aromatic amino acids). This disorder can be further categorized into one of three types (A, B, C) depending on the underlying liver disease. Factors that may precipitate formation of HE include excessive dietary protein intake, gastrointestinal bleeding and the use of medications that require hepatic metabolism.⁶ While there is no definitive diagnostic test for HE, clinical suspicion should be increased in animals with neurologic deficits and liver dysfunction. Specific liver function tests include measurement of fasting ammonia and serum bile acids. Diagnostic imaging may further support the diagnosis of HE (e.g., ultrasonographic visualization of PSS). Treatment of HE should aim to address any predisposing factors. The mainstay of medical therapy entails the use of lactulose and antibiotics (e.g., neomycin, metronidazole). This is the primary form of liver disease where protein restriction should be considered. In addition to the amount of protein fed, the source of the protein should be considered.

NUTRITIONAL MANAGEMENT OF LIVER DISEASE

As previously mentioned, the liver is a complex organ that can be affected by a wide variety of disease processes. Thus, to say that all liver diseases should be nutritionally managed with one

type of diet is a bit presumptuous. Here we will consider each of the above diseases as its own entity in order to appropriately discuss nutritional management. First we should review what exactly is meant by the term “liver diet.”

What makes a “liver diet” a liver diet?

There are two diets specifically marketed as “liver diets” – Hill’s Prescription Diet I/d and Royal Canin Hepatic. These diets have been modified in several ways to set them apart from other commercially available diets. These diets tend to provide less protein than typical canine and feline maintenance diets. While the specific formulations do vary by specific product, the protein sources tend to be higher in soy, egg and vegetable proteins versus meat-based proteins. The rationale for the reduced protein concentration as well as the source of proteins is that higher dietary protein, and meat-based sources, may be more likely to induce HE. In one study that evaluated dogs with congenital PSS, those fed a soy-based diet exhibited less ammonia production than dogs fed a control chicken-based diet with similar dietary total protein concentration (approximately 4 grams protein per 100 kcal). A reduction in HE score was achieved using both reduced protein diets.⁷

These diets are also reduced in copper concentration. As a reference, the canine liver diets provide approximately half of the minimum AAFCO requirement for adult maintenance. Most over-the-counter canine diets provide at least 4-6 times the amount found in these liver diets. Additional nutrients that may be modified in a liver diet include: 1) reduced sodium to avoid contributing to formation of portal hypertension and subsequent ascites; 2) increased zinc to reduce intestinal copper absorption; 3) added soluble fiber to reduce colonic ammonia production and absorption; 4) increased L-carnitine to potentially aid in fatty acid oxidation; 5) added antioxidants. As this list illustrates, many of these nutrient modifications span across various forms of liver disease.

When should I use a liver diet?

Above all else, every animal should be evaluated as an individual when choosing the most appropriate diet to feed it. The animal’s overall health status should be considered, including its body composition and comorbidities, as well as its current diet, including primary diet, treats, supplements, medications and foods used to administer medications. Once that has been determined, nutritional goals can be established and specific nutrients of concern can be modified as deemed appropriate.

Animals with PSS can vary tremendously in their clinical signs and extent of HE. In asymptomatic animals or those that are not exhibiting evidence of HE, there is no good reason to restrict their protein intake, especially since many of those affected with PSS are young, growing animals. Protein restriction may contribute to protein-energy malnutrition and loss of lean body mass. Taking the animal’s life stage into account, there are nearly an unlimited number of appropriate commercial diets that can be fed. In many instances, no specific dietary change is even necessary. For animals that are eating high-protein diets when diagnosed, it may be worth transitioning them to more moderate-protein diets. Commercially available canine maintenance diets range from approximately 4.8 grams protein per 100 kcal to over 14.0 grams protein per 100 kcal. Given that AAFCO minimum for canine maintenance is 4.5 grams protein per 100 kcal, aiming for a diet that provides approximately 4.8-6.0 grams protein per 100 kcal is reasonable. Adjustments may be necessary pending the animal’s response to therapy.

For dogs with primary CAH, feeding a diet reduced in copper is absolutely warranted. The Hill’s Prescription Diet I/d and Royal Canin Veterinary Diet Hepatic diets are the lowest in copper concentration; however, additional research is needed to determine if there is an optimal amount

of dietary copper restriction that will achieve stabilize disease. There is a wide range of copper concentrations in commercially-available diets (approximately 0.2-1.0 mg/100 kcal), so it may be possible to achieve a significant reduction in dietary copper depending on the individual animal's starting point.

For cats with uncomplicated hepatic lipidosis, the use of a long-term feeding tube (i.e., esophagostomy or gastrostomy tube) is typically indicated. Canned "critical care" diets are usually good choices to be fed as they are calorically dense and easily administered via large-bore feeding tubes. They do vary in their specific nutrient profiles; thus, depending on comorbidities, one diet might be most appropriate. When HE is present, the lowest protein critical care diet may still be appropriate. Alternatively, a liver-specific diet may be chosen.

What other diets might be appropriate for animals with liver disease?

Hopefully it is becoming clear that not all liver diseases warrant the exact same nutritional management. Some commercial diets that are not specifically marketed for dogs with liver disease have appropriate protein concentrations and sources of protein for dogs with HE. Without feeding excessive protein, we should aim to feed as much protein as is tolerated. It is not recommended to feed a diet designed for kidney disease to dogs with HE as these diets tend to be lower in protein than the liver diets and typically provide more meat-based protein ingredients. It is important to remember that dry and canned versions of the same diet may have significantly different nutrient profiles.

Owners may inquire about feeding a home-prepared diet to an animal with liver disease. Since most recipes for home-prepared diets found online and in books do not provide complete and balanced nutrition,⁸ owners are strongly encouraged to seek a veterinary nutritionist's assistance in preparing an appropriate diet for the pet. Owners may request home-prepared diet recipes from www.balanceit.com or by contacting a veterinary nutritionist from the American College of Veterinary Nutrition Diplomate directory at www.acvn.org/directory.

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OBESITY PREVENTION & MANAGEMENT

Valerie J. Parker, DVM, DACVIM (SAIM, Nutrition)

Professor - Clinical

College of Veterinary Medicine

The Ohio State University

Columbus, OH, USA

THE PROBLEM

Approximately 59% of dogs and cats are overweight; this is the most diagnosed nutritional disorder in veterinary practice. Overweight is defined as having a body condition score (BCS) >5/9 or >3.5/5 on the 9-point or 5-point scale, respectively. An animal is typically considered obese if it has a BCS of $\geq 8/9$. On the 9-point BCS scale, each point over 5/9 is associated with approximately 10% excess weight (**Table 1**). Thus, a dog with a BCS of 7/9 would be estimated to be 20% overweight.¹

THE CONSEQUENCES

Obesity can have a variety of negative consequences. Excess adipose tissue is not an inert substance. It is a source of inflammatory cytokines that can lead to a state of chronic inflammation. Overweight and obesity are associated with skin and respiratory disorders. Excess weight is associated with an increased risk of metabolic disorders (e.g., diabetes mellitus), orthopedic disease, and certain neoplasms. Perhaps most importantly, excess weight can adversely affect longevity and quality of life.¹

THE SOLUTION

Prevention

The best way to manage obesity is to prevent it! This means addressing a new pet's weight from the first wellness visit and discussing it at every visit thereafter. As recommended by the American Animal Hospital Association (AAHA), every animal should undergo a nutritional assessment at each visit to the veterinarian, including a body weight, BCS, and muscle condition score (MCS). A complete diet history should be obtained, including primary diet, treats (i.e., snacks), chew toys, table foods, and foods used for medication administration. Any animal found to be too thin or overweight or with muscle wasting should undergo an extended evaluation.²

Growth

Puppies and kittens should be fed diets until at least 1 year of age that meet their nutritional requirements for growth. These are diets that have Association of American Feed Control Officials (AAFCO) statements that specify that they are appropriate either for growth or for all life stages. Owners should be instructed to feed their pets to an ideal body weight and BCS (4–5/9). Feedings may need to be adjusted after neutering as energy requirements will decrease. If a young animal is gaining too much weight, options include:

1. Switching it to a lower calorie diet still appropriate for growth;
2. Reducing or eliminating other sources of calories;
3. Increasing caloric expenditure (i.e., exercise);
4. Maintaining the current intake until the animal “grows through” it.

It is important not to transition a puppy or kitten to a diet meant for adult maintenance before it has reached skeletal maturity to avoid contributing to nutritional deficiencies. This is typically when the animal has reached approximately 80% of its adult weight. Monitoring a growing animal's weight and BCS is especially important in animals prone to obesity or animals with low energy expenditure. In addition, large and giant-breed dogs should be kept lean (BCS 4/9) to avoid contributing to developmental orthopedic disease, keeping in mind that genetics play a large role in this.

MANAGING OBESE PATIENTS

The First Step

The first step is to admit that there is a problem. An animal may become overweight or obese for a number of reasons. One instance would be due to an owner's unawareness of caloric density of a diet or treats. Another instance could be summarized with the notion "food is love," and a subsequent overindulgence in food as a sign of affection for one's pet. To effectively manage an overweight patient, there are several crucial factors to consider, including animal-specific and owner-specific factors. Examples of animal-specific factors include comorbid medical conditions and diet preferences (e.g., dry versus canned). Owner-specific factors are variable, for instance an owner's predetermined feelings toward certain diets, ingredients, or treats. A weight loss management plan hinges on an owner's dedication and commitment, so it cannot be overemphasized how critical good client communication is to succeed in effectively managing a weight loss program for an overweight animal.

Assessing the Animal

In order to come up with a plan, we must know our starting point. This includes getting an accurate current body weight, BCS, and MCS. From that, or using historical data, the animal's estimated ideal body weight should be determined. This may be the animal's weight at 1 year of age. Published breed standards may be helpful; however, each animal is an individual and these standards may not apply to all animals. Using the guideline of 10% body weight per BCS score can be utilized to estimate the animal's ideal body weight that would correlate with a BCS of 5/9. For example, let's consider a mixed-breed dog that presents with a body weight of 45 pounds and a BCS of 8/9. Estimating that the dog is approximately 30% overweight (**Table 1**), we would estimate that its ideal body weight would be $[45 - (45 \times 0.3)]$ or $45 \times 0.7 = 31.5$ pounds. This weight can then be used in calculations for determining a starting point for daily caloric needs.

Assessing the Diet

The next step is to get a thorough diet history, including the specific brand(s) and flavor(s) of the animal's primary diet, treats, table foods, and foods used for medication administration. Brief diet history forms can be found on the World Small Animal Veterinary Association (WSAVA) Nutrition Toolkit website. This allows for an estimation of the animal's total daily caloric intake. It also can aid in determining what percentage of the animal's diet is coming from treats and other foods. Whenever treats or other foods that do not provide complete and balanced nutrition exceed 10% of an animal's total daily intake, there is risk of nutritional deficiencies. When performing this nutritional assessment, it is important to gauge which (if any) treats or foods are most important for

an owner to be able to continue giving so that they can ultimately be worked into the nutritional plan.

THE WEIGHT LOSS PLAN

Caloric Intake

Once the animal and its diet have been assessed, it's time to crunch some numbers to calculate a starting caloric goal for the animal. If the animal's diet history allows for an accurate estimation of daily caloric intake, a certain % reduction in that calorie amount can be used as a starting point for daily caloric intake. For example, if an animal is 10% overweight, then reducing its total daily caloric intake by 10% is reasonable. Some animals may require a reduction in caloric intake of upwards of 40% to 50%. If that is not possible, then there are several other equations published for how to get started. I recommend calculating the resting energy requirement (RER) for the animal's estimated ideal body weight. The equation for RER is $70 \times BW_{kg}^{0.75}$. For animals weighing 2-25 kg, a linear equation can be used: $30 \times BW_{kg} + 70$. This equation will overestimate caloric needs for larger animals. Regardless of which calculation is used, it is important to realize that this is just a starting point; some overweight animals may already be eating close to those calculated amounts and further caloric restriction will be required to achieve weight loss.

Treat Allowance

Treats should be kept $\leq 10\%$ of the animal's total daily intake to avoid unbalancing the animal's diet. In addition to the obvious commercial treats given, this allowance includes any table foods given, dental chews, and foods used to administer medications. For animals that require severe caloric restriction to promote active weight loss, it may be safer if the treat allowance is kept to $\leq 5\%$ of the animal's total daily intake. It is best to use the owner's and pet's preferences for treats when establishing a few good choices. Giving several treat choices allows the owner some flexibility in an otherwise precise diet plan. Commercial treats range tremendously in caloric concentration, from 2 kcal per treat to over 1,000 kcal/treat! Thus, each treat should be assessed for its caloric concentration.

Choosing a Weight Loss Diet

Whether to feed a veterinary therapeutic diet or an over-the-counter diet depends on a few factors: 1) the individual animal's starting caloric intake; 2) degree of obesity; and 3) owner preference, for which cost certainly may be a consideration. If it is determined that the animal has simply been receiving an exorbitant excess of calories, it may be appropriate to use any lower calorie diet and reduce the animal's total caloric intake. If the animal needs to be restricted much below what a manufacturer's recommendations for feeding are, however, this can potentially increase the risk of nutritional inadequacies. In these cases, or when animals are very obese, it is typically recommended to use a specific veterinary therapeutic diet. These diets have been formulated to be low in calories but high in nutrients to avoid contributing to any nutrient deficiencies.

The range of caloric density of commercially available dog and cat diets is extremely broad. One cup of food can range from approximately 200 kcal up to 600 kcal. Owners might think they are getting lower calorie options by choosing diets that are marketed for

healthy weight or weight management. In one study evaluating diets marketed for weight loss in dogs and cats, however, the caloric density in the canine dry diets ranged from 217 to 440 kcal/cup; the range for feline dry diets was 235 to 480 kcal/cup. Similar variability was noted for the canned diets. The only terms that specifically refer to caloric concentration are “light,” “lite,” and “low-calorie.” For dry diets, these terms require that a canine diet provide no more than 3,100 kcal/kg and a feline diet no more than 3,250 kcal/kg. There are no specific guidelines for kcal per volume of a diet.³

Macronutrient Composition

One of the most important nutrients to consider is choosing a weight loss diet is the protein concentration. Consuming adequate protein has been shown to aid in the maintenance of lean body mass (i.e., muscle) during weight loss.⁴ Considering protein on a gram per 100 kcal basis, and assuming no other comorbid conditions, cats should be fed diets with at least 8.9 grams protein per 100 kcal and dogs should be fed diets with at least 6.0 grams protein per 100 kcal to provide absolute minimum protein requirements. Most veterinary therapeutic diets designed for weight loss provide significantly more than this minimum. If caloric restriction greater than 80% of RER for ideal body weight, then higher concentrations of protein are required.¹

An easy way to reduce calorie density is to reduce dietary fat as fat provides 2.25 times the number of calories per gram than do protein or carbohydrates; however, not all low-fat diets are low in calories. Thus, assumptions about a diet’s caloric density should not be based on its fat concentration. There is a notion that feeding a low-carbohydrate diet will aid in weight loss. This statement must be interpreted with caution as low-carbohydrate diets can vary tremendously in their caloric concentrations. The feline veterinary therapeutic low-carbohydrate dry diets designed for management of diabetes mellitus have among the highest calorie concentrations of all commercially available diets, providing approximately 500 to 600 kcal/cup. Diets high in insoluble fiber often have lower calorie concentrations. Feeding a diet high in insoluble fiber allows an animal to eat a greater volume of food and may help with owner and pet compliance. It should be pointed out that the crude fiber concentration listed on pet food labels only provides a rough estimate of the diet’s insoluble fiber; it does not account for the soluble fiber in the diet. If recommending a diet high in insoluble fiber for weight loss, owners should be informed that increased frequency of defecation and stool quantity may be noted.

Another strategy to aid in weight loss is feeding a diet with a higher water concentration (i.e., canned diet). One study showed that feeding cats canned diets ad libitum decreased voluntary intake. Anecdotally, some clients report that this helps their pets feel more satiated⁵; however, this may be cost-prohibitive in larger animals. If dry food is being fed, an owner could try adding water to the kibble if the animal tolerates it.

Simply stated, there is no single best diet for every overweight animal. Taking all of the above factors into consideration, it is usually best to discuss a few options with the owners and allow them to have a say in decision.

Exercise

If the animal is able to exercise, this can aid in weight loss. This may be easier for some people and their pets than others. Even a few minutes walking each day can be beneficial, not only in expending calories but also in helping to maintain lean muscle mass. Even meal time can be used as a time for energy expenditure. For food-motivated animals, kibble can be tossed for the animal to retrieve. Meals can be fed in food-dispensing toys to stimulate the animal's mind and to slow down an animal that gulps its food down in seconds. Owners inevitably report that their pets are more active and more comfortable once the extra weight begins to shed.

Monitoring

Frequent monitoring is the single most important aspect of a successful weight loss program. After transitioning the animal to its new diet, a recheck weigh-in should be performed approximately 1 to 2 weeks later. Using a veterinary therapeutic diet designed for weight loss, animals can safely lose 1% to 2% body weight per week. For animals eating over-the-counter diets or those with comorbidities, aiming for a more gradual rate of weight loss (0.5–1% per week) may reduce the risk of inducing nutrient deficiencies. Even in the best-case scenario, animals typically reach one or more weight plateaus during their weight loss. When this occurs, it is recommended to reduce the caloric intake by approximately 2.5% to 5%. For any animal, but especially one receiving small volumes of food, it is preferable to weigh the food provided on a grams per day basis; this allows for more precise adjustments. For very obese animals, successful weight loss plans may take up to 1 year (or longer). It is vital to remain in close contact with owners and to help them make adjustments as needed to avoid frustration and failure.

Once the animal reaches its ideal body weight, it usually does not need many more calories per day to maintain that healthy weight. For some clients and animals, it is best to continue feeding the diet fed during the weight loss and to increase caloric intake by approximately 5%. Clients may prefer to transition to another diet, potentially an over-the-counter maintenance diet if a veterinary therapeutic weight loss diet was used to achieve the weight loss. Then it becomes important to find a similarly low-calorie diet to avoid the weight gain that can occur by switching to a maintenance diet.⁶

Ultimately, prevention is the best way to manage obese animals. But when presented with an overweight animal, successful weight loss plans will depend on individualized nutritional assessment of the pet, excellent client communication, and the flexibility to adjust nutritional plans as needed.

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Table 1. BCS scales and their relationships with % body fat and % overweight¹

BCS (9-point scale)	BCS (5-point scale)	% Body fat	% Overweight
4	2.5	15–19	Ideal
5	3	20–24	Ideal
6	3.5	25–29	10
7	4	30–34	20
8	4.5	35–39	30
9	5	40–45	40
>9	>5	>45	>40

Unconventional Diets

Valerie J. Parker, DVM, DACVIM (SAIM, Nutrition)

What is an Unconventional Diet?

Home-prepared diet

Home-prepared diets may include cooked and/or raw foods. Whether or not a specific recipe is followed is highly variable among pet owners. These diets often include some combination of a protein source and carbohydrate source. There may be an additional fat source and some vitamin and mineral supplementation. There is a seemingly endless supply of recipes to be found in books, on websites, and from friends and family members. However, multiple veterinary studies have shown that the majority of these recipes do not provide complete and balanced nutrition for dogs and cats. This applies to healthy animals as well as animals that may require specific nutritional modifications (e.g., chronic kidney disease).¹⁻⁴

Raw diet

Raw diets come in a variety of formulations. Commercially available raw diets, intended to provide complete and balanced nutrition, can be found in frozen and dehydrated forms (e.g., Primal™ Pet Foods Inc., Nature's Variety®). Many clients may not even be aware that they are feeding raw-coated kibble when using some of these products. Home-prepared raw food diets are also popular [e.g., the bones and raw food (BARF™) diet].

Vegetarian/vegan diet

Vegetarian diets entail feeding diets without meat, poultry or fish. These diets may contain eggs, dairy, soy and/or legumes as protein sources. Vegan diets furthermore exclude all food products that come from animals (e.g., eggs, dairy). Vegan diets rely upon soy, nuts, seeds and legumes for the bulk of their protein concentration. Commercially-available vegetarian diets and home-prepared vegetarian/vegan diet recipes are abundant.

Why Feed an Unconventional Diet?

Knowing why a pet owner chooses to feed an unconventional diet is imperative to be able to address the pet's nutrition. People choose to feed unconventional diets for a variety of reasons.⁵ Some of these reasons include:

- Negative press against commercial pet foods
- Fear of feeding contaminated diets (especially since major melamine-related pet food recall in 2007)
- Ability to avoid unwanted ingredients, additives, preservatives
- Desire to improve human-animal bond
- Belief that it is what's "best" for the pet (e.g., for a specific disease, most similar to ancestral feeding)
- Ability to incorporate personal ethical beliefs about food (e.g., vegetarian, organic)
- Friends and/or family members recommended it

Whatever the reason is for feeding an unconventional diet, most pet owners do want guidance from their veterinarians. Many people ultimately feed an unconventional diet because when they went looking for nutritional advice, the proponents of unconventional diets were perhaps the most compelling. Ultimately it is up to the veterinarian to begin the conversation about the pet feeding strategy. In order to make changes to an existing diet, the veterinarian must first understand the client's perspective to then be able to discuss appropriate dietary options for each individual pet.

What risks are associated with unconventional diets?

Proponents of unconventional diets may be quite adamant about the benefits of feeding these diets. For example, those who feel most strongly about feeding raw diets may assert that "this is what our pets' ancestors ate and thus feeding a raw diet is most natural." While it is true that wild animals eat raw meat, they do not typically live long, healthy lives that pet owners want for their beloved pets. We do not expect our domesticated pets to go out and hunt down a deer for dinner; yet that is the tenet

behind this theory of feeding an ancestral diet. Other claimed benefits include a healthier coat, firmer stools and reduced incidence of allergies. A healthier coat may be the result of eating a higher fat diet and firmer stools may result from high digestibility of these diets. However, these results may easily be achieved using safer, more nutritionally complete diets. Ultimately, while there are no studies that have substantiated any health benefits to animals eating raw or otherwise unconventional diets, there are a number of studies that have proven substantial health concerns.

Nutritional inadequacy

There are many risks associated with feeding unconventional diets. The most notable risk is feeding a nutritionally inadequate diet. Several studies have shown that most home-prepared diet (cooked and raw) recipes do not provide complete and balanced nutrition.¹⁻⁵ Even recipes that can be obtained from books written by veterinarians often give vague preparation and feeding recommendations that ultimately provide inadequate nutrition. Vitamins and minerals are most often deficient among unconventional diets. Despite many recipes calling for a calcium supplement, calcium is frequently deficient. The calcium:phosphorus ratio may also be affected, thus increasing the risk for nutritional secondary hyperparathyroidism. These deficiencies may cause the most profound consequences in young, growing animals.^{6,7} In addition to the risk for nutrient deficiencies, there is also a concern for over-supplementation of nutrients, most commonly vitamins A and D.

Recently, there has been much attention paid to the development of diet-induced dilated cardiomyopathy (DCM) diagnosed in a variety of dog breeds. In one report of Golden Retrievers, taurine deficiency was identified as a contributor.⁸ One suggested reason for this is decreased bioavailability of taurine-precursor amino acids (methionine and cystine) due to high-fiber legume ingredient inclusion. However, additional data suggest that most cases of diet-induced DCM are in fact *not* related to taurine deficiency.⁹ It is unknown whether this is due to a nutrient deficiency, toxicity or other reason. Veterinarians should be aware that increased risk of diet-induced DCM has been

associated with diets coined “BEG” diets (boutique, exotic ingredients, grain-free). Veterinary specialists and the FDA are working to identify the root(s) of the problem.

Infectious disease transmission

Several studies have described the potential for bacterial and protozoal contamination as a result of feeding raw diets.^{4,10} The most common bacteria isolated were *Salmonella* spp and *Escherichia coli*. Infections with *Toxoplasma gondii* and *Cryptosporidium* have been reported. The risk for infectious disease transmission is not isolated to the pets eating the diets. People in the home who prepare and feed the diets are at risk of contracting disease. Additionally, even if the pets are asymptomatic for disease, they can transmit the pathogens in their feces, thus putting other animals and people at risk of acquiring disease. More information about infectious disease transmission from commercial pet foods can be found on the Centers for Disease Control and Prevention website <https://www.cdc.gov/salmonella/outbreaks.html>.

Dietary hyperthyroidism

Recently dietary hyperthyroidism has been described in dogs fed raw diets, presumably secondary to consumption of thyroid hormone from cervical meat.¹¹ The hyperthyroidism resolved in all dogs that were transitioned to commercial dog foods. A case series reporting exogenous thyrotoxicosis (i.e., dietary hyperthyroidism) in dogs fed commercial dog food and dog treats has also recently been published.¹²

How Can I Meet My Client’s Expectations?

First and foremost, address your client’s concerns regarding the pet’s nutritional plan. The internet would have pet owners believe that veterinarians are not educated about pet nutrition. We need to prevent this myth from being perpetuated. The odds are your client wants you to make recommendations for his/her pet. This means first getting the necessary information. Collect a full diet history on the pet, including primary diet, treats, chew toys and rawhides. Ask about what supplements the pet is receiving and how medications are administered. Specific brand names and amounts should be recorded. Assess the animal’s health status, including a body weight, body condition score (BCS)

and muscle condition score (MCS). Perform a thorough physical examination and any pertinent diagnostic tests. What is the animal's life stage? Growing puppies and kittens will have different requirements from adult dogs and cats. Are there any other illnesses present that would warrant additional nutritional modification?

Once you have established the animal's overall health, you can begin to make a nutritional plan. Pet owners should be part of the decision-making process. This will strengthen the doctor-client relationship and most likely will improve owner compliance. Listening to the owner's preferences will allow you to make a recommendation with which everyone can be happy.

When Should I Recommend an Unconventional Diet?

Unconventional diets may be useful in certain circumstances. For pets with multiple medical conditions, there may not be a great commercial diet option available. Even if there is an ideal diet, the pet may refuse to eat it. The pet owner may insist upon feeding a home-prepared diet. In these cases, it is imperative to work with your client to ensure that the pet is getting a nutritionally adequate diet.

Home-prepared diet

As previously mentioned, you don't want your client searching the internet for recipes that are unlikely to provide complete and balanced nutrition, especially if the animal has specific nutrient requirements. A better alternative is to contact a board-certified veterinary nutritionist to assist in the formulation of an appropriate home-prepared diet.

A list of board certified veterinary nutritionists can be found at www.acvn.org.

Alternatively, for healthy pets, clients may request a free home-prepared diet recipe from Davis Veterinary Medical (DVM) Consulting, Inc. at this website:

https://secure.balanceit.com/recipegenerator_ver4/index.php. The company was founded and is managed by board-certified veterinary nutritionists and offers specifically-formulated canine and feline multivitamin/multimineral products (e.g., Balance IT® Canine) to ensure nutritional adequacy for dogs and cats. Whenever an owner does choose to home-prepare a pet's diet, it is imperative that the owner follow

the recipe exactly as it is described to avoid inadvertently contributing to any nutrient deficiencies or excesses.

Raw diet

Given the many risks already discussed, the author does not recommend feeding a raw diet. The American Veterinary Medical Association (AVMA) recently published a policy on the practice of feeding raw or undercooked animal-source protein diets to dogs and cats. That policy can be found at this website:

<https://www.avma.org/KB/Policies/Pages/Raw-or-Undercooked-Animal-Source-Protein-in-Cat-and-Dog-Diets.aspx>.

Vegetarian/Vegan diet

There are some instances in which vegetarian diets may be appropriate for dogs. For example, although not marketed as “vegetarian” diets, a few canine veterinary therapeutic hydrolyzed diets (e.g., Purina HA Vegetarian, Royal Canin Hydrolyzed Protein HP) do rely upon hydrolyzed soy as the predominant protein source. These diets may be recommended as part of a diet trial for a chronic enteropathy or dermatologic disease. However, even though vegetarian diets are available, one must be careful when selecting to feed one of these diets. In one study that evaluated 24 commercially available vegetarian diets for dogs and cats, 6 diets did not meet all amino acid requirements (per AAFCO).¹³ Cats have a higher protein requirement than dogs and they require a few essential nutrients (e.g., taurine, vitamin A) that can only be found in animal proteins. As such, it is strongly discouraged to feed a cat a purely vegetarian diet to avoid causing potentially severe nutrient deficiencies.

In general, before recommending any commercial diet, veterinarians should take a few factors into account:¹⁴

- Is the company well-known and reputable?
 - Does the company employ at least one full-time board-certified veterinary nutritionist?
 - Is nutritional research conducted to improve diets?

- Does the company maintain excellent quality control standards?
- Can the company provide full nutrient profiles for every diet produced?
- What is the Association of American Feed Control Officials (AAFCO) feeding statement?
 - Is the diet complete and balanced?
 - For what life stages is the diet intended?
 - Have feeding trials been performed?

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