

# Pros and Cons of Commercial Pet Foods (Including Grain/Grain Free) for Dogs and Cats



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## KEYWORDS

- Commercial pet food
- Misinformation
- Regulation
- Processed foods
- Grain-inclusive diets
- Grain-free diets

## KEY POINTS

- A lot of misinformation exists about commercial pet food, leading to pet owners feeling overwhelmed and confused about the best diet to feed their pets.
- Not all commercial pet food companies invest the same amount of resources into ensuring the quality of their diets.
- Many foods that both pets and people consume are processed; however the type and extent of processing does not always correlated with the nutritional value of the product.
- Commercial pet food is regulated at both state and federal levels, and many of the same standards apply to both the human food industry and the commercial pet food industry.
- Grains are a rich source of essential nutrients in diets of pets and people. Concerns about grains in pet food was based on marketing rather than science.

## INTRODUCTION

The origins of commercial pet food date back to the mid-1800s, when James Spratt, an American living in the United Kingdom, developed large, hard biscuits and sold them to dog owners.<sup>1,2</sup> The biscuits were made from vegetables, beef blood, wheat, and beetroot. In the 1870s, James Spratt returned to the United States and sold his product to wealthy American dog owners. Later, in 1922, the Chappel Brothers of Rockford, Illinois, introduced Ken-L-Ration, the first canned food available to pet owners in the United States. However, during World War II, when metal and meat were rationed in the United States, canned pet food was not available. As a result, the production of pet food shifted to dry foods consisting of oven-baked, dry food broken into smaller, irregular pieces. The technology of making dry pet food changed in the 1950s when Ralston Purina developed a method of making dry pet food using an extrusion process. This method allowed dry pet food to consist of lighter, larger, uniform kibbles, and eventually this method replaced the older method of making dry pet

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food. During the 1960s and 1970s, pet food companies around the world adopted canning and extrusion technologies to meet increased demand for pet nutrition and convenience. The landscape of the commercial pet food industry continues to change. Not only is the number of new pet food companies increasing but the numbers of new technologies used in making products and packaging are increasing. The commercial pet food industry now consists of a diverse range of diets available to the consumer, such as wet (canned, pouches, rolls) and dry food (extruded and baked), as well as fresh and frozen cooked and raw diets.

## **SOURCES OF PET NUTRITION INFORMATION FOR PET OWNERS**

### ***Challenges Pet Owners Experience When Choosing a Diet***

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The increasing number of pet food companies and variety of commercial pet foods available to consumers makes it increasingly difficult for pet owners to understand the differences between pet food companies and the products they produce. Surveys confirm that dog owners report feeling overwhelmed with the choices of dog food available.<sup>3,4</sup> In addition, availability of nutrition information and misinformation from the Internet, pet retail stores, veterinarians, and through pet food company marketing adds to this confusion. To illustrate the overwhelming amount of information readily available to pet owners, a Google search was performed using the phrase, “How safe is commercial pet food?” The search yielded about 608,000,000 results.<sup>5</sup> The first 10 results consisted of a variety of sources with often contrasting and conflicting information. For example, 1 site provides information published by a governmental agency (United States Food and Drug Administration [FDA]) involved with overseeing aspects of commercial pet food. Another site is from a trade magazine on pet food safety. However, more than half of the first 10 sites contain opinion-based information and misinformation that seems intent on evoking fear in pet owners regarding commercial pet food. One site discusses by-products but incorrectly lists multiple things contained in animal by-products used to make pet food, such as hooves, hair, and feathers. The Association of American Feed Control Officials (AAFCO), an organization that defines ingredients allowed in pet food, specifically excludes these in their definitions of meat by-products and poultry by-products.<sup>6</sup> However, most pet owners do not know that some of the information provided by the Web site is false. Another site, run by a human dentist, provides consumers with information about the operations of a rendering plant without mentioning that there are different types of rendering plants in the United States, or that most pet food manufacturers in the United States do not obtain any ingredients from rendering plants of the type described on this Web site. Yet another site warns consumers how commercial pet foods are making pets sick. The site provides consumers with a long list of harmful ingredients that should not be in pet food, such as grains and meat meal, but it lacks any credible references to support these claims. It is easy to see why pet owners are so confused about what to feed their dogs and cats, and why some think negatively about commercial pet foods.

In addition to false or conflicting information about commercial pet food and pet nutrition available on the Internet and in other places, there are many other factors playing a role in determining the diet pet owners choose to feed their pets. One of these factors is the growing trend in humanization of pets.<sup>7</sup> A recent study evaluating the determinants of food purchasing decisions of both dog and cat owners showed that pet owners ranked health and nutrition as their top priority, followed by quality, ingredients, freshness, and taste.<sup>8</sup> The least important characteristics were that the product was on sale, followed by color, packaging, and being gluten free.

### ***Pet Owners Want and Value Nutritional Advice from Veterinarians***

One of the surveys showing that pet owners feel overwhelmed by the number of pet food choices available also asked pet owners, “Would you like your veterinarian to recommend a routine/maintenance diet for your pet?”<sup>4</sup> Most pet owners (68%) answered “Yes” to that question. Despite this, only 38% of pet owners reported their veterinarians had made a recommendation about a maintenance diet during the previous year. An additional 22% reported that they received recommendations from their veterinarian, but had to ask for it, although the rest reported they had received no dietary advice from their veterinarians. Similarly, other data show veterinarians are the primary source of pet nutrition information, as well as being viewed as the most important source of nutrition information for pet owners (Table 1).<sup>8</sup>

### **COMMERCIAL PET FOOD INDUSTRY CONTINUES TO GROW**

#### ***Why Are There so Many Commercial Pet Food Companies?***

The 2019 to 2020 American Pet Product Association (APPA) National Pet Owners Survey showed that 63.4 million US households own a dog and 42.7 million own a cat.<sup>9</sup> As of 2017, there were 89.7 million dogs<sup>10</sup> and 94.2 million cats<sup>11</sup> in the United States. The APPA survey showed Americans spent more than \$95 billion on their pets in 2019,<sup>9</sup> versus \$48.35 billion in 2010<sup>12</sup> (Table 2).

Consumers spend more on pet food and treats than on any other area of the pet industry, including veterinary care. This trend has been a consistent and growing for more than a decade so it is easy to see why making and selling pet food has become such an attractive industry for so many people. Lawyers, veterinarians without any advanced training in small animal nutrition, people with marketing degrees, and lay people are just a few examples of people making and marketing their own brands of pet food. This trend is in contrast with major pet food companies that employ a team of qualified experts, such as boarded veterinary nutritionists, PhD nutritionists, food safety specialists, toxicologists, microbiologists, and engineers, just to name a few.

#### ***Marketing Claims***

As more and more companies enter into the pet food market, many use marketing as a way to distinguish their diets from their competitors’ diets. However, many of the

<b>Information Source</b>	<b>Primary Source of Pet Dietary or Nutrition Information (%)</b>	<b>Perceived Importance of Dietary Recommendations<sup>a</sup></b>
Veterinarian	40.65	3.82
Veterinary staff	2.91	3.12
Internet	24.57	2.62
Breeder/trainer	4.03	2.20
Books/magazine	5.67	2.17
Friends/family	3.32	2.12
Pet store staff	1.94	1.80

<sup>a</sup> Using a 5-point Likert scale (1, not important at all; 2, slightly important; 3, moderately important; 4, very important; and 5, extremely important).

<b>Total Consumer Spending on Pets in the United States in 2010<sup>12</sup> and 2109<sup>9</sup></b>		
	<b>2010 (\$ Billions)</b>	<b>2019 (\$ Billions)</b>
Pet Food and Treats	18.76	36.9
Vet Care and Product Sales	13.01	29.3
Supplies, Live Animals and Over-the-counter Medicine	13.07	19.2
Other Services <sup>a</sup>	3.51	10.3
<b>Total Spending on Pets</b>	<b>48.35</b>	<b>95.7</b>

<sup>a</sup> Includes boarding, grooming, insurance, training, pet sitting and walking, and all services outside of veterinary care.

marketing claims made about certain types of commercial pet food lack research to support these claims. For example, through marketing, some companies vilified certain ingredients used in pet foods, such as grains and by-products, while making claims that diets without these ingredients were healthier for dogs and cats.<sup>13</sup> This marketing resulted in some pet owners believing that the best diets to feed their pets were grain-free diets. It is ironic that recommendations to avoid pet food containing grains is occurring at the same time that experts in human nutrition are promoting greater consumption of whole grains in our own diets because of the health benefits associated with such diets.<sup>14</sup>

## **FEEDING COMMERCIAL PET FOOD**

### ***Most Pet Owners in the United States Feed Commercial Cooked Pet Food***

Most dog and cat owners (>90%) in the United States feed their pets commercial cooked pet food.<sup>4,9,15</sup> In contrast, raw diets (both commercial and home prepared) and homemade pet foods were never fed to more than 73% of dogs and 88% of cats: among veterinary professionals participating in this survey, 85.9% did not consider raw meat-based diets to be healthier than commercial pet foods.<sup>4</sup>

The percentage of pet owners feeding cooked commercial pet food has remained high, and pets are living longer than they used to.<sup>16</sup> Although numerous factors may be involved, advances in companion animal nutrition and veterinary care play a role in the increasing lifespan of dogs and cats.<sup>17,18</sup>

### ***Commercial Pet Food Industry and Human Food Industry in the United States Are Both Highly Regulated***

Regulation of commercial pet food occurs at both the state and federal levels, and many of the same regulations that apply to the human food industry apply to the commercial pet food industry. For example, the FDA is a federal agency that regulates both industries.<sup>19</sup> The US Federal Food, Drug, and Cosmetic (FD&C) Act states that the FDA is responsible for making sure food for both people and animals is safe to eat, properly manufactured, contains no harmful substances, and is truthfully labeled. Congress further strengthened the food safety system in the United States in 2011 and amended the FD&C by passing the FDA Food Safety Modernization Act (FSMA). This act overhauled regulations regarding food production both for human and animal foods, and it gave the FDA more authority to oversee and enforce food

supply chains. It also shifted the focus of the FDA from responding to contamination of the food supply to preventing contamination.

The FSMA requires animal food production facilities to register with the FDA and create and implement a food safety plan that includes both hazard analysis and steps to reduce or eliminate any potential food safety hazards identified. It also requires that these facilities comply with good manufacturing practices, including baseline standards for manufacturing, processing, packing, and holding commercial pet food to ensure it is safe for animals to eat. As a result, many of the same standards that apply to the human food industry also apply to the commercial pet food industry.

The AAFCO is a nongovernmental organization, comprising the State Feed Control Officials from each of the 50 states and Puerto Rico, plus Canada, which provides standards for the pet food industry. AAFCO establishes model animal feed regulations and ingredient definitions.<sup>20</sup> AAFCO is not a regulatory body: regulatory adoption and enforcement are done at the state level. The FDA is also a voting member of AAFCO, and it plays a role in many of AAFCO's standardization activities, including safety reviews of ingredients defined by AAFCO. Pet food industry representatives may attend AAFCO meetings, but they have no voting authority.

### **Concerns About Commercial Pet Foods**

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Misinformation published on the Internet<sup>21</sup> and on social media undermines consumer confidence in commercial pet foods. See **Box 1** for details regarding some common concerns about commercial pet food. This misinformation is one reason some pet owners believe they need to make their own pets' food at home. Although feeding a homemade diet may be appealing to some pet owners and something they enjoy doing, there is no evidence to support that home-prepared diets are healthier or safer to feed than good-quality complete and balanced commercial pet food. Nonetheless, if pet owners want to feed a homemade diet, they should have a board-certified veterinary nutritionist<sup>24</sup> formulate a diet for them. A study evaluating nutrient composition of 200 home-prepared maintenance diets for dogs obtained from veterinary textbooks, pet care books, and Web sites showed that 95% of recipes had at least 1 essential nutrient at concentrations that did not meet National Research Council (NRC) or AAFCO guidelines.<sup>29</sup> Multiple nutrient deficiencies were found in 83.5% of recipes, 9 recipes surpassed the safer upper limit for vitamin D, and 6 recipes surpassed the safe upper limit for the fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). This study reinforces the importance of working with a board-certified veterinary nutritionist<sup>24</sup> to formulate homemade diets.

Commercial pet food companies that employ a team of qualified experts invest significant financial resources overseeing all aspects of development and production of their pet foods and ensuring they are adhering to FSMA food safety requirements. Members of this team also conduct in-house research evaluating things such as digestibility and bioavailability of nutrients in their diets. Although in-house research is not always published, it is important for pet food companies to evaluate how diets perform when fed to animals before selling diets to pet owners. Some of these larger companies have fed these diets to their own colonies of dogs and cats for years to determine how they perform when fed to dogs and cats long term. These companies also conduct clinical research with specialists to support their claims and advance nutrition knowledge, and publish these results in peer-reviewed journals.

Occasional health problems have been associated with feeding both commercial pet foods as well as homemade diets. However, considering the millions of pets fed commercial diets each year,<sup>4,15</sup> the risks of nutrient deficiencies or excesses associated with these foods, especially those produced by companies that employ a team of

**Box 1****Examples of perceived cons of commercial pet foods**

1. Commercial pet food is the equivalent to eating fast food or junk food.<sup>22</sup>  
 Claim: commercial pet food is heavily processed fast food, just like burgers, fries, tacos, potato chips, cake, and candy.  
 Response: the type and extent of processing does not necessarily correlate with the nutritional content of food. Most commercial pet foods provide complete and balanced nutrition, unlike fast food, candy, cake, and ice cream.
  
2. Veterinarians receive little training on nutrition, and what they are taught is paid for by commercial pet food companies. That is why veterinarians recommend commercial pet foods.<sup>22,23</sup>  
 Claim: veterinarians, like medical doctors, learn little about nutrition in school, and what they do learn about nutrition is paid for by pet food companies. The reason veterinarians recommend commercial pet food is because the commercial pet food companies have paid for their nutrition education.  
 Response: 19 of 32 accredited veterinary colleges in the United States and Canada have at least 1 board-certified veterinary nutritionist<sup>24</sup> on faculty. These veterinarians have advanced training in veterinary nutrition and have passed a rigorous certification examination to become diplomats in the American College of Veterinary Nutrition (ACVN). They are experts in their field of veterinary medicine. ACVN diplomats teach nutrition to veterinary students at many accredited veterinary colleges. For veterinary colleges that do not have a board-certified veterinary nutritionist on faculty, some may have a board-certified veterinary nutritionist associated with a nonprofit organization teach students about nutrition, whereas others have other faculty teach nutrition. In addition, many veterinary conferences offer lectures devoted to nutrition, so, even after graduation, veterinarians continue to learn about nutrition.  
 At the author's veterinary college, nutrition is a core course in the curriculum. In addition, there is a 3-week clinical nutrition rotation that students can take to learn even more about small animal nutrition.
  
3. Veterinarian get kickbacks and huge profit margins when they sell commercial pet food.<sup>25,26</sup>  
 Claim: veterinarians are in the pockets of the big pet food companies, and, when they sell these diets to their clients, they get kickbacks and receive huge profit margins from doing so.  
 Response: most veterinarians do sell some pet foods, including therapeutic diets, in their clinics for the convenience of the pet owners, for the welfare of the pet, or to help manage certain medical conditions. They do make some profit from these sales. However, they generally have the same markup fee that online retailers do, and this would happen whether they sold you a commercial diet, heartworm prevention, or a medication.  
 Veterinarians are just like anyone else that owns a business: this is how they make a living. Veterinarians should not be expected to give their services away or sell products at cost, just as auto mechanics would not be expected to fix cars for free and sell parts at cost. Veterinarians love animals but they also need to make money to live on, just like anyone else.
  
4. Commercial pet food contains 4 D (dead, dying, diseased, disabled) meat, roadkill, and euthanized dogs and cats.<sup>22,27</sup>  
 Claim: 4 D meat, roadkill, euthanized dogs and cats, and spoiled supermarket food is just some of the things that can legally be used in pet food.  
 Response: many of the same regulations that apply to the human food industry also apply to the pet food industry, including that the food produced is safe to eat, properly manufactured, contains no harmful substances, and is truthfully labeled.<sup>19</sup> In addition, AAFCO<sup>20</sup> defines what ingredients can be legally used in pet food, and any food that contains pentobarbital is considered adulterated and illegal to sell.  
 There are also 2 types of rendering plants: independent rendering plants and integrated rendering plants. Integrated rendering plants only receive animal products from the US Department of Agriculture (USDA)-inspected meat or poultry plants they are affiliated with, and these are the types of rendering plants that reputable pet food companies

purchase their ingredients from. Because 4 D meat, roadkill, euthanized dogs and cats, and spoiled supermarket food would not be associated with a USDA-inspected plant processing animal protein for human consumption, these types of materials would also not be found in by-product meals used in pet food.<sup>28</sup>

5. Commercial pet foods are loaded with cheap fillers.<sup>22,28</sup>

Claim: things, such as corn and soy, are used as cheap fillers in commercial pet food. Fillers in commercial pet food are there for the benefit of the manufacturers, not for the animals that are fed these diets. The focus should be on ingredients.

Response: a filler is an ingredient that adds bulk to the diet but provides no nutritional value or benefit to the animal. Ingredients such as corn or soy do not meet the definition of a filler (see text). Dietary fiber is also not a filler. Dietary fiber feeds the beneficial bacteria in the gastrointestinal (GI) tract, which in turn produce short-chain fatty acids that feed the intestinal cells lining the large intestines. Seventy percent of the immune system lies within the GI tracts, and having a robust population of beneficial bacteria in the GI tract not only affects the health of the gut but also has beneficial effects systemically. Fiber also affects stool quality.

Animals require nutrients, not ingredients. Focusing on the nutrients that diets provide so that dogs and cats receive all the nutrients they require in a complete and balanced diet should be what is important to pet owners.

experts, are low. In contrast, there are numerous examples of health problems related to feeding an improperly balanced homemade diet to pets.<sup>29-37</sup>

The FDA reports recalls and withdrawals of both pet food and treats<sup>38</sup> as well as recalls of human food and beverages.<sup>39</sup> **Table 3** illustrates the total number of commercial pet foods or treats recalled during a 12-month time frame. Recalls of all pet food and treats averaged less than 3 per month, and recalls for commercial cooked pet foods and treats averaged less than 1 per month. Most recalls were not associated with any illnesses in dogs or cats; however, 1 canned dog food and 1 canned cat food were associated with illnesses, as were 3 brands of treats. One brand of pig-ear treats contaminated with *Salmonella* was associated with illnesses in both dogs and people.

Contrast the number of pet food and treat recalls during a 12-month period with the number of recalls of human food and beverages during that same time.<sup>39</sup> There were

**Table 3**  
United States Food and Drug Administration commercial pet food and treat recalls from July 17, 2019 to July 17, 2020<sup>38</sup>

Type of Food Recalled	No. of Recalls	Reasons for Recalls
Raw or freeze-dried diets or treats	16	(15) Potential contamination or proven contamination with pathogens ( <i>Salmonella</i> , <i>Listeria monocytogenes</i> , Shiga toxin-producing <i>Escherichia coli</i> 0128, <i>Clostridium botulinum</i> ); (1) incorrect compliance guidelines
Pig-ear pet treats	7	Potential contamination or proven contamination with <i>Salmonella</i>
Cooked dog or cat diets	7	Increased levels of choline chloride, thyroid hormone, vitamin D; products not meeting company's quality and safety standards; low levels of thiamine (vitamin B1)
Cooked dog treats	2	Increased levels of thyroid hormone
Bully sticks	1	Potential contamination with <i>Salmonella</i>
Total	33	—

more than 800 human food and beverage recalls during this same time, and many of the recalls were for potential contamination with pathogens. Examples of the types of human foods recalled included fresh fruits and vegetables, eggs and cheese, and many other foods. These foods are the same foods pet owners often purchase to make homemade diets for their pets. The US Department of Agriculture (USDA) also reports recalls of meat and poultry products.<sup>40–42</sup> Meat and poultry products meant for human consumption can contain pathogens, undeclared allergens, foreign material, or be produced without the benefit of inspection. The FDA classifies commercial pet food contaminated with *Salmonella* to be adulterated, and therefore unfit for sale,<sup>43</sup> but it is not illegal to sell raw chicken to consumers that is contaminated with *Salmonella*, including strains resistant to multiple antibiotics, and other pathogens.<sup>44,45</sup> As a result, purchasing foods meant for human consumption to use in homemade diets for pets does not guarantee that it is safer than purchasing cooked commercial pet food products. In addition, there is no evidence that pets fed homemade diets are healthier or live longer than pets fed good-quality commercial complete and balanced diets.

### ***Current Classification Systems of Processed Foods Does Not Equate to Nutrient Quality***

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There is no shortage of false information available on the Internet about the dangers of feeding processed commercial pet food.<sup>46,47</sup> These sites often present their false information in a tabloid fashion, with the intent of convincing pet owners that feeding their dogs and cats commercial pet foods “are wreaking havoc on our pets’ lives.”<sup>46</sup> They go on to make claims, such as “processed diets have created generations of sick pets”<sup>47</sup> and “prepared pet foods help provide patients for vets.”<sup>46</sup> They further state that feeding commercial complete and balanced diets does not promote long-term health, but feeding a biologically appropriate raw diet does. These sites make these types of claims without any scientific studies or credible references to support them, and, at most, just provide testimonials from pet owners to support their claims. As a result, some pet owners refuse to feed commercial pet food because of negative perceptions that they have about processed foods and the belief that all processed foods are inherently unhealthy or biologically inappropriate.

The USDA defines processed food as any raw agricultural commodity that has been subject to washing, cleaning, milling, cutting, chopping, heating, pasteurization, blanching, cooking, canning, freezing, drying, dehydrating, mixing, packaging, or other procedures that alter the food from its natural state.<sup>48–50</sup> If the strict USDA definition of processed food is used, any food not eaten raw and unwashed is processed to some extent. The term processed has such a broad definition that it is almost meaningless when discussing food.

Processed foods may also include the addition of other nutrients to food products, such as vitamins, minerals, salt, sugars, and fat. The Institute of Food Technologists includes additional processing terms to this definition, such as storing, filtering, fermenting, extracting, concentrating, microwaving, and packaging.

The type and extent of processing does not necessarily correlate with the nutritional content of the food, and processing can improve the nutritional value of food. Some food processing techniques, such as enrichment and fortification, can add essential nutrients to foods that may be otherwise limited and enhance the nutritional value of that food. Some examples include the fortification of milk with vitamin D; fortification of wheat flour with folic acid or salt with iodine; ready-to-drink beverages fortified with protein, vitamins, or electrolytes; as well as vitamins and minerals added to commercial pet foods to provide complete and balanced nutrition. In contrast, adding a lot of



salt or refined sugar to foods are examples where a processed food may be less healthy for a person to consume, but that is not the type of processing that applies to most commercial pet foods.

Numerous systems exist that distinguish human foods or drinks based on different levels of processing. These systems use terms such as minimally processed, moderately processed, moderately processed for flavor, moderately processed grain, highly processed, food processed for preservation, processed culinary ingredients, ultraprocessed, highly processed ingredients, highly processed stand-alone, ready-to-eat processed, prepared foods/meals.<sup>49,51</sup> However, these classification systems seem arbitrary and often contradict one another when defining this terminology. They also fail to acknowledge the benefit of different degrees of processing on the nutritional value of a food or its effect on food safety. Conclusions about the association between the degree of food processing and nutritional quality are inconsistent.<sup>52,53</sup>

Human foods classified as highly processed or ultraprocessed products are often characterized by foods that are energy dense; high in simple sugars, unhealthy fats, and salt; and low in dietary fiber. Examples of these types of foods include cookies, sweets and deserts, sugar-sweetened drinks, white bread, French fries and chips, and hot dogs. Humans consuming large quantities of these types of food may be at risk for adverse effects on their health. However, these characteristics are not typical of commercial pet food, and therefore classifying pet food using terminology used to describe ultraprocessed human foods and beverages is misleading.

Most dry commercial pet foods are produced by extrusion cooking. There is a lot of misinformation about this method of producing dry pet food. **Box 2** provides an overview of the steps involved with extrusion cooking, as well as the beneficial effects and the less desirable effects of this method of cooking.

Cooking food is an example of food processing that can increase or decrease the availability of nutrients. For example, some vegetables show greater antioxidant, carotenoids, and polyphenol availability when consumed cooked compared with when consumed raw, whereas others show the reverse.<sup>59–61</sup> Moist cooking enhances the digestibility of grains. **Box 3** lists the impact cooking has on dietary protein.

## NOT ALL COMMERCIAL PET FOOD COMPANIES ARE THE SAME

Pet foods have been classified as either conventional or unconventional.<sup>70</sup> Commercial dry and canned diets are considered conventional diets, whereas homemade diets, whether fed raw or cooked, are considered unconventional diets. The line between conventional and unconventional diets has become less distinct as the variety of commercially available diets has expanded to include raw diets and diets that resemble homemade diets but are produced on a large commercial scale. Even conventional diets can no longer be thought of as monolithic diets because the number of pet food companies has expanded and the qualifications of the people behind companies has changed. As a result, the old adage that people should feed their pets any commercial diet because they are all very similar no longer holds true.

Anyone can make and sell commercial pet food, but not all companies or their products are of equivalent quality. For example, inappropriate processing can negatively affect the bioavailability of nutrients. It is often challenging and confusing for pet owners and veterinary professionals to evaluate commercial pet foods when there is so much information, including misinformation, about pet foods available on the Internet, at pet stores, and other places.

The World Small Animal Veterinary Association (WSAVA) is a global community of more than 200,000 veterinarians from around the world whose goal is “to advance

**Box 2****Processing steps used in manufacturing dry kibble<sup>1,54–58</sup>**

Step 1. Procure ingredients in various forms that meet specifications and safety standards.

- Whole, pellets, granules, powders, liquids

Step 2. Convert ingredients into appropriate particle size or consistency.

- Whole grains and pelleted ingredients: grinding
- Frozen blocks of raw meat: frozen block breaking, grinding, and mixing with water to create a meat slurry

Step 3. Dry ingredients weighed and added to standard mixer for blending.

- Dry blended ingredients are dropped into a hopper (holding container) and conveyed to either a final grinding step or to overhead bins above the preconditioner and extruder.

Step 4. Preconditioning stage.

- Water and steam are added to dry blended ingredients.
- Heat is applied to begin the cooking process of starches (gelatinization).
- Liquid additions, such as fat and meat slurries, if included in the diet, are added toward the middle to end of preconditioning stage.
- Temperature of ingredients at end of preconditioning is approximately 80°C (176°F).

Step 5. Once ingredients have completed the preconditioning phase, they are transferred to the extruder.

- The extruder consists of a single screw or twin screws within a barrel.
- Extrusion cooking is a thermomechanical process that uses a combination of moisture, pressure, temperature, flow rate, residence time, and mechanical shear energy exerted by the rotating screws.
  - Adjustments of these properties contributes to the overall nutritional value of the product.
  - Extrusion cooking is referred to as a high temperature short time method.
    - The residence time (time ingredients spend in extruder) can vary from 10 to 270 seconds.
    - The temperature within the extruder can vary from 80°C to 200°C (176°F–392°F).
    - Although the name states high temperatures, the temperatures used during extrusion cooking are consistent with oven temperatures people use to cook their own foods. However, by leveraging pressure to facilitate cooking during extrusion, the cooking time is much shorter than the standard cooking times people use for cooking their own foods.
- Examples of human and pet food products that use extrusion cooking include pasta, baby foods, texturized vegetable protein, ready-to-eat breakfast cereals, snack foods, dried soups, dry beverage mixes, dry pet food, and pet treats.

Step 6. A die plate is located at the end of the extrusion barrel that contains 1 or more openings.

- The materials exiting the die resemble a rope as it leaves the extruder.
- Pressure generated within the extrusion barrel forces the material through the openings in the die plate and a knife cuts the material as it exits the die plate. The speed at which the die plate rotates determines how long each piece is.
- Die inserts fitted onto the outside of the die plate determine the final shape of the food. Depending on the food, these shapes can vary from circles, stars, bones, and fish to flat ribbon shapes used for some pet treats and pastas.

Step 7. Once the food exits the extruder, it is conveyed to the dryer to achieve the desired moisture content of the food.

- The drying chamber consists of a conveyer belt (dryer deck) that the food rests on as it goes through the drying process.
- The depth of the product on the conveyer belt, zone temperatures, retention times, and humidity all influence the drying of the food.
- Different zones within the dryer use different temperatures to optimize the drying process as the food passes through it.
  - The first zone warms the food to 80°C to 100°C (176°F–212°F).
  - The food then moves to the primary drying zone with temperatures of 120°C to 150°C (248°F–302°F).

- The last zone is the cooling zone.
- The residence time within the dryer including a cooling zone varies from 20 to 30 minutes.

Step 8. The food then goes through the enrobing step, which adds liquid and dry coatings to the food.

- Fat is often added during this step because it disrupts starch gelatinization to prevent expansion of the product.
- Flavor enhancers are also added during this step.

Step 9. The last step is packaging, which protects the food from infestation, reduces oxidation of fat, and increases the shelf life of the product.

Beneficial effects of extrusion cooking include:

- Improved digestibility of starch and protein.
- Improved bioavailability of bioactive compounds by forming complexes with protein.
- Destruction of antinutritional factors that can inhibit protein digestibility, such as protease inhibitors, trypsin inhibitors, hemagglutinins (lectins), tannins, and phytates.
- Starch cooking (gelatinization) to enhance digestibility.
- Inactivation of lipoygenases and peroxidases, which cause lipid deterioration during storage.
- Sterilization (destruction of pathogens, such as *Salmonella*).
- Retains natural colors and flavors of foods.

Some nutrient loss occurs during extrusion cooking.

- Vitamin loss.
  - The stability of vitamins during extrusion is variable and depends on the chemical structure and composition of the vitamin, as well as the conditions used during extrusion.
  - B vitamins, vitamin A, and vitamin E are negatively affected by extrusion cooking.
  - Although some loss of vitamins occurs during the extrusion process, these losses are compensated for upstream by adjusting the amount added to the food before extrusion.
- Amino acid loss.
  - Lysine, arginine, tryptophan, cysteine, and histidine are the most common amino acids affected by extrusion. These losses during extrusion must also be accounted for when formulating diets.
- Reduction in protein availability through Maillard reactions.
  - Maillard reactions occur between reducing sugars and amino acids in proteins.
  - Maillard reaction products (MRPs) occur during heating but also when food is placed at room temperature. MRPs also form endogenously in the body.
  - Maillard reactions occur during extrusion cooking of pet food but also in many foods people consume, including roasted or grilled meats, coffee, baked goods with darkened crust, toast, fried onions, malt whiskey and beer, dried and condensed milk, toasted marshmallows, roasted peanuts, and chocolate.
  - Parameters that promote Maillard reactions are temperature, moisture content, thermal duration, and pH value.
  - Mild extrusion conditions, defined as high moisture content, low residence time, and low temperatures, improve nutrition quality of food.
  - More extreme extrusion conditions, defined as high extrusion temperatures ( $\geq 200^{\circ}\text{C}$  [ $392^{\circ}\text{F}$ ]), low moisture content ( $<15\%$ ), and improper formulation (presence of highly reactive sugars) can impair nutritional quality of food.
    - Extrusion temperature and duration (residence time) also seem to be important parameters determining the degree of Maillard reactions, with increases in both variables increasing the reaction rate.
  - Extrusion cooking of commercial dry pet food generally occurs at temperatures less than  $200^{\circ}\text{C}$  ( $<392^{\circ}\text{F}$ ), which is lower than temperatures used for extreme extrusion conditions.

the health and welfare of companion animals worldwide through an educated, committed and collaborative global community of veterinary peers.<sup>71</sup> WSAVA established the WSAVA Global Nutrition Committee, which has created guidelines comprising 8 criteria for selecting diets made by reputable companies (Box 4).<sup>72</sup>

**Box 3****Benefits associated with cooking dietary protein**

1. Cooking improves digestibility of protein.
  - Cooking can improve protein digestibility through protein denaturation, but it can also destroy some heat-sensitive amino acids.<sup>62</sup>
    - The impact of cooking depends, in great part, on the method of cooking and parameters such as moisture, temperature, and other variables.
      - For example, a study done in humans showed that digestibility of chicken eggs was increased by 45% to 78% when eggs were consumed microwaved versus raw.<sup>63</sup>
      - Another study in Burmese pythons evaluated the impact of cooking and grinding of beef sirloin on the cost of digestion.<sup>64</sup> Cooking reduced the energy cost of digestion by 12.7%, and grinding reduced the energy cost of digestion by 12.4%. The effects of both cooking and grinding are additive.
      - A study comparing apparent total tract macronutrient digestibility in cats fed extruded, raw beef-based and cooked beef-based diets showed that the raw and cooked beef-based diets were more digestible than the extruded diet. However, all diets used were highly digestible so the variation in digestibility among diets would be unlikely to affect the long-term health of the cats.<sup>65</sup> Commercial extruded diets vary considerably in their digestibility so comparison with one extruded diet, such as the diet used in this study, may not be representative of all dry pet foods.
2. Cooking has the potential to affect protein digestibility or losses.
  - Depending on the methods and temperatures used, cooking can either increase or decrease protein digestibility and nutritional value.
    - Cooking of foods (meats and grains) was a major factor in human evolution, including advances in brain function caused by better nutrition.<sup>66</sup>
  - Most commercial pet food companies are aware of the impact of cooking on protein digestibility or losses and can compensate to ensure the final product fed to the pet has adequate levels of protein and essential amino acids.
3. Cooking destroys antinutritional factors found in some foods.
  - Examples of antinutritional factors destroyed by cooking include thiaminases found in raw fish, which destroy thiamine; trypsin inhibitors found in raw soybeans, which interfere with protein digestion; and avidin found in raw eggs, which destroys biotin.
4. Cooking food is also important from a food safety standpoint.
  - The US Department of Health and Human Services and the FDA list food safety standards, including recommended cooking temperatures for meat, poultry, and seafood.<sup>67,68</sup>
  - It is also important to keep in mind that dogs can shed *Salmonella* in their feces for 1 to 7 days after consuming 1 *Salmonella*-contaminated meal. Most dogs fed raw meats are asymptomatic for salmonellosis but pose a potential zoonotic risk.<sup>69</sup>

Recommending diets made by companies that meet WSAVA Guidelines is one way to distinguish reputable and high-quality pet food companies from the rest.

### ***Grain-Inclusive and Grain-Free Diets***

Grains, such as corn, wheat, and rice, provide a rich source of nutrients in diets for humans, dogs, and cats. For example, corn is an excellent source of linoleic acid, an essential fatty acid required in the diets of all mammals. Corn also provides protein, essential amino acids, antioxidants, vitamins, minerals, fiber, and energy. Grains have been part of complete and balanced commercial pet foods for decades, and dietary guidelines for humans strongly recommend including more whole grains in the diet as a key element of healthy eating patterns.<sup>73</sup> Properly processed grains are highly digestible in both dogs and cats.<sup>74,75</sup>

Some pet owners have expressed concern that glutens in grains may be a source of allergies in dogs. Glutens are the protein component of grains, and it is the gliadin, a

**Box 4****Examples of criteria that the World Small Animal Veterinary Association recommends for selecting pet foods<sup>72</sup>**

- Does the company employ a full-time qualified nutritionist, such as a PhD in animal nutrition or someone board certified by the American College of Veterinary Nutrition (AVN) or European College of Veterinary Comparative Nutrition (ECVCN)?
  - Some companies employ a team of experts, including full-time nutritionists, food scientists, microbiologists, food safety scientists, and toxicologists.
- What are the credentials of the people that formulate the diets for the company?
- What AAFCO protocol does the company use to substantiate that their diets are complete and balanced? Do they use AAFCO feedings trials or the formulation method? If the formulation method is used, do their diets meet AAFCO nutrient profiles by formulation or do they have the finished product analyzed for nutrient content?
- Does the company produce their diets in their own manufacturing plants or do they subcontract production of their foods to a third-party manufacturer?
  - Owning their manufacturing plants allows oversight of all aspects of diet production
- What quality-control measures does the company use to ensure consistency and quality of ingredients and end products?
- Will the company provide the average content of important nutrients in their diet? Are they able to provide the average or typical analysis for their diets, rather than just the guaranteed analysis, which only lists minimums and maximums of nutrients and not exact amounts?
  - They should also be able to provide individual nutrients on an energy basis, rather than just an as-fed or dry-matter basis
- What kind of research does the company conduct? If they are developing a new or novel diet, have they conducted research to validate their claims and to ensure that the diet is safe to feed on a long-term basis? Do they do internal feeding trials on their diets, and do they conduct research that is published in peer-reviewed journals?

specific protein within the gluten from wheat, rye, and barley, that people with celiac disease have reactions to.<sup>76</sup> Gluten found in corn and rice does not contain this gliadin. As a result, people with celiac disease generally do not have a reaction to gluten from corn or rice. Gluten sensitivity in dogs is rare. A heritable form of gluten-sensitive enteropathy that is similar to celiac disease in people can occur in specific lines of Irish setters.<sup>77,78</sup> Some border terriers with epileptoid cramping syndrome responded well to what the investigators described as a gluten-free diet.<sup>79</sup> However, the diet fed to the dogs that showed improvement was not a grain-free or gluten-free diet because it contained rice. Thus, it seems that these dogs tolerate rice gluten, just like people with celiac disease do.

Concerns about the use of grains in commercial pet food began occurring about 10 to 15 years ago, and this concern seems to have been driven largely by marketing<sup>13,80,81</sup> and not science. Through marketing and the Internet, pet owners were told to focus on ingredients in pet food as a way to determine its quality. They were also told that grains in pet foods are fillers; grains rejected for use in human foods ended up in pet food, cause allergies and other health problems, and are harmful to have in pet food. Despite educational materials and articles written by board-certified veterinary nutritionists discussing the myths and misperceptions of grains in pet food,<sup>82,83</sup> demand for grain-free diets steadily increased. Alternative ingredients, such as legumes and potatoes, seem to have replaced grains in many over-the-counter grain-free diets. Long-term safety studies with these newer ingredients do not seem to have been done. Now some grain-free diets have been associated with

dogs developing secondary dilated cardiomyopathy (DCM).<sup>84–89</sup> The FDA initiated an investigation into the problem, and it is an ongoing investigation (**Box 5**).

Studies validating the association between dogs consuming grain-free diets and DCM have been published since the FDA announced its investigation in 2018.<sup>87,88</sup> A Facebook group entitled Diet-Associated Dilated Cardiomyopathy (DCM) in Dogs, whose membership includes veterinary professionals, such as boarded veterinary cardiologists, nutritionists, internists, as well as pet owners, is continuing to collect information on the diets consumed by dogs developing DCM (the author is a consultant for this group). This group also has long-term follow-up on many of the cases of DCM reported to them. Just as the most recent report from the FDA shows, the DCM in many dogs with DCM is improving dramatically or even reversing completely after changing diets and receiving appropriate therapy, which is consistent with these dogs having secondary (nutritional) DCM. The author continues to receive consults about dogs diagnosed with DCM while consuming these grain-free diets, so the problem continues.

To date, no specific nutritional cause and effect has been found for the association between grain-free diets and DCM, but a significant association has been confirmed. Other observations include multiple unrelated dogs from the same household fed the same grain-free diet developing DCM. Echocardiogram clinics screening dogs for DCM show that some asymptomatic dogs have occult DCM, and, as a result, it is difficult to know the true extent of the problem at this time. In addition, the author and others involved with this group find that veterinarians are not consistently reporting these cases to the FDA or having their clients report these cases, so the problem is likely underreported. Veterinarians should advise pet owners about the risks for DCM associated with grain-free diets and should consider recommending a different diet for those already feeding grain-free diets.

Diet-associated DCM associated with grain-free diets is an example of problems that can occur when marketing, not science, drives sales of a certain types of commercial pet food. Therapeutic grain-free diets for dogs have been around for almost 2 decades and have not been associated with DCM. These therapeutic diets are made by pet food companies that meet (and exceed) WSAVA guidelines. They also established their diets as complete and balanced using AAFCO animal feeding trials rather than the formulation method used by many of the companies whose grain-free diets are associated with DCM.

### ***Commercial Pet Food May Not Be the Best Option for all Dogs and Cats***

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Some pets refuse to eat a commercial diet. This refusal may be the result of pet owners feeding their own food to their pets when they are eating, and that becomes the expectation of those pets when they want food. This situation may also occur as a result of food aversion caused by an underlying disease, or for other reasons. Some pets have multiple health problems for which available commercial diets are not appropriate. Some pet owners also enjoy making their own pets' food, and feeding a commercial diet may not fulfill this desire. For these patients, feeding a homemade diet formulated by a board-certified veterinary nutritionist<sup>24</sup> may be the best option.

There are also some healthy dogs and cats that refuse to eat a commercial diet. Although this is most often the result of learned behavior, it is the author's opinion that the owners should not be told that, if their pets get hungry enough, they will eat that diet. Not only is this not always true, but it is not in the best interest of any dog or cat to starve, and cats are also at risk of developing hepatic lipidosis if they refuse to eat. Even in healthy pets, starvation has adverse effects. Telling the clients to let their pets starve until they eat the diet the owners want them to eat also has the potential to disrupt the veterinary-client relationship. It also ignores the human-animal

**Box 5****Timeline of United States Food and Drug Administration investigation of diets associated with dilated cardiomyopathy**

2017. Veterinary cardiologists began to notice an increased incidence of DCM in golden retrievers and other breeds of dogs, including breeds that typically are not at risk of developing primary DCM.<sup>85,86</sup>

As veterinary cardiologists and others in the veterinary community investigated factors that these cases shared in common, they discovered that most were consuming grain-free diets.<sup>81,82</sup> These cases were also unusual because many of the cases seemed to be consistent with secondary (nutritional) DCM, and not primary DCM. Dramatic improvement or reversal of DCM in some dogs occurred when the owners changed the dog's diet to a grain-containing diet, often combined with taurine and/or L-carnitine supplementation, as well as appropriate cardiac medications. A concurrent diagnosis of taurine deficiency was made in some dogs with DCM, but this was not a consistent finding.

Members of the veterinary community notified the FDA about these cases and their concern about this problem.

July 12, 2018. The FDA formally announced they were conducting an investigation into the potential connection between diet and cases of canine heart disease.<sup>86</sup> They asked pet owners and veterinary professionals to report cases of DCM to them.

June 27, 2019. The FDA published an update on this investigation.<sup>89</sup> The FDA reported that 91% of the patients with DCM reported to them were consuming grain-free diets, 93% of the diets contained peas and/or lentils, and 89% contained peas. There are numerous breeds of dogs involved with this problem, most of which are not breeds predisposed to primary DCM. The FDA issued the following statement: "Based on the data collected and analyzed thus far, the agency believes that the potential association between diet and DCM in dogs is a complex scientific issue that may involve multiple factors."<sup>89</sup>

Sept 29, 2020. The FDA updated the findings of their investigation at a scientific forum.<sup>84</sup> As of July 20, 2020, more than 1100 cases of dogs with DCM and more than 20 cats with DCM have been reported to the FDA.

Data from a subset of approximately 150 dogs with DCM were presented in greater detail. Group 1 consists of 121 dogs reported to them from January 2018 to April 2019. One-hundred and seven of 121 dogs in this group have had full or partial recovery of the heart disease. Two of 107 cases of full or partial recovery did not have enough information to determine the type of diet these dogs were consuming at the time of their diagnosis. Of the remaining 105 dogs, the following are the characteristics of the diets the dogs were consuming at the time of the diagnosis.

- 98 of 105 (93%) were consuming grain-free diets.
  - 95 of 105 (90%) were consuming a grain-free diet exclusively.
  - 7 of 105 were consuming grain-containing diets.
    - 4 of 7 were consuming a vegan diet with whole peas as the first ingredient.
    - 2 of 7 were consuming chicken or lamb and rice diets containing split peas.
    - 1 of 7 was consuming a lamb meal and rice diet.
  - 100 of 103 (97%) were consuming diets containing whole-pulse ingredients.
  - 0% of cases were exposed to diets with meat by-products or poultry by-products.
- All dogs with DCM in group 1 that fully recovered consumed a different diet from the one they were consuming when the diagnosis of DCM was made.
- 96% consumed a grain-containing diet during the recovery period.
    - 3 consumed hydrolyzed protein diets (2 contained corn starch and 1 contained brewers rice).
    - Peas were reported as the top ingredient in 8% of diets; 4% contained whole peas.
    - None of the recovery diets contained lentils.
    - Meat by-products or poultry by-products were contained in 42% of recovery diets.
    - Lamb meal was present in 8% of recovery diets.

Group 2 consisted of 40 dogs with DCM reported to the FDA from November 2019 to July 2020. To date, 12% recovered fully, 75% have had partial recovery, and 13% had no recovery.

- Diet changes were made in all dogs diagnosed with DCM. The FDA did not provide a breakdown of the diets that group 2 dogs were changed to.



- Key take home points from the FDA's most recent reports include from group 1 dogs include:
  - Most dogs diagnosed with DCM have secondary DCM because dogs are making either full or partial recovery.
  - Most dogs were consuming grain-free diets containing whole-pulse ingredients and no meat by-products or poultry by-products at the time DCM was made.
  - All dogs that have fully recovered were changed to diets containing grains during the recovery period.
  - The association between dogs consuming grain-free diets and developing secondary DCM is clear, and consuming grain-containing diets is an important component in the treatment of dogs that fully recover.
  - The cause of dogs developing DCM while consuming grain-free diets is still unknown; however, there are numerous grain-containing diets not associated with this problem. Veterinarians should reconsider recommending grain-free diets to their clients.

bond that exists, where food often plays an important role in that relationship. Instead, owners should be given advice on how best to transition to a new diet. Sometimes pets do not like the specific brand of food the owner is feeding, so trying a different brand of food results in some pets consuming a commercial diet. Sometimes, a gradual transition, slowly adding more and more of the commercial food while decreasing the alternative diet, can promote acceptance.

## SUMMARY

Commercial pet food has existed for nearly 100 years in the United States. That industry now consists of a diverse range of diets made by a diverse range of companies with varying degrees of expertise. The plethora of misinformation about commercial pet food available on the Internet, through advertising, social media, and other sources has led to many pet owners feeling overwhelmed and confused about what is the best diet to feed their dogs or cats. However, veterinarians are still the most trusted source of information about nutrition for pet owners, and it is important that veterinarians include nutrition as part of routine visits. The commercial pet food industry continues to grow not only in sales but also in the number of companies making commercial diets. As a result, marketing is a way for some companies to distinguish their products from those of their competitors. However, marketing claims are not always supported by research, which can lead to untoward problems, such as what is being seen with grain-free diets and their association with DCM in dogs. Both the commercial pet food industry and the human food industry are highly regulated in the United States, to ensure that both pet food and human food is safe to eat. Although recalls of commercial pet food occasionally occur, they happen less frequently than recalls of human foods. Commercial pet foods are processed, as are essentially all the foods humans consume, and commercial pet food, which is a complete and balanced diet, currently does not fit well into the classification of ultraprocessed foods. These types of foods include candy, cake, and ice cream. In addition, the current definitions of processing are confusing, inconsistent, and do not necessarily correlate with the nutritional content of the food or its safety. Although commercial pet foods provide excellent nutrition and are still the most common type of food fed to pets in the United States, and pets continue to live longer, it is not the best option for all pets. If pet owners do not feed a commercial pet food, it is important that they feed a homemade diet formulated by a board-certified veterinary nutritionist.<sup>24</sup>



## CLINICS CARE POINTS

- Veterinarians remain the most important source of nutritional advice for pet owners.
- Most pet owners want their veterinarians to recommend a diet for their pets, but only about a third of veterinarians routinely provide this information to their clients.
  - Include a discussion about pet nutrition at each pet owner visit.
  - Provide a list of specific pet diets or pet food companies that the practice is comfortable recommending.
  - Provide additional nutritional advice and resources through the clinic's webpage or as printed handouts.
- Be willing to discuss potential myths and misinformation pet owners may have if the pet owner is interested in hearing what your understanding of a particular topic is.
- New information about pet nutrition continues to increase, so it is important for veterinarians to provide current and accurate information to their clients.
  - Many opportunities exist to receive continuing education (CE) in the area of pet nutrition, but choose CE that is given by qualified individuals who support their recommendations with published scientific studies

## DISCLOSURE

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