

Pet Food Production and Ingredient Analysis



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for:



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Table 1, Acronym

| Name or Entity | Acronym |
|---|---------|
| Institute for Feed Education and Research | IFEEDER |
| Pet Food Institute | PFI |
| North American Renderers Association | NARA |

Executive Summary

The pet food manufacturing industry is an increasingly important partner in the agricultural industry. The production of animal and plant-based protein and energy sources for use in pet food is tremendously diverse, providing nearly countless opportunities for creating recipes for the nation's pets. This research has sought to quantify the influence, from a volume and value standpoint, of the pet food manufacturing industry on the broader agriculture community. Consider the following findings from sales in 2018:

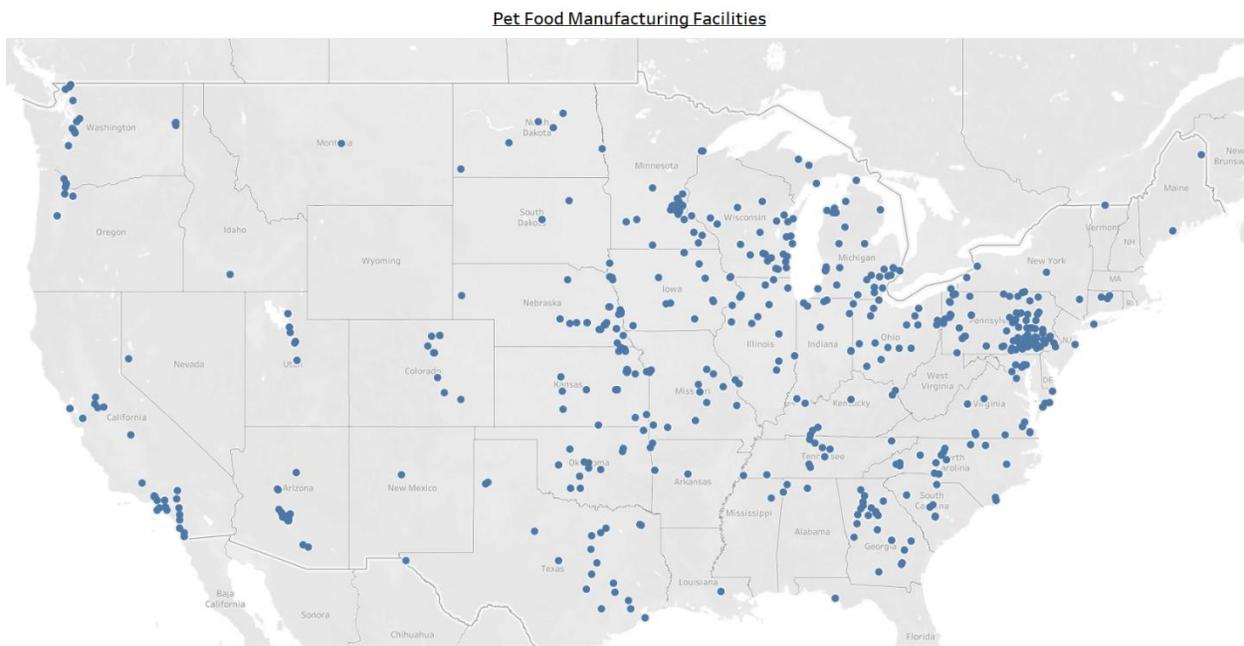
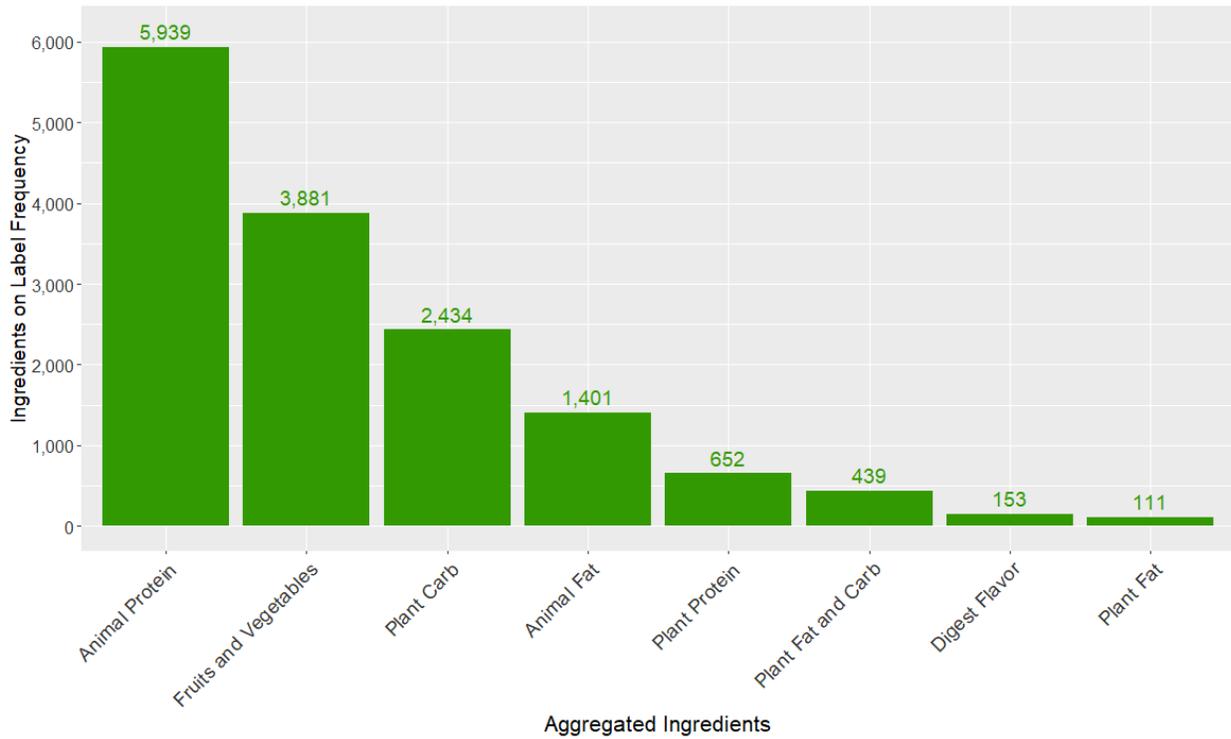
- Farmers and farm-product processors sell \$6.9 billion worth of products to pet food manufacturers every year that are used as ingredients.
- Sales made by farmers and processors of farm products to pet food manufacturers stimulates further upstream economic activity, leading to the purchase of \$5.3 billion of materials and services from farm suppliers providing necessary inputs such as seed, fertilizer, fuel, labor, machinery and repairs to produce high quality products that are used as pet food ingredients.
- In addition, farm suppliers buy \$4.1 billion in materials and services such as fuel, fertilizer, equipment and labor that they in turn sell to suppliers of farmers.
- The data analyzed indicates that 2018 U.S. retail dog and cat food sales were estimated to be \$30.3 billion from 9.8 million tons of product sales.
- Among all pet food products, the lead product was dry dog food by both volume and value, with 5.6 million tons (57% of total) and \$11.2 billion dollars (37% of total).
- Pet foods use a wide variety of ingredients. The “reverse engineering” of the pet food ingredients from the retail product labels identified 542 standardized food ingredients used in dog and cat foods. These ingredients were further categorized into 353 similar or combined ingredient classifications for which quantities and prices were determined.
- There are 164 ingredients shared by both cat and dog foods.
- There were 8.65 million tons of food ingredients used in U.S. dog and cat food manufacturing with an ingredient value of \$6.9 billion¹.
 - There were 4.0 million tons of farm and farm-product processor ingredients valued at \$1.4 billion.
 - There are more than 3.8 million tons of animal-based products with a value of \$4.6 billion used in dog and cat foods.
 - There were 1.83 million tons of meat and poultry products valued at \$3.1 billion.
 - Rendered protein meals contributed 1.5 million tons with a value of \$563 million.

¹ See Appendix D for additional information regarding comparison to total reported volumes.

- There were 289,037 tons of animal and poultry fats with a value of \$153 million.
- Broth ingredients account for 166,851 tons with a value of \$834 million.
 - Fishery ingredients contributed 198,671 tons with a value of \$893 million.
 - Water and minerals contributed 571,164 tons with a value of \$13.7 million.
- By weight, whole grains (1,869,087 tons) are the most used ingredients in dog and cat foods. This is followed by chicken (854,988 tons), meat and bone meal (635,652 tons), corn gluten meal (476,599 tons) and soybean meal (437,251 tons).
- By value, beef (\$1.22 billion), lamb (\$691 million), chicken (\$650 million), salmon (\$430 million) and chicken broth (\$353 million) are the top five ingredients.
- Among all the 542 standardized food ingredients, 280 of them were aggregated into nutrient groups such as animal protein, animal fat, plant protein, plant carbohydrate, fruit and vegetable crop ingredients, etc. Animal protein ingredients comprised a majority of the total number of ingredients, followed by fruit and vegetable crop ingredients such as apples, blueberries, peas, spinach, etc.

Introduction

As shown in the following map, there are pet food manufacturing facilities in 42 of 50 states. The pet food produced throughout these facilities is diverse in quantity, type and the inclusion and prevalence of many types of ingredients. In many ways, the production and marketing of pet food is not all that different than the food sold to pet owners.



There have been numerous efforts to quantify the volumes and value of pet foods sold. To meet the needs and expectations of pet owners, maintain profitability and still provide nutritionally-balanced food for dogs and cats, substantial efforts are routinely conducted by pet food manufacturers to better understand trends in consumer preferences and their ability and willingness to pay for diverse ingredients.

Understanding pet food ingredient composition and consumption is uniquely complicated when compared to livestock and poultry feed consumption because of at least the following:

- Pets can be considered “family” – pet food is marketed and produced similarly to human food and health trends find their way to pet food.
- Ingredient inputs can include both human grade as well as other ingredients deemed suitable for use in animal food.
- Consumption of pet food is not necessarily close to points of production. It’s not a stretch to say that pet food produced in Missouri can be purchased in Washington, California, Texas, Maine or Florida. Likewise, pet food ingredients are sourced locally, regionally and nationally. Pet food ingredients are also sourced through a variety of purchasing channels: direct from farm, through brokers, direct from farm-product processors, from renderers, etc.
- There are many breeds and sizes of cats and dogs, each with unique nutritional requirements.
- While certain minimum nutritional standards need to be met, these standards can be met in a variety of ways and pet food manufacturers do not generally share their formulations.

This effort seeks to overcome the above challenges in drawing conclusions about pet food ingredients by creating and then adopting a thorough methodological framework, which utilizes multiple, large data sources (purchased and publicly-available), extensive online research, the use of scripting, statistical and data manipulation software, industry experience and a wide variety of technical skills offered by the DIS team.

A few notes for reference that readers will find useful:

- By virtue of the nature of the purchased Nielsen dataset, for the purpose of this report, “pet food” is defined as dog and cat food only. This includes all forms of dog and cat food such as dry/kibble, moist, wet/canned, treats, etc.
- The Nielsen data used to do the reverse ingredient analysis is not the complete “universe” of pet food sales but assumed to be a representative sample. According to the Petfoodindustry.com 2018 Industry Report, total pet food sales in 2018 reached \$30.3 billion. Thus, the data purchased for this analysis represents approximately 68.3%

of national sales. Topline numbers have been “factored up” to estimate total U.S. sales of cat and dog food. The factor used is 1.465 which is 1 divided by 0.683.

- The Nielsen data represents retail sales and therefore does not seek to quantify “upstream” volumes and values. The DIS team has used a variety of data sources, software and industry experience to estimate the upstream volumes and values.

Results

Using methodology outlined in Appendix A, the following results are presented here:

1. Total national pet food retail volume and sales (total, cats and dogs)
2. Upstream volume and sales
3. Sales analysis (total, cats and dogs)
4. Ingredient analysis (total, cats and dogs)

While there are many charts and maps included in this section as images, we point readers to [this link](#) for an interactive visualization tool to gain additional insight into ingredient quantities included in cat and dog foods by species (dogs and cats), aggregated food type, commodity type and state.

Total National Pet Food Retail Volume and Sales

As stated by Nielsen, the pet foods analyzed for this study directly represented about 68.3% of national retail pet food sales. Total U.S. pet food volume and sales, and the upstream volumes and values presented here, have been factored up by 1.4648 which is 1 divided by 0.683. Thus, the tables and charts in this section reflect values for the U.S. pet food industry as a whole and not just the Nielsen data directly analyzed.

Table 2 shows total 2018 U.S. retail dog food and cat food sales which is estimated to be more than \$30 billion from 9.8 million tons² of product sales.

Table 2, Total U.S. Retail Pet Food Volume and Sales

| Total U.S. Retail Pet Food Volume and Sales - 2018 | | |
|---|------------------|-------------------------|
| Pet Food Category | Tons | Value |
| Dog Food Dry | 5,566,057 | \$11,200,781,260 |
| Dog Food Moist | 83,294 | \$189,536,920 |
| Dog Food Wet | 934,143 | \$3,442,725,642 |
| Dog Treats | 547,046 | \$6,219,381,116 |
| Cat Food Dry | 1,761,347 | \$4,216,919,904 |
| Cat Food Wet | 884,848 | \$4,054,279,323 |
| Cat Treats | 60,914 | \$1,061,199,978 |
| Total | 9,837,648 | \$30,384,824,143 |
| Note: Data factored up from Nielsen Data to represent National Data | | |

² Where data are reported in terms of weight throughout this report, "ton" is used, which is 2,000 pounds.

Summary of Total Ingredient Analysis

Nielsen data were obtained for U.S. retail pet food sales. This data was analyzed for its standardized ingredient content by both ingredient and weight of the ingredients in those pet foods. In total, there were 542 standardized food ingredients found to be used in the pet foods analyzed. These 542 standardized food ingredients were further categorized into 353 similar or combined ingredient classifications. These 353 ingredients were then used to quantify total ingredient weight. Representative wholesale prices for these ingredients were obtained from a variety of public data sources and from internet searches on wholesale markets. Total ingredient values were determined by multiplying the quantity of each ingredient (tons) by its associated price per ton.

Upstream Volumes and Values

For summary presentation, the major pet food ingredients were categorized into the following primary categories: farm and mill-based ingredients (ingredients from grains and oilseeds, processed grain and oilseed products, dairy products, egg products, forages, fruits, herbs, nuts, root crops, sweeteners, tree oils and vegetables), fresh or frozen meat and poultry products, rendered protein meals, water, fishery products and ingredients, broth from animal and poultry products, and minerals and other additives. The summary of the ingredient product-types and commodity-types are listed in Appendix B.

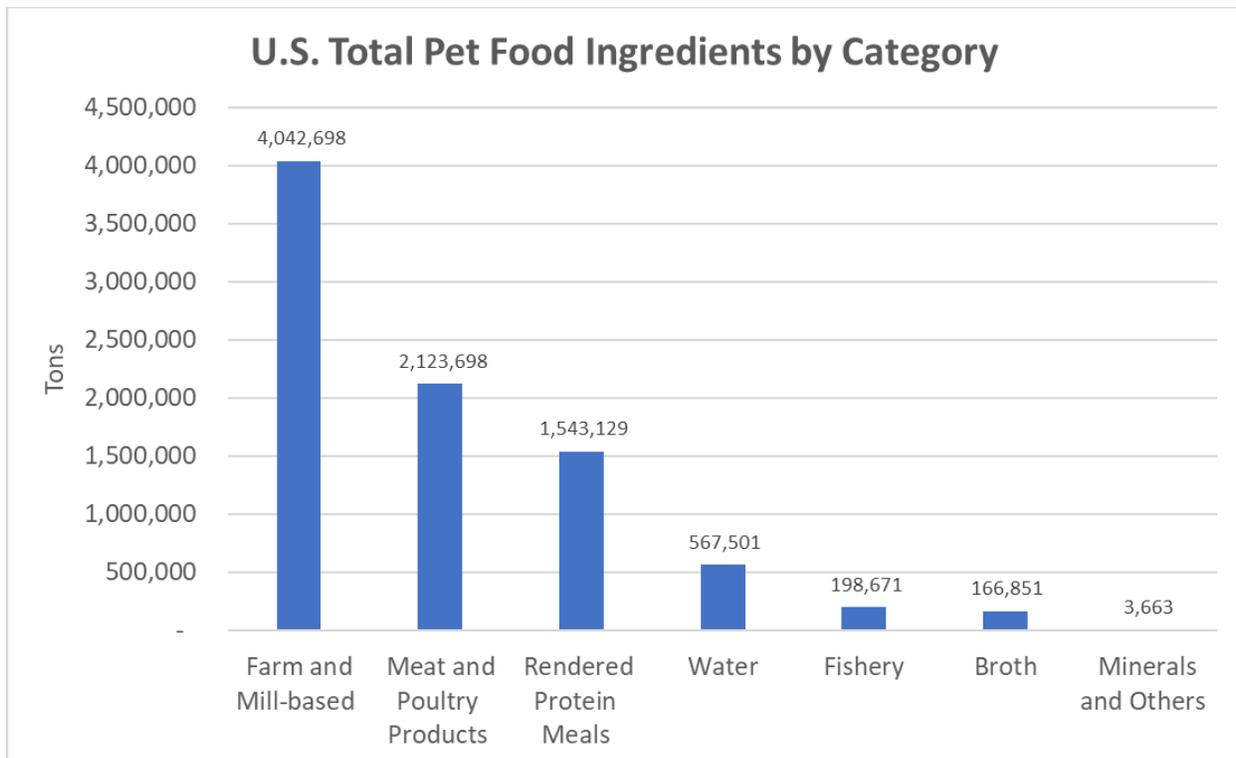


Figure 1, Pet Food Ingredients by Category

Farm and mill-based products make up 46.8% of the ingredient tonnage, but only 20.1% of the ingredient value (see Table 3). Similarly, fresh and frozen meat and poultry products, which includes fresh meat and poultry by-products and organ meats, make up 24.6% of tonnage and 46.7% of ingredient value. Rendered protein products are 17.8% of tonnage but 8.1% of ingredient value. Fishery ingredients make up 2.3% of ingredient tonnage but 12.9% of ingredient value. Broth makes up 1.9% of tonnage and 12.0% of ingredient value.

Total food ingredients used in U.S. pet food manufacturing was 8.65 million tons with an ingredient value of \$6.9 billion. Meat and poultry products are 2.1 million tons valued at \$3.2 billion. Farm and mill-based ingredients are 4.0 million tons valued at \$1.39 billion. Rendered protein meals are 1.5 million tons with a value of \$563 million. Water as an ingredient is 568,000 tons with a value of \$1.13 million. Fishery ingredients are 198,671 tons with a value of \$893 million and broth ingredients accounts for 166,851 tons with a value of \$834 million. Not all minerals nor all minor additives were included in the analysis, but for the major minerals and other ingredients calculated, there are 3,663 tons with a value of \$12.5 million. The estimated total weight of all non-food ingredients such as minerals, additives and preservatives is 13% of total ingredient weight and explains the difference between the 9.84 million tons of pet food sold at retail versus the 8.65 million tons of pet food “food” ingredients analyzed in this study.

Table 3, U.S. Total Pet Food Ingredients by Category

| U.S. Total Pet Food Ingredients by Category | | |
|--|------------------|------------------------|
| Commodity Type | Tons | \$ Value |
| Meat and Poultry Products | 2,123,698 | \$3,242,773,275 |
| Farm and Mill-based | 4,042,698 | \$1,394,879,026 |
| Fishery | 198,671 | \$893,153,404 |
| Broth | 166,851 | \$834,255,514 |
| Rendered Protein Meals | 1,543,129 | \$562,588,878 |
| Minerals and Others | 3,663 | \$12,520,150 |
| Water | 567,501 | \$1,135,003 |
| Grand Total | 8,646,211 | \$6,941,305,251 |
| Note: Data factored up from Nielsen Data to represent National Data | | |
| Note: Commodity Type of all ingredients Items are listed in the Appendix | | |

Because of the prominence of animal-based ingredients in pet foods, a summary of the animal-based ingredients is shown. Animal-based products account for 3.83 million tons of ingredients with a total U.S. value of \$4.64 billion (see Table 4, Figure 2 and Figure 3). Animal-based

ingredients include the fresh and frozen meat and poultry, broth, meat and poultry by-products and organ meats, rendered protein meals (poultry meal, animal meal, fish meal) and animal fats and poultry fats.

Table 4, U.S. Total Pet Food Animal-based Ingredients

| U.S. Total Pet Food Animal-based Ingredients | | |
|---|------------------|------------------------|
| Commodity Type | Tons | \$ Value |
| Meat and Poultry | 1,333,248 | \$2,794,604,543 |
| Broth | 166,851 | \$834,255,514 |
| By-Product and Organ Meat | 501,413 | \$294,733,555 |
| Poultry Meal | 768,949 | \$276,747,695 |
| Animal Meal | 715,130 | \$211,345,820 |
| Animal Fat | 232,174 | \$125,003,968 |
| Fish Meal | 59,050 | \$74,495,363 |
| Poultry Fat | 56,862 | \$28,431,210 |
| Total Animal-based Ingredients | 3,833,678 | \$4,639,617,668 |

Note: Data factored up from Nielsen Data to represent National Data
 Note: Commodity Type of all ingredients Items are listed in the Appendix

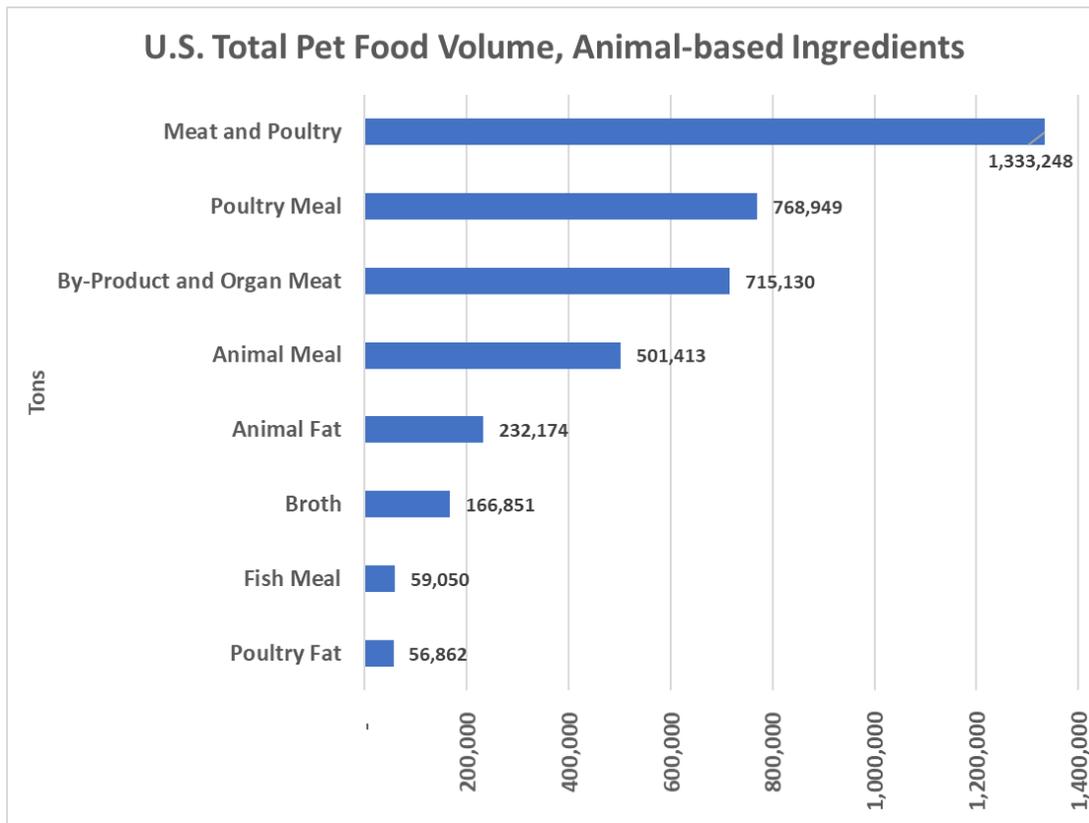


Figure 2, U.S. Total Pet Food Animal-based Ingredients

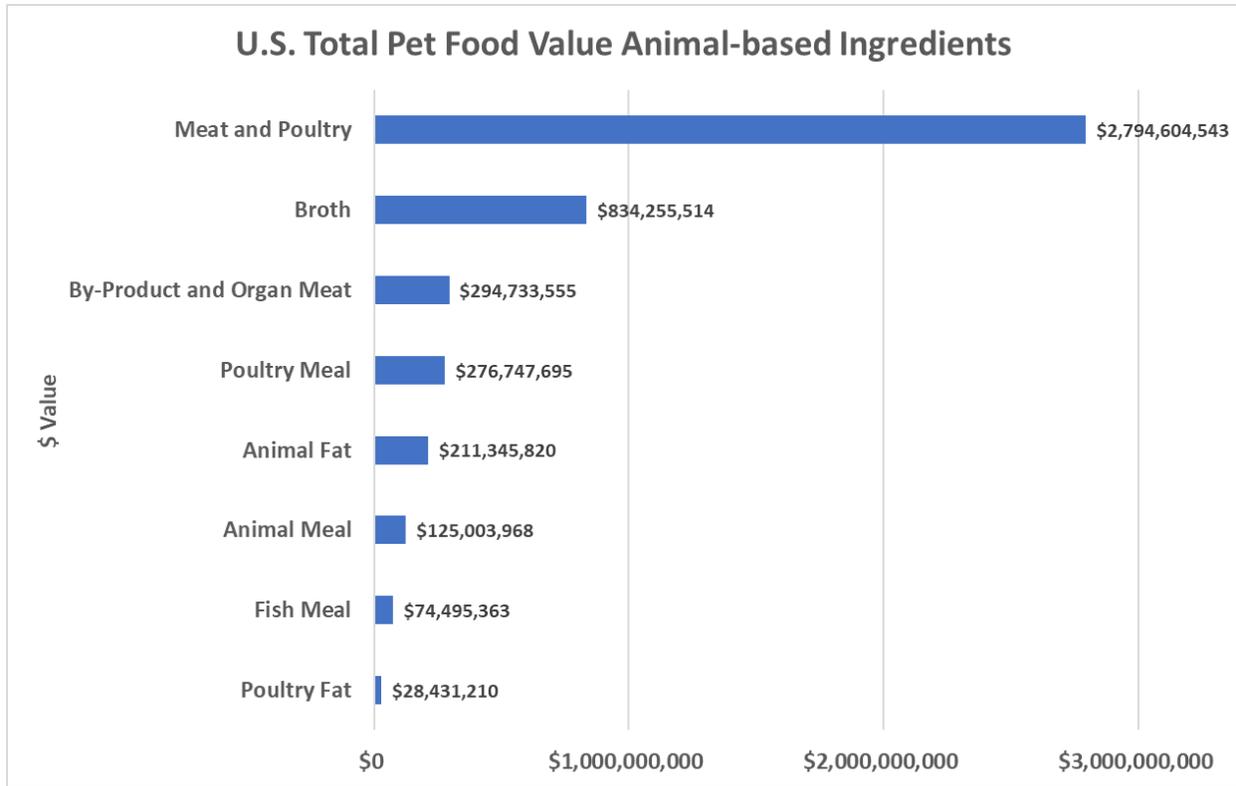


Figure 3, U.S. Total Pet Food Value Animal-based Ingredients

Rendered protein meals are made primarily from by-products of beef, pork, lamb, chicken and turkey production. The rendering processing takes a variety of nutritious animal and poultry by-products of with relatively low value and makes them into sustainable, higher-value feed products with relatively high protein content. There are 1.5 million tons of rendered protein meals in pet foods with a value of \$563 million (see Table 5, Figure 4 and Figure 5).

Table 5, U.S. Total Pet Food Rendered Protein Meal Ingredients (Aggregated)

| U.S. Total Pet Food Rendered Protein Meal Ingredients | | |
|--|------------------|--------------------|
| Item | Tons | \$ Value |
| Poultry Meals | 768,949 | 276,747,695 |
| Meat and Bone Meals | 714,921 | 211,057,665 |
| Fish Meals | 59,050 | 74,495,363 |
| Bone Meal | 209 | 288,155 |
| Total Rendered Protein Meals | 1,543,129 | 562,588,878 |
| Note: Data factored up from Nielsen Data to represent National Data | | |
| Note: Commodity Type of all ingredients Items are listed in the Appendix | | |

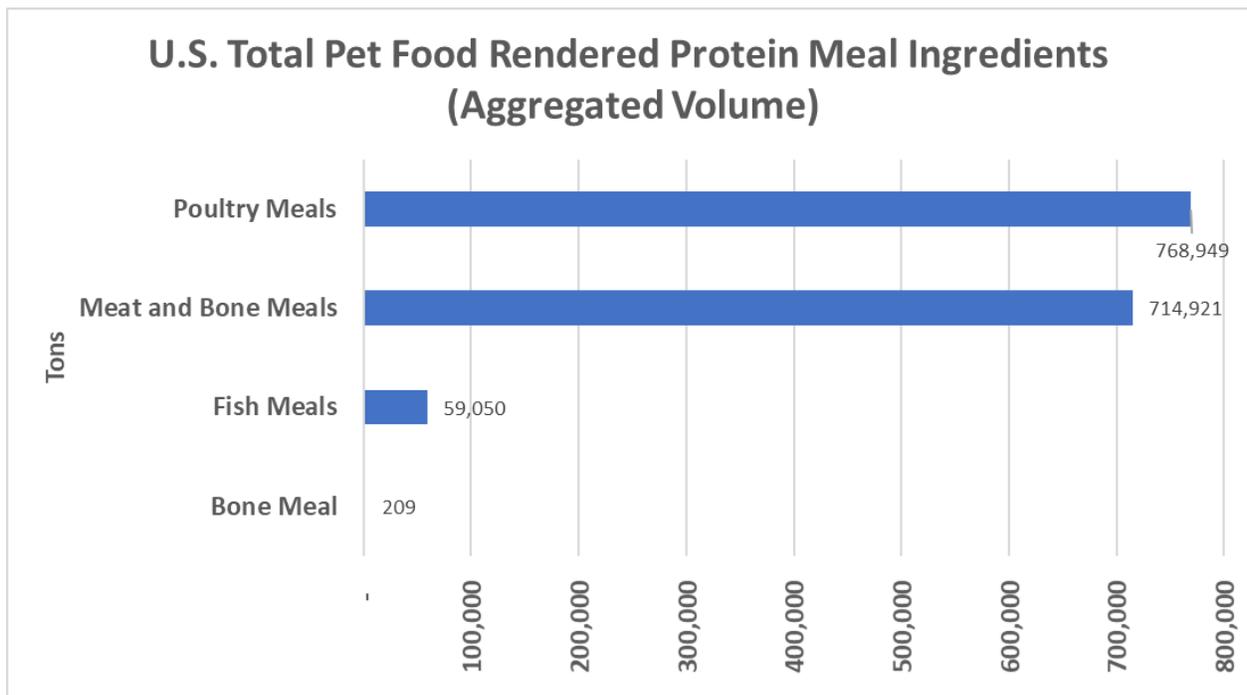


Figure 4, U.S. Pet Food Rendered Protein Meal Ingredients (Aggregated)

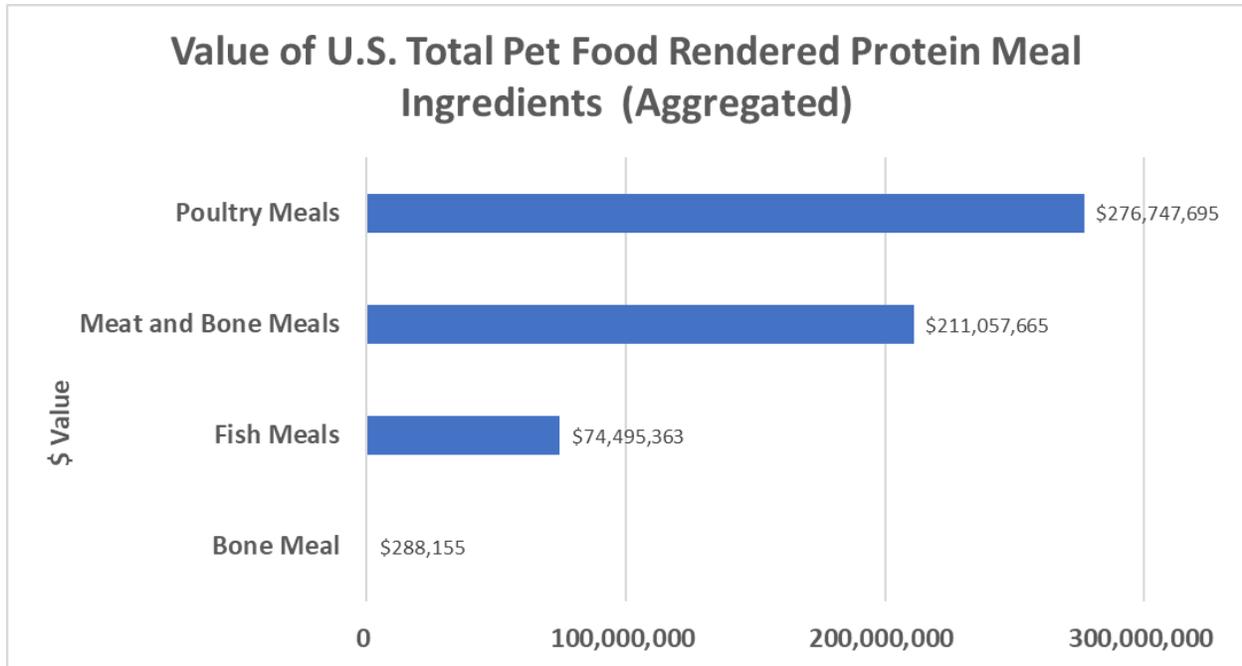


Figure 5, Value of U.S. Total Pet Food Rendered Protein Meal Ingredients (Aggregated)

Meat and bone meal is the most used rendered protein ingredient in pet foods at 635,652 tons, valued at \$184.6 million (see Table 6, Figure 6 and Figure 7). Other significant rendered protein ingredients include chicken by-product meal (353,608 tons, \$126.9 million value), chicken meal (192,370 tons, \$69.1 million value) and poultry by-product meal (190,023 tons, \$68.2 million value). Volumes and values from other protein meals can be found in Table 6.

Table 6, U.S. Total Pet Food Rendered Protein Meal Ingredients

| U.S. Total Pet Food Rendered Protein Meal Ingredients | | |
|--|------------------|----------------------|
| Item | Tons | \$ Value |
| Meat and Bone Meal | 635,652 | \$184,581,405 |
| Chicken By-product Meal | 353,608 | \$126,933,164 |
| Chicken Meal | 192,370 | \$69,054,065 |
| Poultry By-product Meal | 190,023 | \$68,211,595 |
| Fish Meal | 35,245 | \$62,030,697 |
| Lamb Meal | 40,649 | \$18,443,414 |
| Salmon Meal | 17,893 | \$10,716,376 |
| Turkey Meal | 17,578 | \$7,031,267 |
| Turkey By-product Meal | 15,371 | \$5,517,604 |
| Beef Meal | 26,011 | \$3,901,628 |
| Meat Meal | 8,669 | \$3,343,249 |
| Shrimp Meal | 3,161 | \$932,324 |
| Pork Meal | 3,940 | \$787,969 |
| Tuna Meal | 1,981 | \$449,420 |
| Crab Meal | 769 | \$366,546 |
| Bone Meal | 209 | \$288,155 |
| Total Rendered Protein Meals | 1,543,129 | \$562,588,878 |
| Note: Data factored up from Nielsen Data to represent National Data | | |
| Note: Commodity Type of all ingredients Items are listed in the Appendix | | |

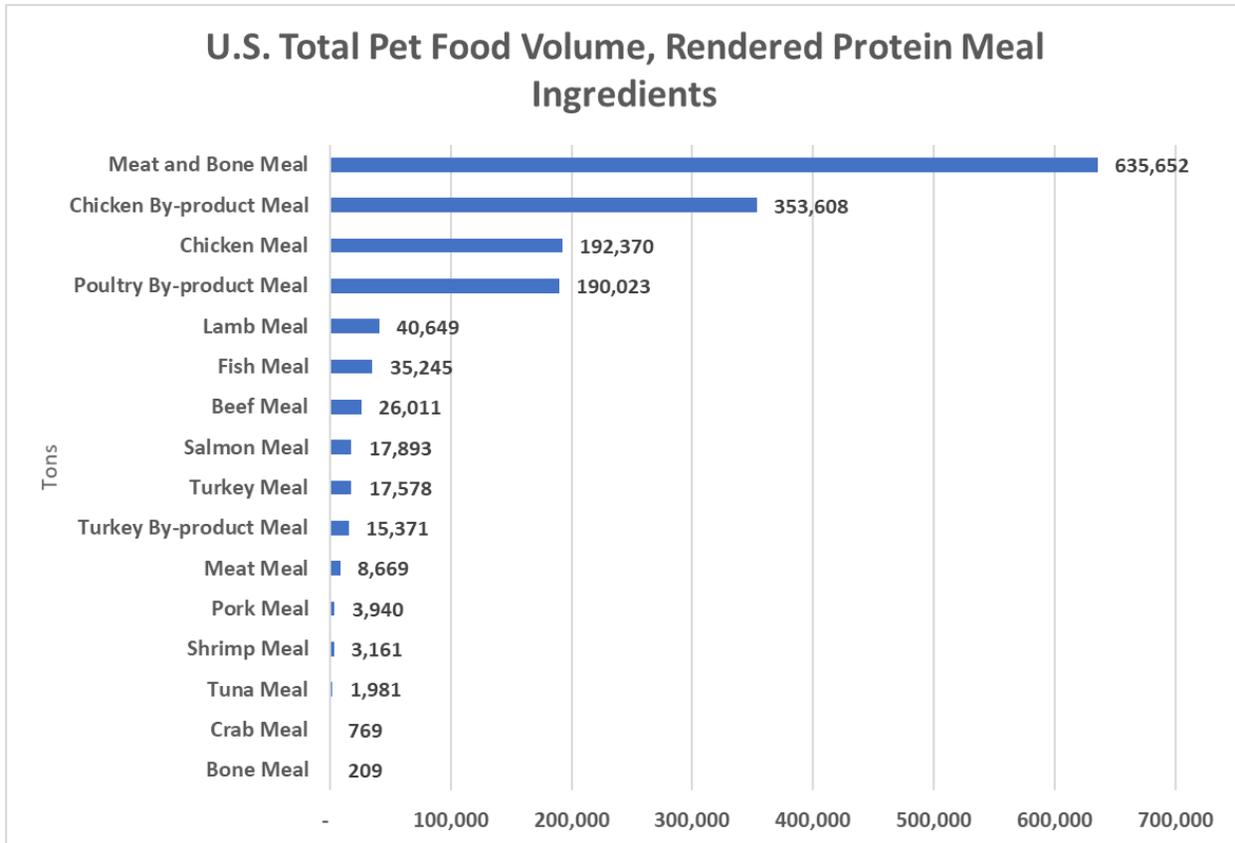


Figure 6, U.S. Total Pet Food Rendered Protein Meal Ingredients

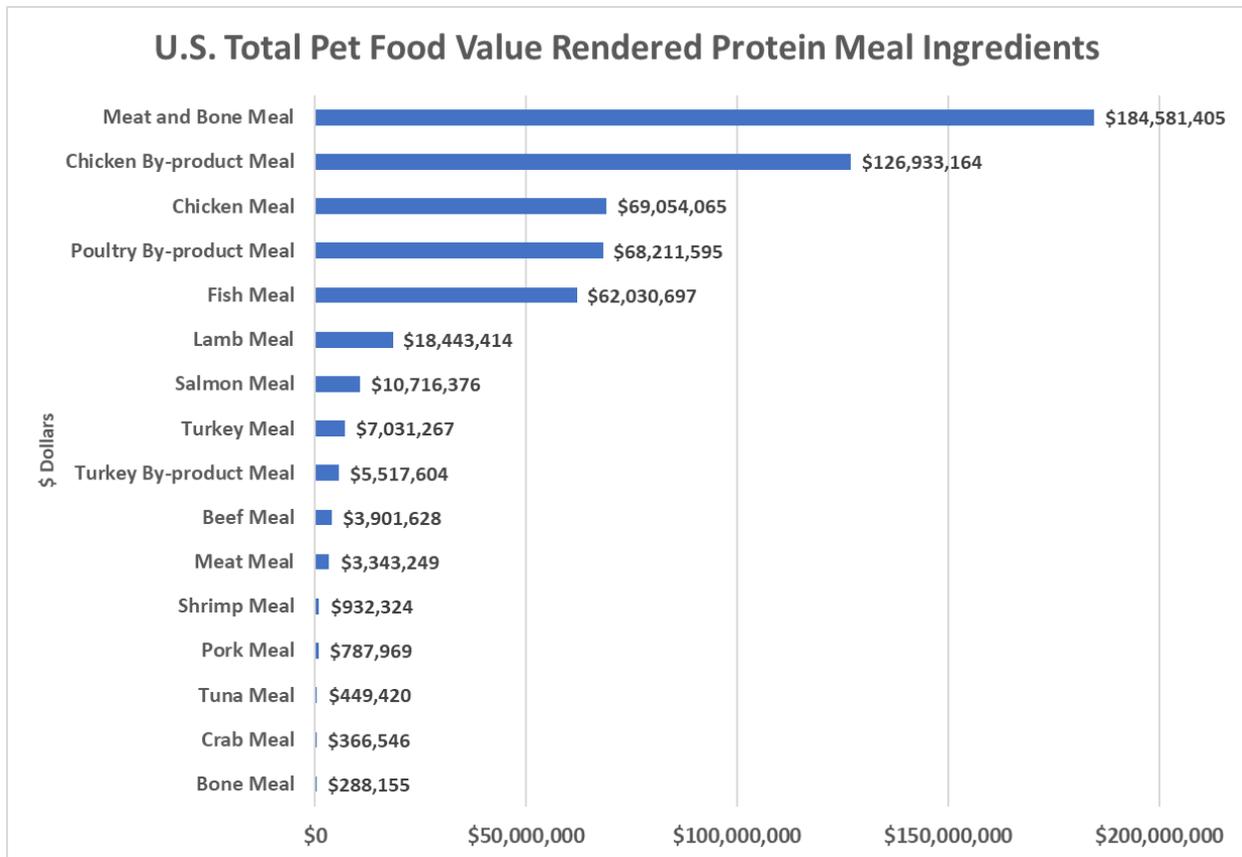


Figure 7, U.S. Total Pet Food Value Rendered Protein Meal Ingredients

Referring to Table 7, Figure 8 and Figure 9, there are 31 ingredient groups from animal and poultry processing and/or rendering that are used in pet foods. The title “slaughter/rendering” is used for this category since some of the products can be sourced directly from animal and poultry processing facilities and some of the same products can be sourced from rendering facilities. The leading ingredients by value are beef (244,113 tons, \$1.2 billion value), lamb (86,375 tons, \$690 million value) and chicken (854,988 tons, \$650 million value). Volumes and values from other “slaughter/rendering” can be found in Table 7.

Table 7, U.S. Total Pet Food Ingredients from Slaughter/Rendering

| U.S. Total Pet Food Ingredients from Slaughter/Rendering | | |
|--|------------------|------------------------|
| Item | Tons | \$ Value |
| Beef | 244,113 | \$1,220,567,238 |
| Lamb | 86,375 | \$690,998,965 |
| Chicken | 854,988 | \$649,791,168 |
| Turkey | 74,734 | \$119,574,657 |
| Organ Meat | 149,673 | \$89,803,719 |
| Digest Flavor | 88,146 | \$88,146,296 |
| Beef Fat | 132,456 | \$72,850,575 |
| Animal Fat | 98,147 | \$51,409,408 |
| Meat By-products | 137,684 | \$49,153,149 |
| Pork | 14,437 | \$43,311,698 |
| Poultry | 34,332 | \$27,063,577 |
| Other Animal By-products | 31,445 | \$25,156,160 |
| Chicken Fat | 43,778 | \$21,888,996 |
| Chicken By-products | 31,909 | \$13,596,616 |
| Beef By-products | 29,320 | \$12,959,231 |
| Bacon | 1,891 | \$12,401,893 |
| Poultry By-products | 25,622 | \$10,917,502 |
| Bison | 3,589 | \$10,049,177 |
| Duck | 10,221 | \$8,346,179 |
| Venison | 7,734 | \$7,017,703 |
| Poultry Fat | 13,084 | \$6,542,213 |
| Wild Boar | 802 | \$5,450,693 |
| Gelatin | 657 | \$3,400,241 |
| Pork By-products | 5,913 | \$792,329 |
| Animal Plasma | 695 | \$520,973 |
| Pork Fat | 1,186 | \$480,157 |
| Bacon Fat | 386 | \$263,828 |
| Hydrolyzed Chicken Liver | 246 | \$246,148 |
| Animal Liver Flavor | 103 | \$41,190 |
| Pheasant | 27 | \$22,385 |
| Ham | 6 | \$9,212 |
| Total Slaughter/Rendering Ingredients | 2,123,698 | \$3,242,773,275 |
| Note: Data factored up from Nielsen Data to represent National Data | | |
| Note: Commodity Type of all ingredients Items are listed in the Appendix | | |

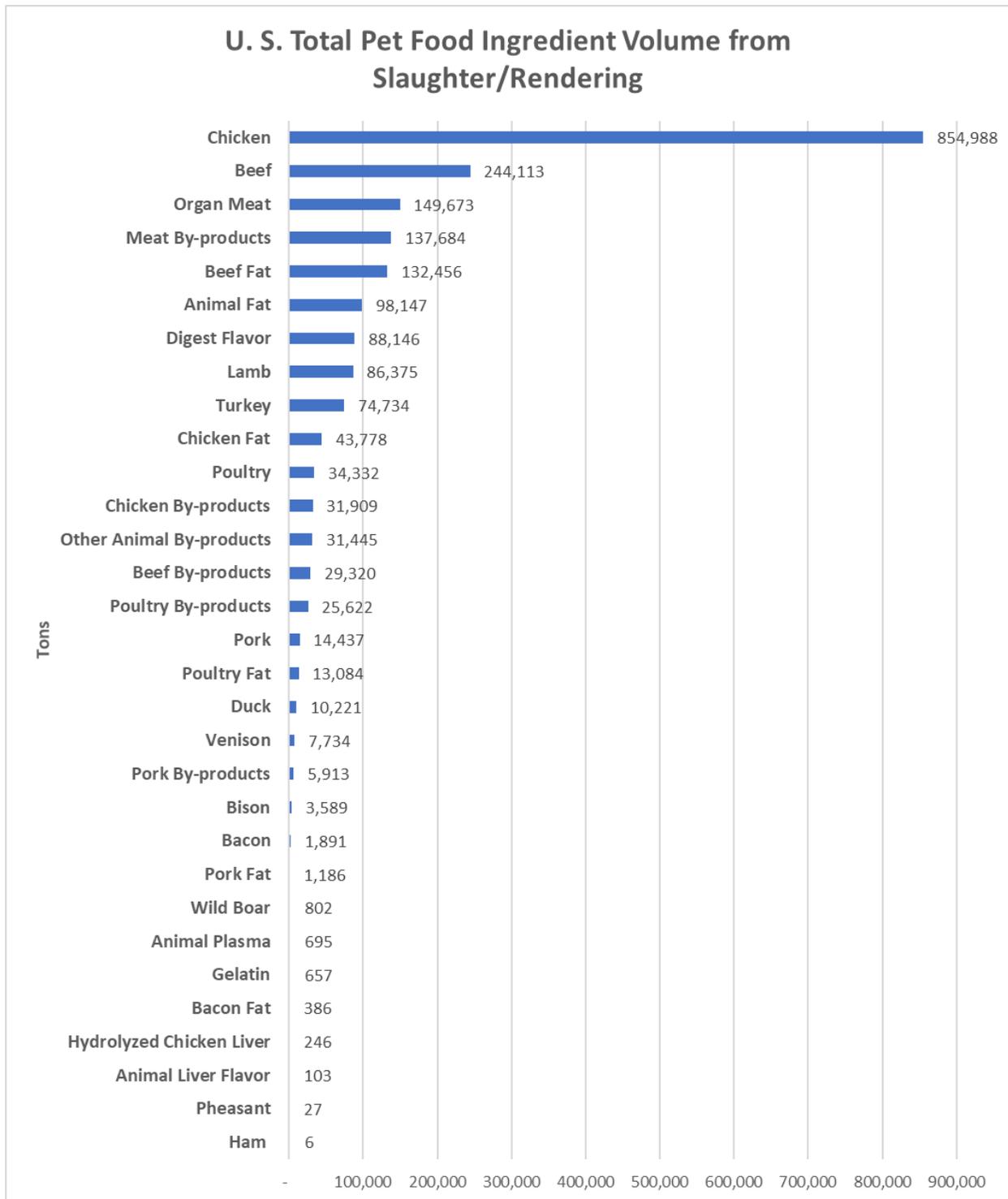


Figure 8, U.S. Total Pet Food Ingredients from Slaughter/Rendering

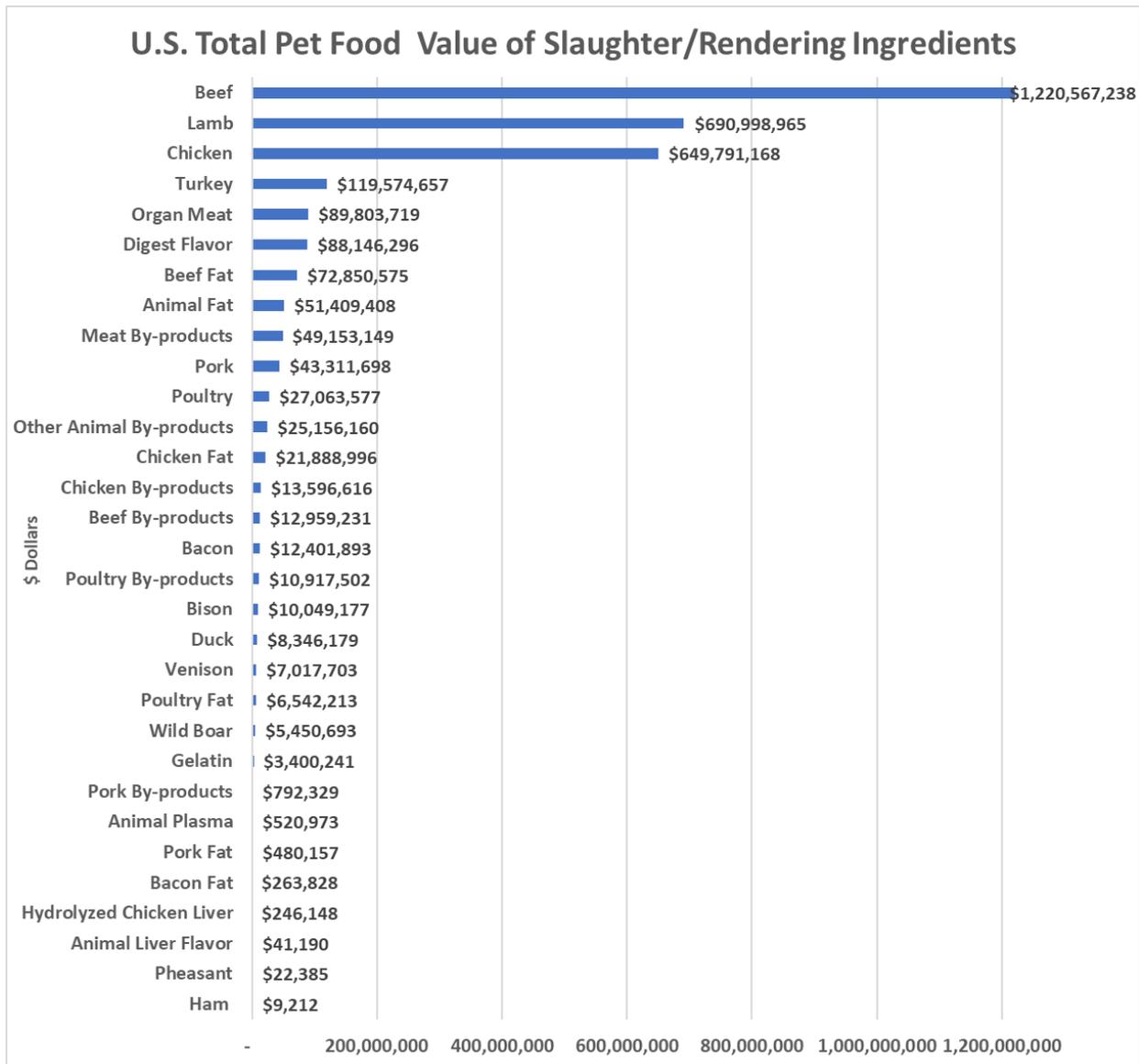


Figure 9, U.S. Total Pet Food Value of Slaughter/Rendering Ingredients

Referring to Table 8, Figure 10 and Figure 11, 4.0 million tons of farm and mill-based ingredients used in pet foods are valued at \$1.4 billion. This category includes unprocessed ingredients sourced directly from the farm such as whole grains (barley, corn, oats and wheat), mill feeds (malted barley, corn gluten feed, corn meal, rice flour, etc.), soy products (soybean meal, soy protein concentrates, etc.), fruits and vegetables (dried beans carrots, green beans, celery, tomatoes, squash, etc.), dairy and egg products, root products (peanuts, peanut butter, chicory root, etc.), vegetable oils (soybean oil, canola oil, coconut oil, etc.) and sweeteners (sugar, corn sugar, etc.).

In the mill feed product category, there are five alfalfa products, nine barley products, four coconut/palm products, 16 processed corn products and six milled oat products. Vegetable

products include beets, broccoli, carrots, celery, pumpkin, tomatoes and yams, to name a few. The full list of all farm and mill-based ingredients is in Appendix B, Ingredient List and Categorization Used for Upstream Analysis.

Table 8, U.S. Total Pet Food Ingredients from Farm and Mill-based

| U.S. Total Pet Food Farm and Mill-based Ingredients | | |
|---|------------------|------------------------|
| Ingredient Category | Tons | \$ Value |
| Mill Feed | 1,164,019 | \$612,764,471 |
| Whole Grain | 1,869,087 | \$297,429,027 |
| Soy Product | 534,069 | \$182,024,067 |
| Fruit and Vegetable | 346,434 | \$160,579,975 |
| Dairy and Egg | 95,151 | \$112,467,832 |
| Root | 15,728 | \$15,888,767 |
| Vegetable Oil | 12,206 | \$10,304,888 |
| Sweetener | 6,004 | \$3,419,998 |
| Farm and Mill-based Total | 4,042,698 | \$1,394,879,026 |

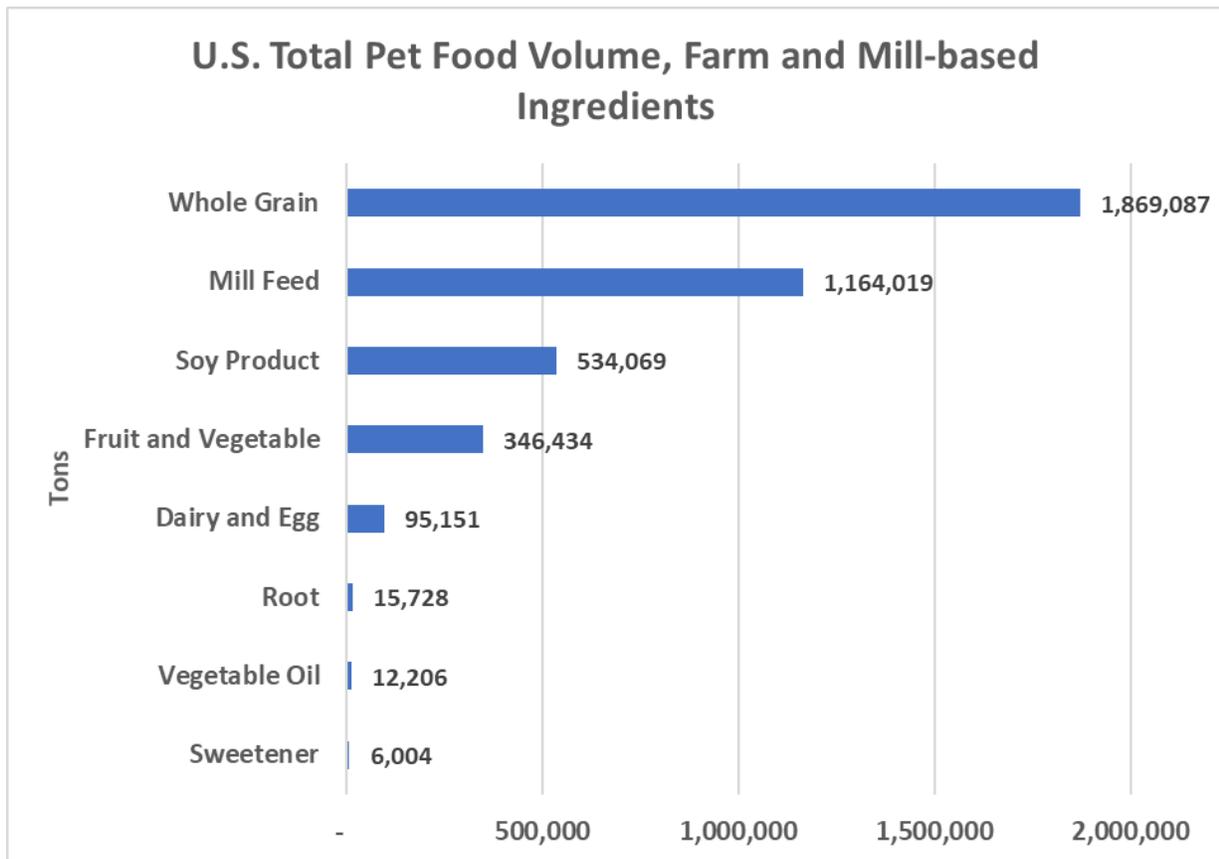


Figure 10, U.S. Total Pet Food Ingredients from Farm and Mill-based Products

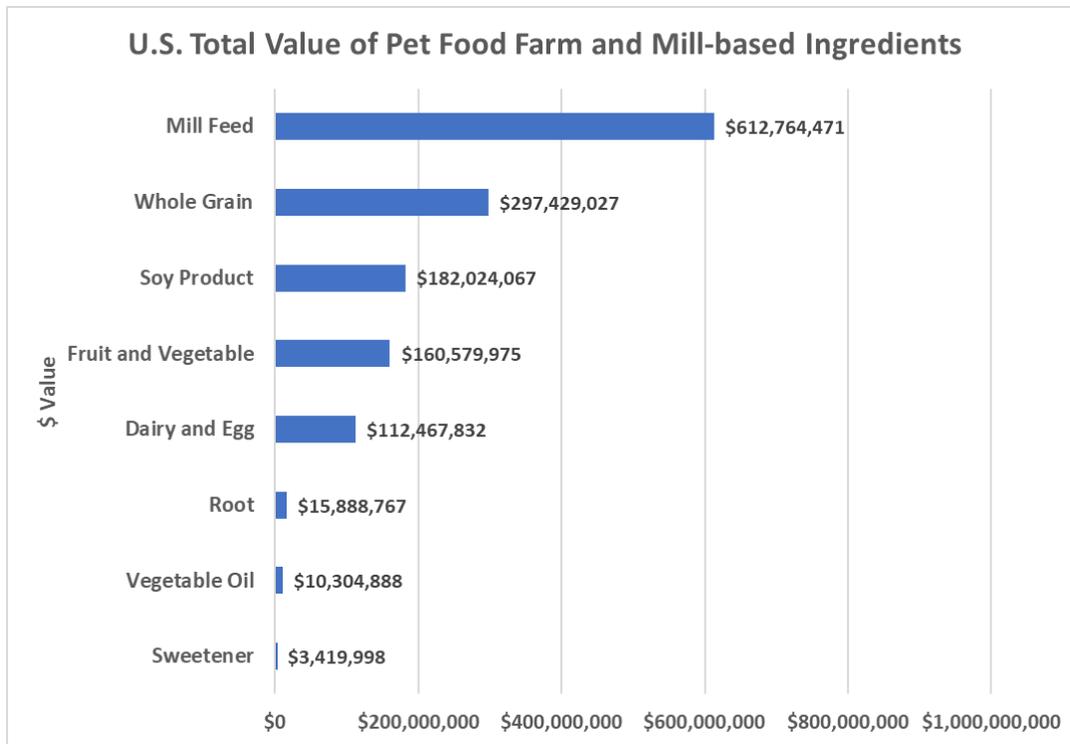


Figure 11, U.S. Total Value of Pet Food Farm and Mill-based Ingredients

Referring to Table 9, Figure 12 and Figure 13, there are 198,671 tons of fishery ingredients in pet foods with a value of \$893 million. Fishery ingredients include a variety of fish and fish products such as salmon, tuna, whitefish, cod, etc., fish oil products, anchovies, crab and mussels. Kelp, kelp meal, algae and seaweed meal, while not fish products, are included in this category.

Table 9, U.S. Total Pet Food Ingredients from Fishery

| U.S. Total Pet Food Ingredients from Fishery | | |
|--|----------------|----------------------|
| Item | Tons | \$ Value |
| Salmon | 87,495 | \$429,521,196 |
| Other Fish | 49,072 | \$123,634,040 |
| Tuna | 14,472 | \$101,301,814 |
| Cod | 10,270 | \$88,692,469 |
| Whitefish | 29,052 | \$85,416,069 |
| Fish Oils | 5,104 | \$54,406,300 |
| Shrimp | 3,206 | \$10,181,473 |
| Total Fishery Ingredients | 198,671 | \$893,153,362 |
| Note: Data factored up from Nielsen Data to represent National Data | | |
| Note: Commodity Type of all ingredients Items are listed in the Appendix | | |

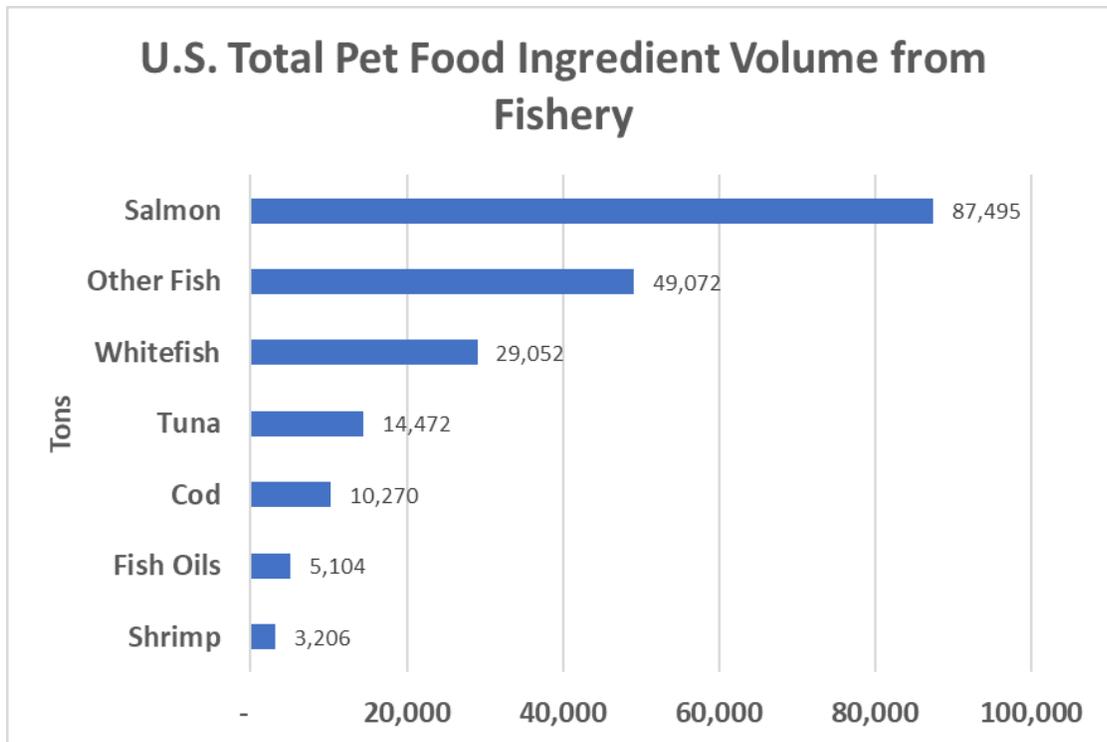


Figure 12, U.S. Total Pet Food Ingredients from Fishery

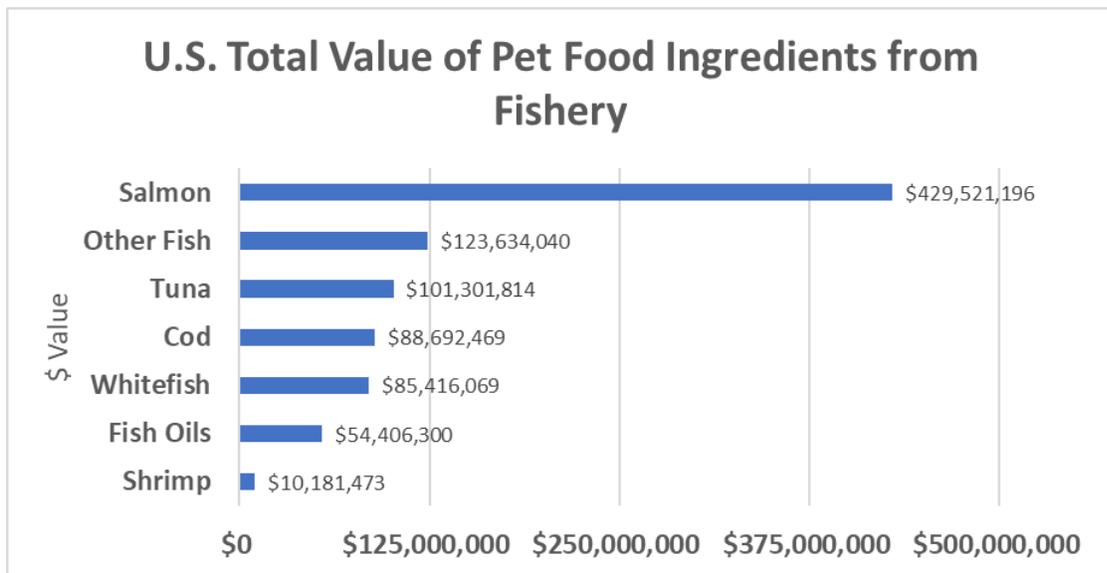


Figure 13, U.S. Total Value of Ingredients from Fishery

Referring to Table 10, Figure 14 and Figure 15, there are 166,851 tons of broth ingredients in pet foods with a value of \$834 million. Wet broth ingredients tend to be used in wet dog and cat foods and a dried broth ingredient in dry dog and cat foods. The leading broth ingredient is chicken broth (70,563 tons, \$353 million value), beef broth (39,580 tons, \$198 million value) and unspecified poultry broth (27,046 tons, \$135 million value). Other broths used include fish

broth, bacon broth, chicken and turkey broth, meat broth, turkey broth, tuna broth, lamb broth, lamb and chicken broth, vegetable broth, pork broth and liver broth.

Table 10, U.S. Total Pet Food Ingredients from Broth

| U.S. Total Pet Food Ingredients from Broth | | |
|--|----------------|----------------------|
| Item | Tons | \$ Value |
| Chicken Broth | 70,563 | \$352,812,987 |
| Beef Broth | 39,580 | \$197,900,124 |
| Poultry Broth | 27,046 | \$135,229,749 |
| Fish Broth | 15,018 | \$75,091,496 |
| Other Broths | 14,644 | \$73,221,158 |
| Total Broth Ingredients | 166,851 | \$834,255,514 |
| Note: All broth valued at \$250/cwt | | |
| Note: Data factored up from Nielsen Data to represent National Data | | |
| Note: Commodity Type of all ingredients Items are listed in the Appendix | | |

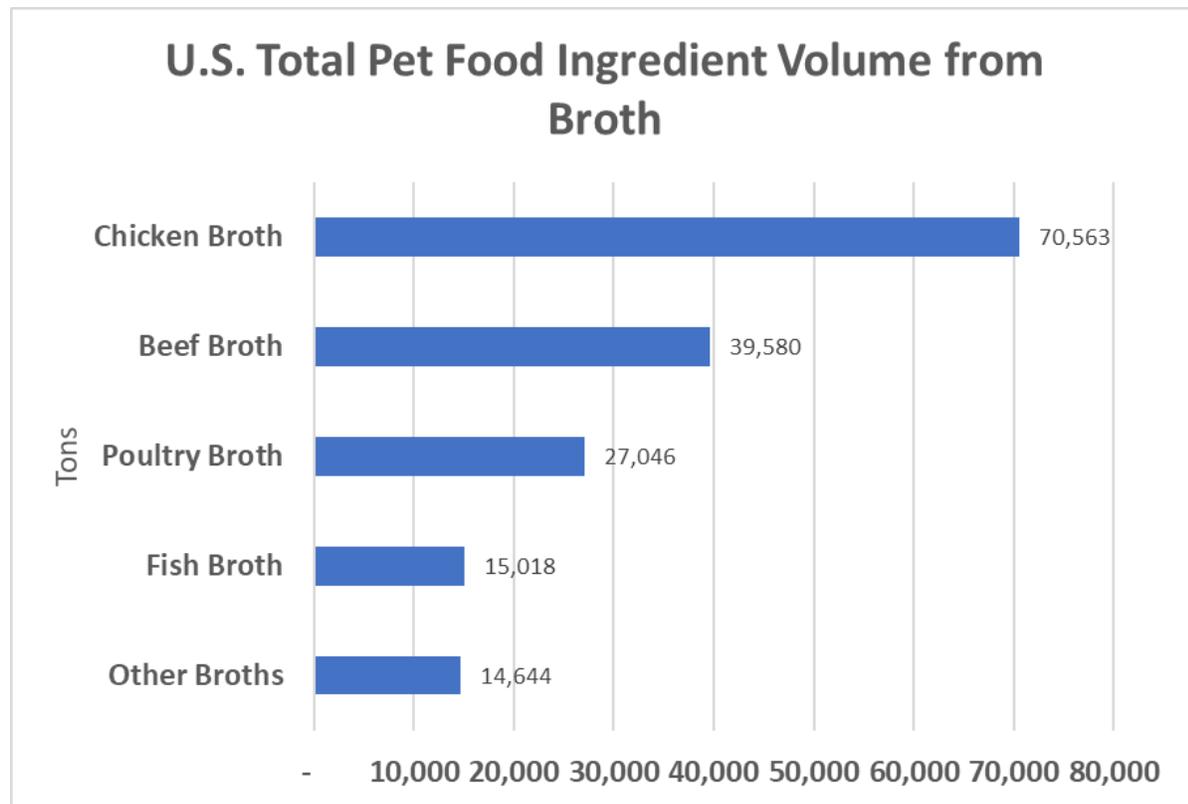


Figure 14, U.S. Total Pet Food Ingredients from Broth

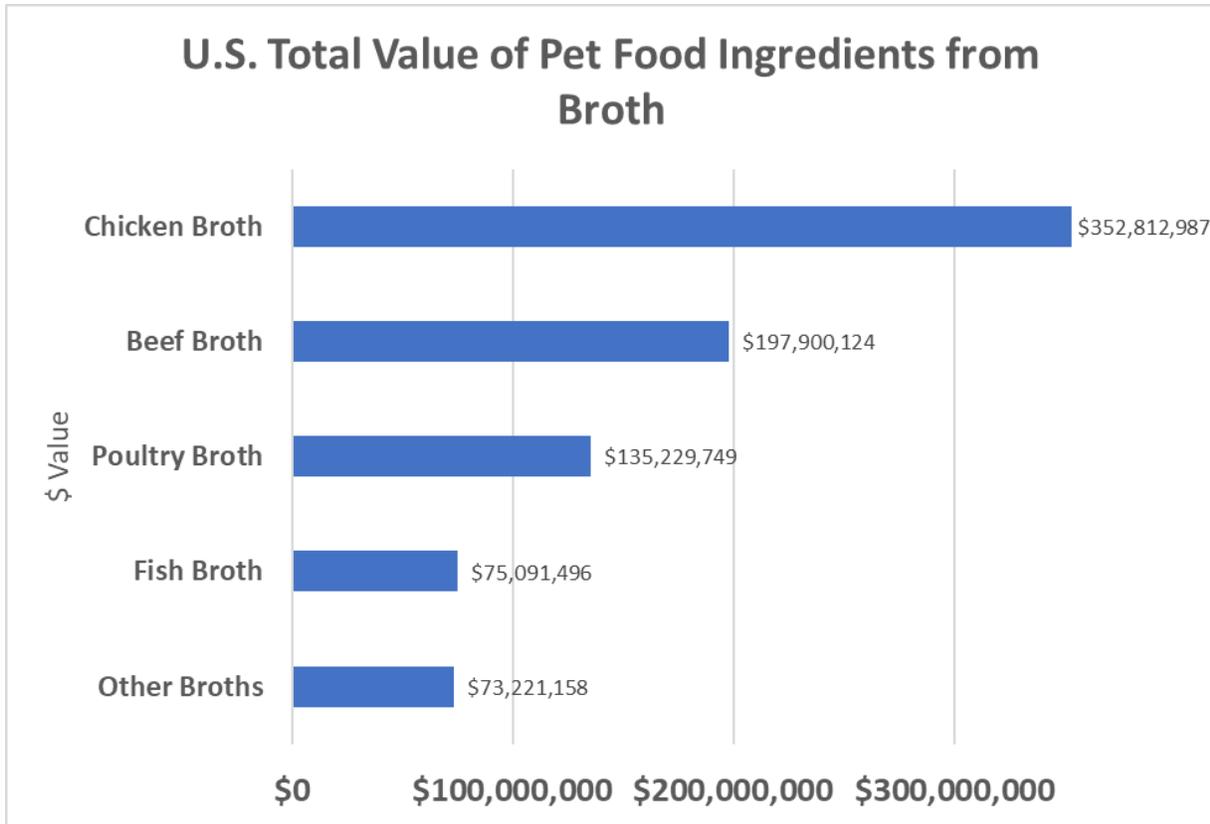


Figure 15, U.S. Total Value of Pet Food Ingredients from Broth

Upstream Impacts of Ingredient Purchases by Pet Food Manufacturers

Pet food ingredients are sourced from a wide geographic and often multi-state area and while there are eight states that do not have pet food manufacturers registered in that state, there are crops and livestock produced in these states that are used as pet food ingredients. A full tracing of pet food ingredients to their sourcing was beyond the scope of this study; therefore, the value of ingredients processed in each state was the basis for allocation of upstream values.

Farmers and farm product processors sell \$6.9 billion worth of products to pet food manufacturers that they use as ingredients. These sales by farmers and processors of farm products stimulate further upstream economic activity. Farmers buy \$5.3 billion of inputs and services from **farm suppliers** (seed, fertilizer, fuel, labor, machinery, repairs, etc.) to produce the products that are used as pet food ingredients. In addition, these farm suppliers buy \$4.1 billion in materials and services (fuel, fertilizer, equipment, labor, etc.) that they sell to farmers in order to produce the products for pet food ingredients.

Table 11 shows a summary of the ingredient purchases by pet food manufacturers, by state, with the number of Food and Drug Administration (FDA)-registered pet food manufacturing facilities, pet food ingredient purchased (tons) and resulting farm and farm-product processors sales (dollars), farm input purchases (dollars) and farm-supplier input purchases (dollars) that occur due to ingredient purchases by pet food manufacturers. Purchases of pet food ingredients are allocated to the state in which the processor resides. Farm input purchases and farm input supplier purchased are driven by the state-level allocation of the pet food ingredient purchases.

The leading states for farm and farm-product processing sales to pet food manufacturers are Missouri (\$999 million), Kansas (\$574 million), Pennsylvania (\$571 million), Iowa (\$422 million), and Ohio (\$367 million). Other states with more than \$100 million in purchases of ingredients from farmers and farm-product processors by pet food manufacturers are: Alabama, Arkansas, California, Colorado, Georgia, Illinois, Indiana, Nebraska, New Jersey, New York, Oklahoma, South Carolina, Tennessee, Texas, Utah, Virginia and Wisconsin.

Farm input suppliers are also positively impacted by the purchase of pet food ingredients. In economic terms, these are indirect impacts in that the sales of farm-based products, whether fresh or processed, require inputs be purchased to support the production of those products. U.S. farm input purchases that happen due to pet food ingredient purchases total \$5.3 billion. The leading states that drive farm purchases to support the production of pet food ingredients are Missouri (\$674 million), Kansas (\$478 million), Pennsylvania (\$448 million), Iowa (\$340 million) and Ohio (\$243 million). Other states where ingredient purchases by pet food manufacturers drive more than \$100 million in farm input supply sales are: Alabama, Arkansas,

California, Colorado, Illinois, Indiana, Nebraska, New Jersey, New York, Oklahoma, South Carolina, Texas, Utah and Wisconsin.

The production of farm-based products for pet food ingredients also results in purchases of supplies by the farm-suppliers. In the U.S., this totals \$4.1 billion. The leading states for purchases by farm-input suppliers due to pet food ingredient purchases are Missouri (\$530 million), Kansas (\$378 million), Pennsylvania (\$344 million), Iowa (\$269 million) and Ohio (\$177 million). Other states with more than \$100 million in purchases driven by farm-input suppliers to support the production of pet food ingredients are: Alabama, Arkansas, California, Colorado, Nebraska, New York, Oklahoma, South Carolina, Texas, Utah and Wisconsin.

Table 11, Impacts of Pet Food Ingredient Purchases on Farms, Farm Product Processors and Farm Suppliers

| Impacts of Pet Food Ingredient Purchases on Farms, Farm Product Processors and Farm Suppliers | | | | | |
|--|----------------------------|--|--|--|---|
| State | Pet Food Facilities | Pet Food Ingredients Purchased (Tons) | Pet Food Processor Purchases of Farm and Farm Product Processor Ingredients (Dollars) | Farm Input Purchases Resulting from Pet Food Ingredient Purchases (Dollars) | Farm Supplier Input Purchases Resulting from Pet Food Ingredient Purchases (Dollars) |
| Alabama | 3 | 209,996 | \$180,401,509 | \$146,360,138 | \$124,818,675 |
| Alaska | 0 | *Insufficient Data | | | |
| Arizona | 4 | 102,369 | \$87,942,042 | \$64,691,310 | \$51,971,042 |
| Arkansas | 16 | 218,037 | \$187,308,829 | \$145,859,999 | \$119,325,288 |
| California | 27 | 360,066 | \$309,321,531 | \$247,831,261 | \$165,030,188 |
| Colorado | 10 | 231,501 | \$198,875,121 | \$159,556,047 | \$112,802,518 |
| Connecticut | 3 | 11,878 | \$10,203,735 | \$8,167,790 | \$6,714,554 |
| Delaware | 0 | *Insufficient Data | | | |
| Florida | 1 | 44,304 | \$38,060,029 | \$35,646,960 | \$27,964,483 |
| Georgia | 21 | 140,723 | \$120,890,650 | \$97,187,008 | \$74,205,829 |
| Hawaii | 0 | *Insufficient Data | | | |
| Idaho | 1 | 38,211 | \$32,826,051 | \$22,182,456 | \$18,123,962 |
| Illinois | 11 | 196,664 | \$168,948,071 | \$140,191,850 | \$99,456,794 |
| Indiana | 10 | 181,848 | \$156,219,664 | \$122,208,718 | \$99,415,814 |
| Iowa | 20 | 491,033 | \$421,831,333 | \$340,102,101 | \$268,636,095 |
| Kansas | 21 | 667,796 | \$573,682,880 | \$477,893,881 | \$377,790,076 |
| Kentucky | 6 | 71,534 | \$61,452,474 | \$51,425,081 | \$43,112,750 |
| Louisiana | 1 | 8,557 | \$7,351,281 | \$6,784,974 | \$5,633,207 |
| Maine | 2 | 1,052 | \$903,813 | \$755,714 | \$646,035 |
| Maryland | 9 | 50,735 | \$43,585,080 | \$28,107,502 | \$23,129,898 |
| Massachusetts | 0 | *Insufficient Data | | | |
| Michigan | 35 | 46,066 | \$39,574,119 | \$28,471,902 | \$22,860,540 |
| Minnesota | 29 | 84,855 | \$72,895,908 | \$60,782,953 | \$42,737,404 |
| Mississippi | 1 | 44,496 | \$38,225,144 | \$22,442,125 | \$19,209,547 |
| Missouri | 15 | 1,162,612 | \$998,764,390 | \$673,943,870 | \$530,455,666 |
| Montana | 1 | 8,124 | \$6,978,795 | \$6,185,740 | \$5,180,463 |

| <u>State</u> | <u>Pet Food Facilities</u> | <u>Pet Food Ingredients Purchased (Tons)</u> | <u>Pet Food Processor Purchases of Farm and Farm Product Processor Ingredients (Dollars)</u> | <u>Farm Input Purchases Resulting from Pet Food Ingredient Purchases (Dollars)</u> | <u>Farm Supplier Input Purchases Resulting from Pet Food Ingredient Purchases (Dollars)</u> |
|----------------------|----------------------------|--|--|--|---|
| Nebraska | 23 | 379,394 | \$325,925,841 | \$266,924,385 | \$198,474,861 |
| Nevada | 1 | 39,966 | \$34,333,211 | \$25,157,509 | \$21,281,306 |
| New Hampshire | 0 | *Insufficient Data | | | |
| New Jersey | 2 | 149,009 | \$128,009,313 | \$106,068,931 | \$81,656,981 |
| New Mexico | 1 | 1,584 | \$1,360,486 | \$1,309,859 | \$1,167,505 |
| New York | 6 | 251,827 | \$216,337,057 | \$181,822,368 | \$142,817,912 |
| North Carolina | 16 | 103,554 | \$88,960,086 | \$74,981,982 | \$59,016,515 |
| North Dakota | 6 | 48,742 | \$41,872,772 | \$37,114,441 | \$31,082,775 |
| Ohio | 18 | 427,674 | \$367,401,178 | \$242,915,139 | \$176,704,471 |
| Oklahoma | 12 | 235,619 | \$202,412,757 | \$162,738,881 | \$129,696,711 |
| Oregon | 3 | 14,062 | \$12,080,349 | \$11,068,966 | \$8,873,900 |
| Pennsylvania | 83 | 664,966 | \$571,251,589 | \$448,478,652 | \$344,262,657 |
| Rhode Island | 0 | *Insufficient Data | | | |
| South Carolina | 6 | 183,456 | \$157,601,289 | \$122,652,016 | \$103,030,871 |
| South Dakota | 3 | 79,392 | \$68,203,606 | \$64,672,811 | \$52,683,375 |
| Tennessee | 10 | 133,645 | \$114,810,338 | \$79,765,579 | \$63,735,474 |
| Texas | 20 | 226,853 | \$194,882,556 | \$161,905,019 | \$107,005,349 |
| Utah | 6 | 217,445 | \$186,800,101 | \$145,567,579 | \$111,979,292 |
| Vermont | 1 | 7,569 | \$6,501,933 | \$6,370,069 | \$5,622,758 |
| Virginia | 12 | 150,955 | \$129,681,053 | \$86,250,302 | \$68,382,553 |
| Washington | 18 | 74,858 | \$64,308,193 | \$55,126,633 | \$40,930,220 |
| West Virginia | 0 | *Insufficient Data | | | |
| Wisconsin | 25 | 259,613 | \$223,025,450 | \$174,685,417 | \$131,156,886 |
| Wyoming | 0 | *Insufficient Data | | | |
| United States | 519 | 8,022,241 | \$6,891,659,850 | \$5,342,053,032 | \$4,118,529,550 |

Notes: 1) There was insufficient data to allocate pet food ingredient purchases and upstream impacts to: Alaska, Delaware, Hawaii, Massachusetts, New Hampshire, Rhode Island, West Virginia and Wyoming; 2) Dollar denominated data in this table are not additive.

This allocation of ingredient purchases and values to individual states was done based on each state’s share of direct output from pet food manufacturing sales (from the 2016 analysis that DIS conducted for IFEEDER) multiplied times the U.S. total ingredient purchases as factored up to U.S. totals.

Farm and farm-product processor sales due to ingredient purchases by pet food manufacturers is the sum of all pet food ingredients sold to pet food manufacturers either directly by farmers or through farm-product processors. **Farm input purchases** is a measure of the materials and services that farmers purchase to produce the products that are sold to pet food manufacturers as ingredients. **Farm-supplier input purchases** is a measure of the materials and services that farm-input suppliers buy as they provide materials and services to farmers to produce the

products that are sold to pet food manufacturers as ingredients. Figure 16 through Figure 19 refer to data in Table 11. The amounts credited to each state are driven by pet food ingredient purchases in that state and do not necessarily reflect the amount of inputs sourced specifically within that state.

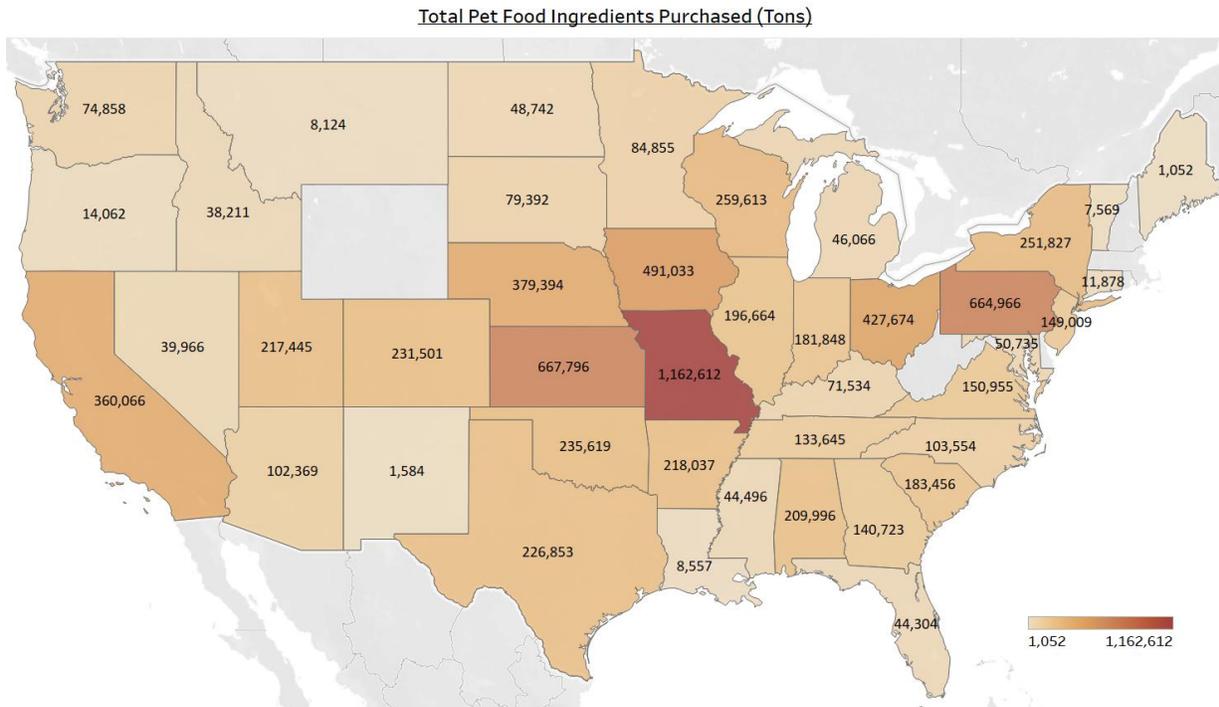


Figure 16, Total Pet Food Ingredients Purchased (Tons)

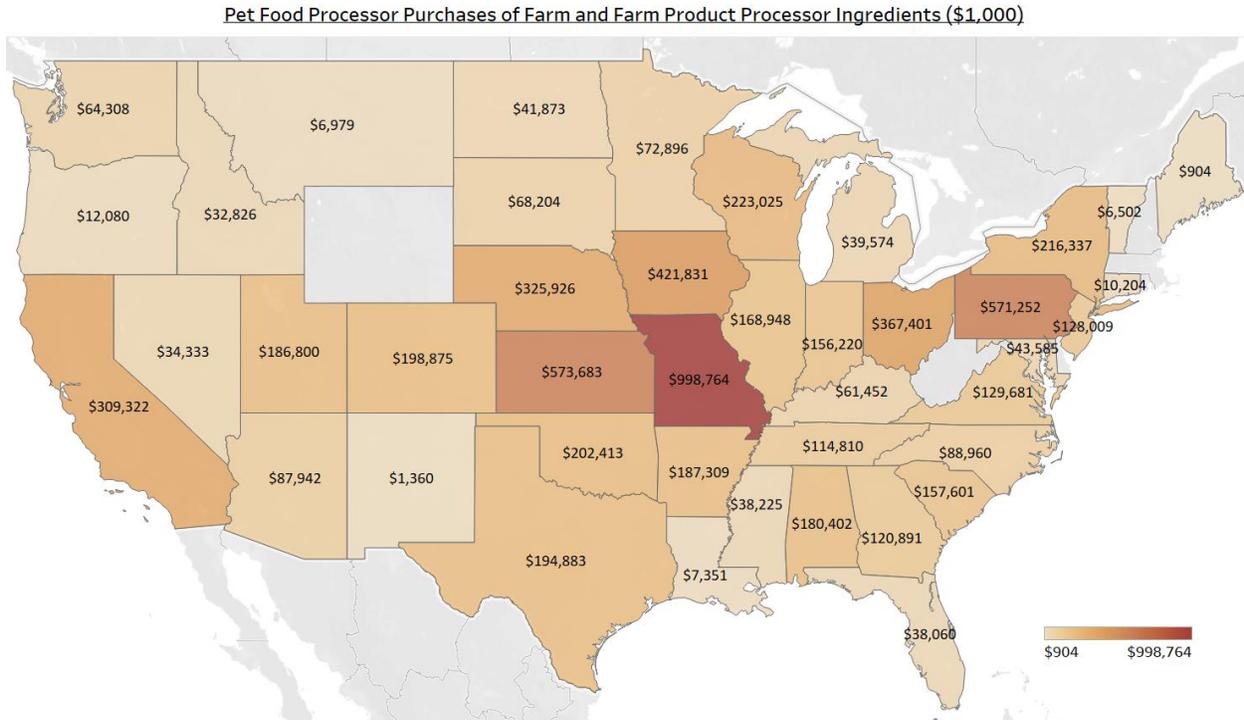


Figure 17, Pet Food Processor Purchases of Farm and Farm Product Processor Ingredients (\$1,000)

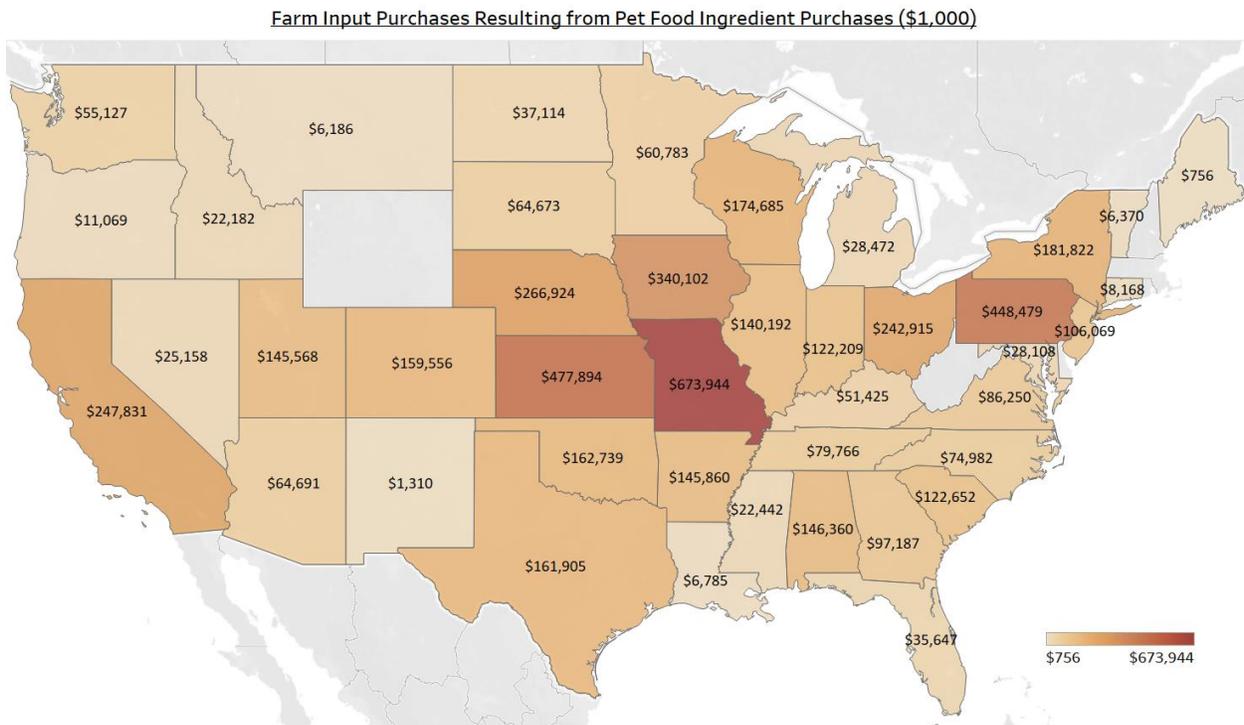


Figure 18, Farm Input Purchases Resulting from Pet Food Ingredient Purchases (\$1,000)

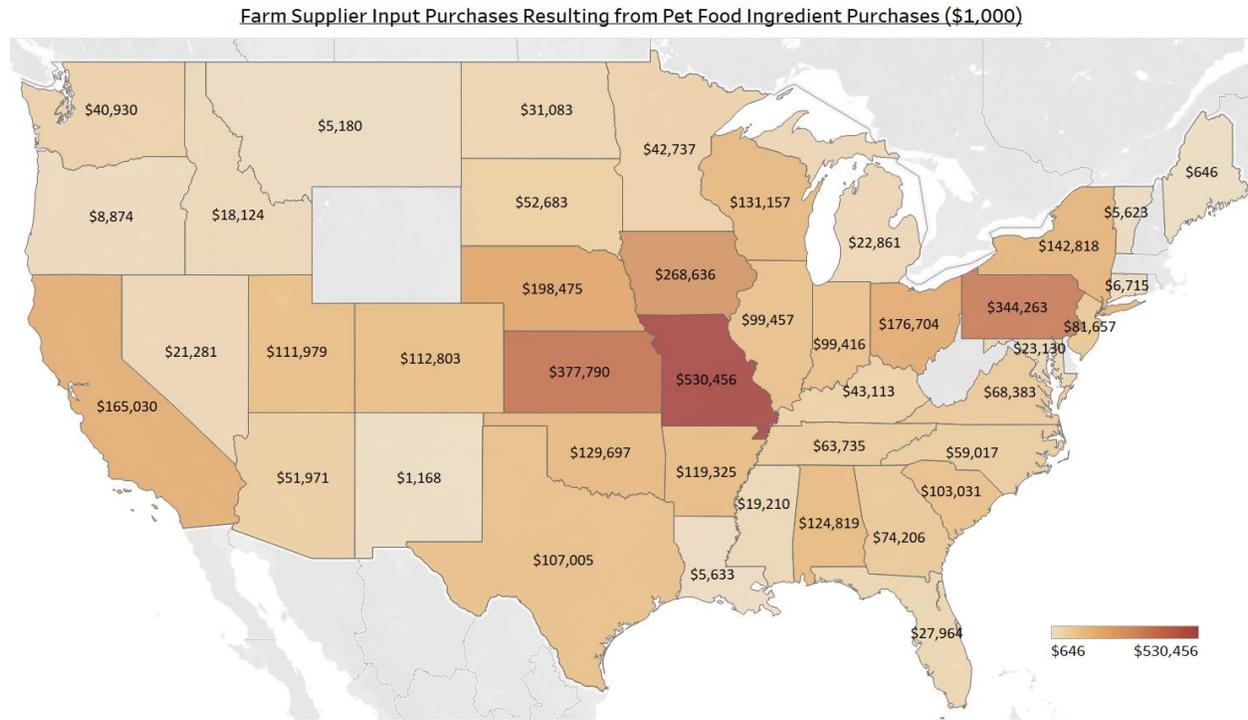


Figure 19, Farm Supplier Input Purchases Resulting from Pet Food Ingredient Purchases (\$1,000)

In the U.S., there are 519 FDA-registered pet food manufacturing facilities that may vary greatly in size and production. Referring to Table 12, on average, a pet food manufacturing plant buys 15,457 tons of ingredients worth \$13.3 million from farmers and farm-product processors. The pet food ingredient purchases for each national-average plant results in \$10.2 million of farm input purchases across the country and results in \$7.9 million in farm-input supplier purchases of materials and services.

Missouri (\$66.6 million) and New Jersey (\$64 million) have the largest average per plant pet food ingredient purchases. Other states with average per-plant purchases of ingredients greater than the national average (\$13.3 million) are: Alabama, Arizona, Colorado, Florida, Idaho, Illinois, Indiana, Iowa, Kansas, Mississippi, Nebraska, New York, Ohio, Oklahoma, South Carolina, South Dakota and Utah.

In Table 12, state-level average impacts per pet food manufacturing facility in the respective states are shown. The averages are calculated by dividing the quantities or dollar impacts in Table 11 by the number of pet food manufacturing plants in each respective state. The averages provide more information about the relative size and scale of the pet food manufacturing industry in each state. For example, Pennsylvania is the third largest state with regards to overall pet food manufacturing, but that is due to the number of facilities in Pennsylvania (83) even though the average size of a pet food manufacturing facility in

Pennsylvania is below the national average in size. On the other hand, Idaho only has one pet food manufacturing facility, but it is more than twice as large as the national average.

Table 12, Average Impact Per Facility to Farms, Farm Product Processors and Farm Suppliers for Pet Food Ingredient Purchases

| Average Impact Per Pet Food Manufacturing Facility to Farms, Farm Product Processors and Farm Suppliers Due to Pet Food Ingredient Purchases | | | | |
|---|--|--|--|---|
| <u>State</u> | <u>Average Pet Food Ingredients Purchased (Tons)</u> | <u>Average Farms and Processors Sales Resulting from Pet Food Ingredient Purchases (Dollars)</u> | <u>Average Farm Input Purchases Resulting from Pet Food Ingredient Purchases (Dollars)</u> | <u>Average Farm Supplier Input Purchases Resulting from Pet Food Ingredient Purchases (Dollars)</u> |
| Alabama | 69,999 | \$60,133,836 | \$48,786,713 | \$41,606,225 |
| Alaska | *Insufficient Data | | | |
| Arizona | 25,592 | \$21,985,510 | \$16,172,827 | \$12,992,761 |
| Arkansas | 13,627 | \$11,706,802 | \$9,116,250 | \$7,457,830 |
| California | 13,336 | \$11,456,353 | \$9,178,936 | \$6,112,229 |
| Colorado | 23,150 | \$19,887,512 | \$15,955,605 | \$11,280,252 |
| Connecticut | 3,959 | \$3,401,245 | \$2,722,597 | \$2,238,185 |
| Delaware | *Insufficient Data | | | |
| Florida | 44,304 | \$38,060,029 | \$35,646,960 | \$27,964,483 |
| Georgia | 6,701 | \$5,756,698 | \$4,627,953 | \$3,533,611 |
| Hawaii | *Insufficient Data | | | |
| Idaho | 38,211 | \$32,826,051 | \$22,182,456 | \$18,123,962 |
| Illinois | 17,879 | \$15,358,916 | \$12,744,714 | \$9,041,527 |
| Indiana | 18,185 | \$15,621,966 | \$12,220,872 | \$9,941,581 |
| Iowa | 24,552 | \$21,091,567 | \$17,005,105 | \$13,431,805 |
| Kansas | 31,800 | \$27,318,232 | \$22,756,851 | \$17,990,004 |
| Kentucky | 11,922 | \$10,242,079 | \$8,570,847 | \$7,185,458 |
| Louisiana | 8,557 | \$7,351,281 | \$6,784,974 | \$5,633,207 |
| Maine | 526 | \$451,906 | \$377,857 | \$323,018 |
| Maryland | 5,637 | \$4,842,787 | \$3,123,056 | \$2,569,989 |
| Massachusetts | *Insufficient Data | | | |
| Michigan | 1,316 | \$1,130,689 | \$813,483 | \$653,158 |
| Minnesota | 2,926 | \$2,513,652 | \$2,095,964 | \$1,473,704 |
| Mississippi | 44,496 | \$38,225,144 | \$22,442,125 | \$19,209,547 |
| Missouri | 77,507 | \$66,584,293 | \$44,929,591 | \$35,363,711 |
| Montana | 8,124 | \$6,978,795 | \$6,185,740 | \$5,180,463 |
| Nebraska | 16,495 | \$14,170,689 | \$11,605,408 | \$8,629,342 |
| Nevada | 39,966 | \$34,333,211 | \$25,157,509 | \$21,281,306 |
| New Hampshire | *Insufficient Data | | | |
| New Jersey | 74,505 | \$64,004,657 | \$53,034,466 | \$40,828,490 |
| New Mexico | 1,584 | \$1,360,486 | \$1,309,859 | \$1,167,505 |
| New York | 41,971 | \$36,056,176 | \$30,303,728 | \$23,802,985 |
| North Carolina | 6,472 | \$5,560,005 | \$4,686,374 | \$3,688,532 |
| North Dakota | 8,124 | \$6,978,795 | \$6,185,740 | \$5,180,463 |
| Ohio | 23,760 | \$20,411,177 | \$13,495,285 | \$9,816,915 |
| Oklahoma | 19,635 | \$16,867,730 | \$13,561,573 | \$10,808,059 |

| <u>State</u> | <u>Average Pet Food Ingredients Purchased (Tons)</u> | <u>Average Farms and Processors Sales Resulting from Pet Food Ingredient Purchases (Dollars)</u> | <u>Average Farm Input Purchases Resulting from Pet Food Ingredient Purchases (Dollars)</u> | <u>Average Farm Supplier Input Purchases Resulting from Pet Food Ingredient Purchases (Dollars)</u> |
|----------------|--|--|--|---|
| Oregon | 4,687 | \$4,026,783 | \$3,689,655 | \$2,957,967 |
| Pennsylvania | 8,012 | \$6,882,549 | \$5,403,357 | \$4,147,743 |
| Rhode Island | *Insufficient Data | | | |
| South Carolina | 30,576 | \$26,266,882 | \$20,442,003 | \$17,171,812 |
| South Dakota | 26,464 | \$22,734,535 | \$21,557,604 | \$17,561,125 |
| Tennessee | 13,365 | \$11,481,034 | \$7,976,558 | \$6,373,547 |
| Texas | 11,343 | \$9,744,128 | \$8,095,251 | \$5,350,267 |
| Utah | 36,241 | \$31,133,350 | \$24,261,263 | \$18,663,215 |
| Vermont | 7,569 | \$6,501,933 | \$6,370,069 | \$5,622,758 |
| Virginia | 12,580 | \$10,806,754 | \$7,187,525 | \$5,698,546 |
| Washington | 4,159 | \$3,572,677 | \$3,062,591 | \$2,273,901 |
| West Virginia | *Insufficient Data | | | |
| Wisconsin | 10,385 | \$8,921,018 | \$6,987,417 | \$5,246,275 |
| Wyoming | *Insufficient Data | | | |
| United States | 15,457 | \$13,278,728 | \$10,292,973 | \$7,935,510 |

Notes: 1) There was insufficient data to allocate pet food ingredient purchases and upstream impacts to: Alaska, Delaware, Hawaii, Massachusetts, New Hampshire, Rhode Island, West Virginia and Wyoming; 2) Dollar denominated data in this table are not additive.

Figure 20 through Figure 23 refer to Table 12. The average values in Table 12 were calculated by dividing the values for each of the variables in Table 11 by the number of **pet food manufacturing facilities** in each state.

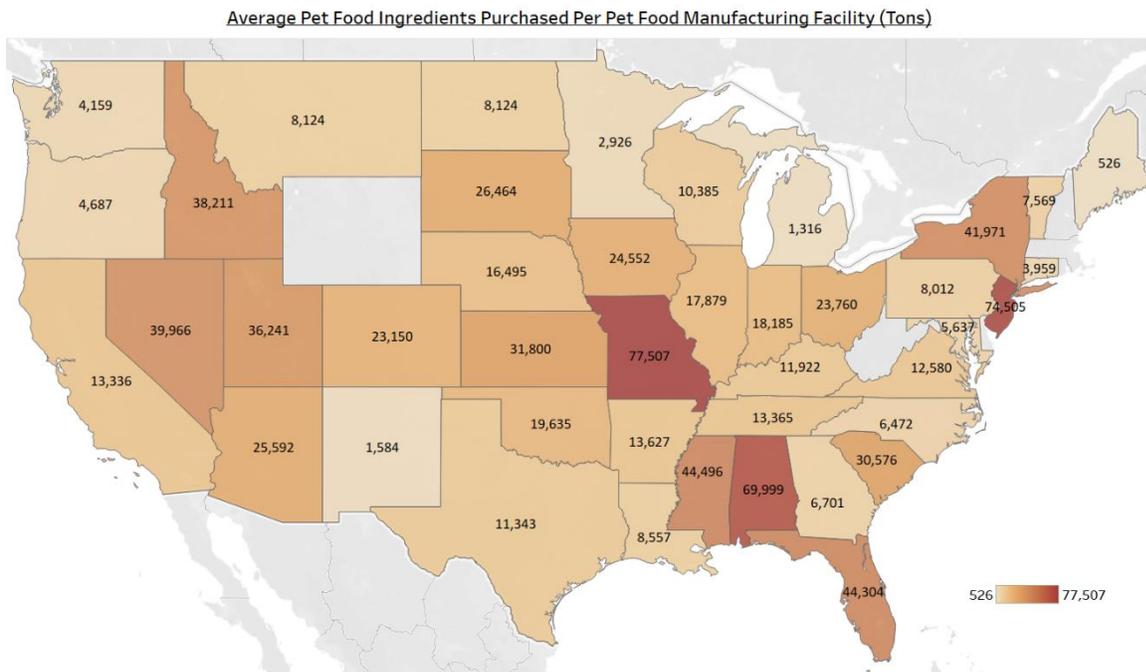


Figure 20, Average Pet Food Ingredients Purchased Per Pet Food Manufacturing Facility (Tons)

Average Farms and Processor Sales Resulting from Pet Food Ingredient Purchases Per Pet Food Manufacturing Facility (\$1,000)

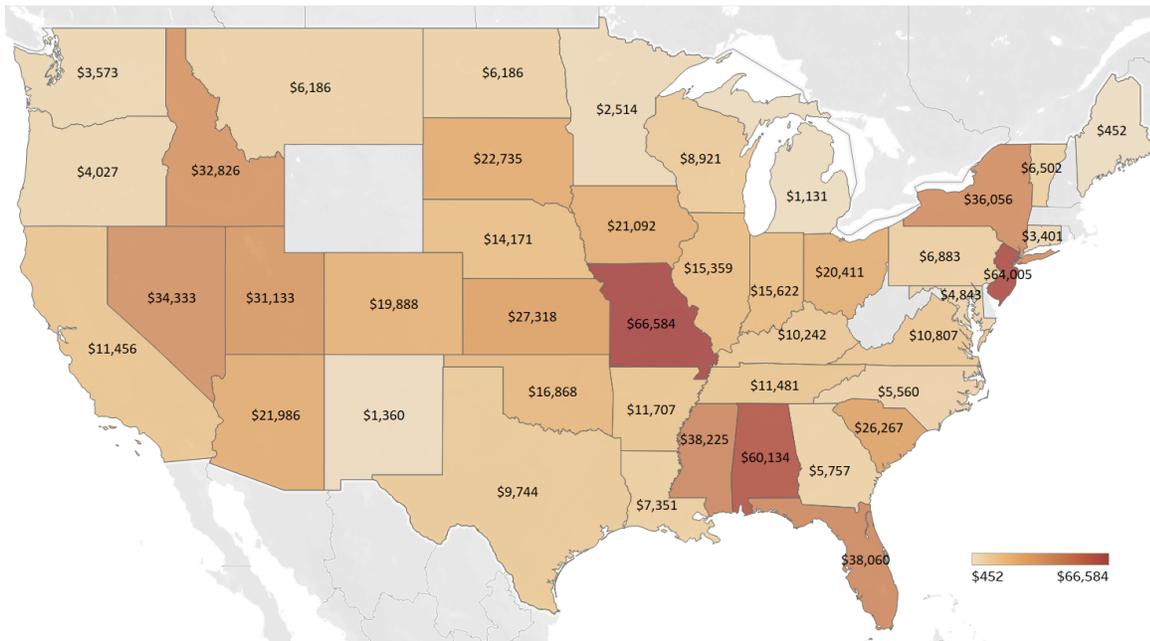


Figure 21, Average Farms and Processors Sales Resulting from Pet Food Ingredient Purchases Per Pet Food Manufacturing Facility (\$1,000)

Average Farm Input Purchases Resulting from Pet Food Ingredient Purchases Per Pet Food Manufacturing Facility (\$1,000)

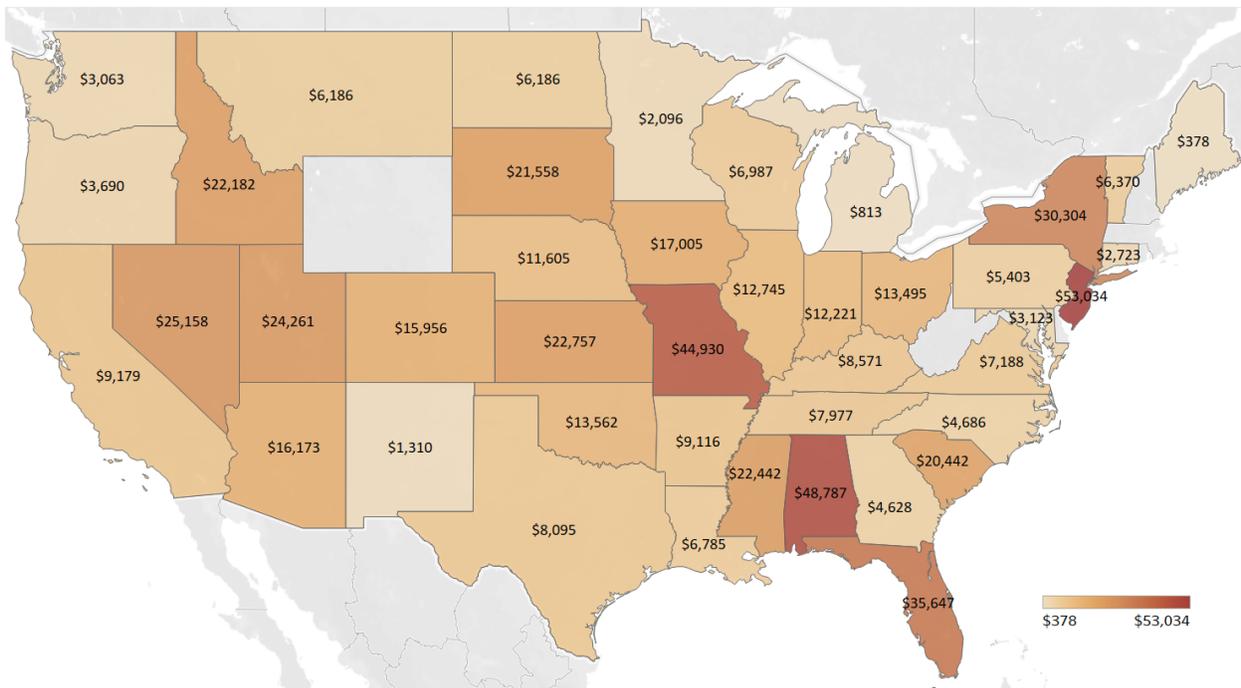


Figure 22, Average Farm Input Purchases Resulting from Pet Food Ingredient Purchases Per Pet Food Manufacturing Facility (\$1,000)

Average Farm Supplier Input Purchases Resulting from Pet Food Ingredient Purchases Per Pet Food Manufacturing Facility (\$1,000)

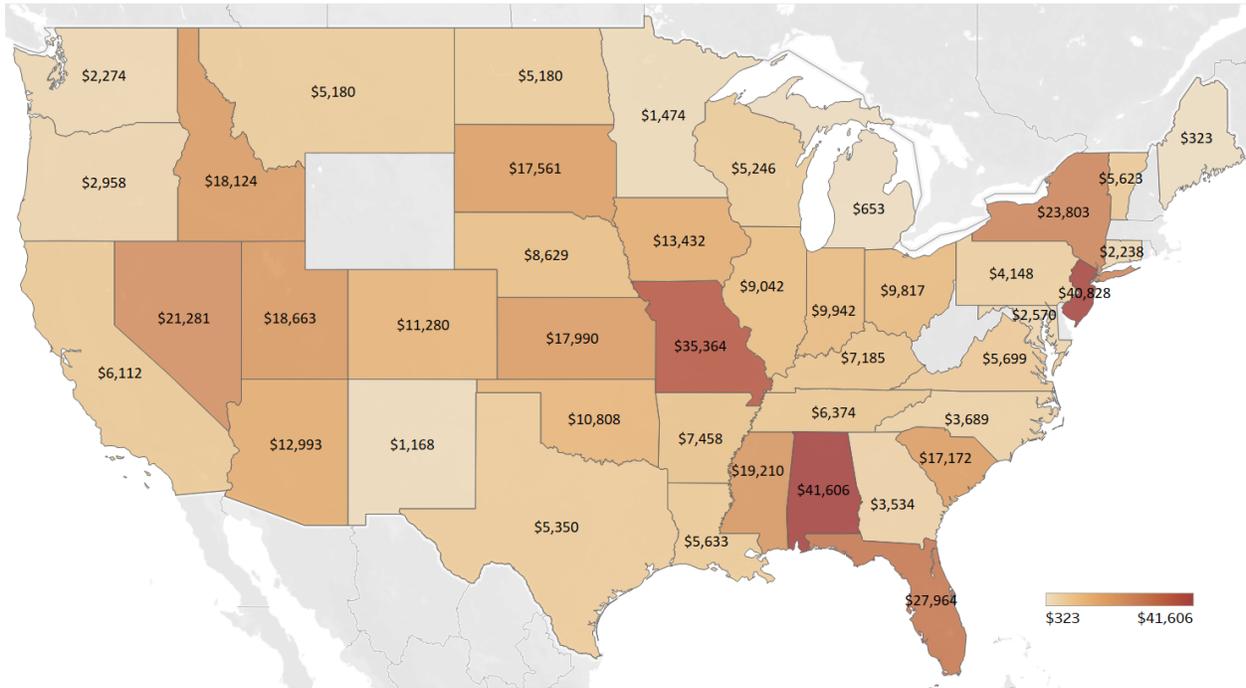


Figure 23, Average Farm Supplier Input Purchases Resulting from Pet Food Ingredient Purchases Per Pet Food Manufacturing Facility (\$1,000)

Sales Analysis

The sales analysis results included here are based upon the purchased Nielsen data³. Data are summarized according to “sub-category” for:

- Total volume and value of cat and dog foods
- Total volume and value of cat foods
- Total volume and value of dog foods

Total

The Nielsen data covered 6.7 million tons of pet food sales with a value of \$20.7 billion. This represents 68.3% of U.S. pet food sales.

Table 13, Total Pet Food Volume and Sales

| Pet Food Category | Tons | Value |
|-------------------|------------------|-------------------------|
| Dog Food Dry | 3,799,875 | \$7,646,628,386 |
| Dog Treats | 373,461 | \$4,245,890,986 |
| Cat Food Dry | 1,202,449 | \$2,878,836,636 |
| Cat Food Wet | 604,074 | \$2,767,804,016 |
| Dog Food Wet | 637,727 | \$2,350,304,234 |
| Cat Treats | 41,585 | \$724,467,489 |
| Dog Food Moist | 56,864 | \$129,394,402 |
| Total | 6,716,035 | \$20,743,326,148 |

Table 13 and Figure 25 show the volume and value of total (both cat and dog) pet food products, by different food types (sub-category). Among all pet food products, the lead product was dry dog food by both volume and by value, 57% and 37%, respectively. This suggests, that while dry dog food comprises the majority of total cat and dog food sold by volume, its value per pound is less than other sub-categories of cat and dog foods.

The inverse of the volume to value comparison for dry dog food is also true. For example, both cat and dog treats comprise a small portion of total volume (0.6% and 5.6%, respectively), yet make up a much larger share of the total when summarized by value (3.5% and 20.5%, respectively).

³ Data contained in Table 13 and all other results in this “Sales Analysis” section of the report, represents the total volumes and values included in the purchased Nielsen data. Nielsen claims this data represents 68.3% of the industry total. If one were to estimate the national total, it could be calculated by dividing results by 0.683 or multiplying them by 1.465 (1/0.683). See Appendix B, Ingredient List and Categorization Used for Upstream Analysis for adjusted “top line” estimates.

Total Pet Food Sales -- By Volume (Tons)

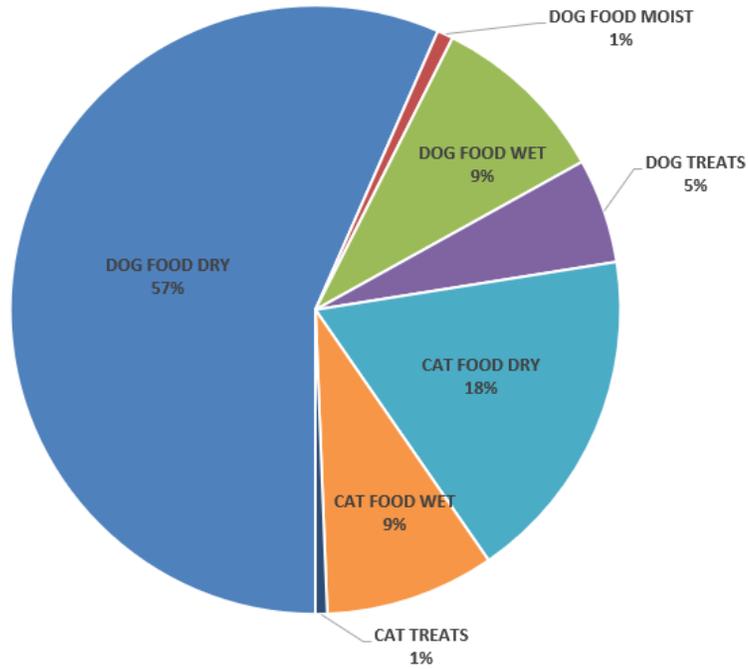


Figure 24, Total Pet Food Sale Analysis -- By Volume (Tons)

Total Pet Food Sales -- By Value

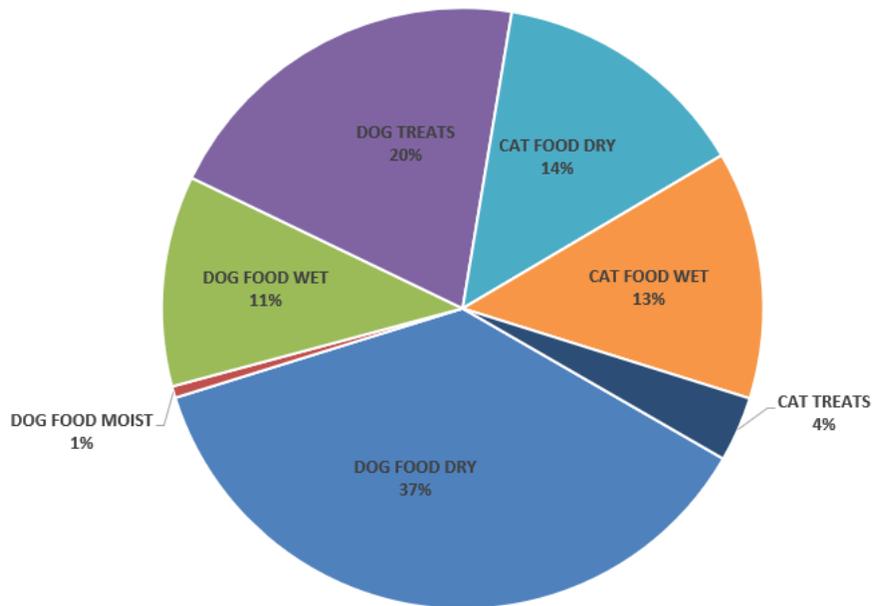


Figure 25, Total Pet Food Sale Analysis -- By Value

Cats

Total cat food sales were 1.85 million tons with a value of \$6.37 billion, covered by the Nielsen data. Figure 26 and Figure 27 show volume and value of cat food products by sub-category. By volume, the lead sub-category is dry cat food, 65% of total volume. By value, dry cat food and wet cat food are similar, occupied 45% and 44%, respectively.

Cat Food Sales -- By Volume (Tons)

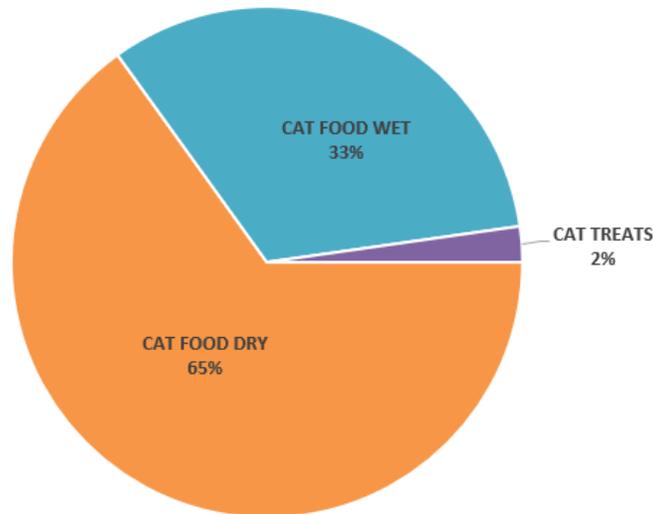


Figure 26, Cat Food Sales – By Volume (Tons)

Cat Food Sales -- By Value

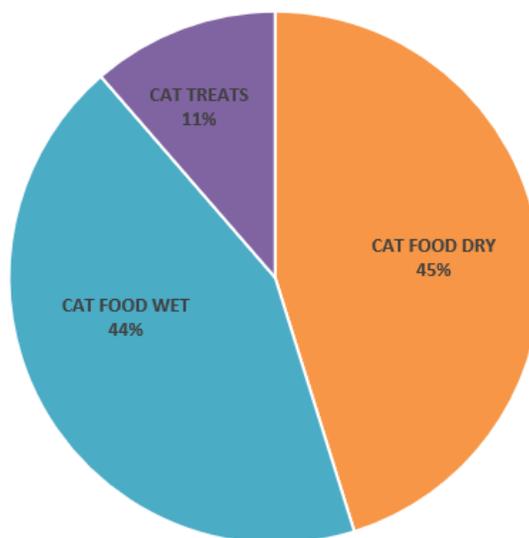


Figure 27, Cat Food Sales – By Value

Dogs

Total dog food sales were 4.87 million tons with a value of \$14.37 billion, covered by the Nielsen data. Figure 28 and Figure 29 show volume and value of dog food products by sub-category. By volume, the lead sub-category is dry dog food, with 78% of total volume. By value, dry dog food accounted for 53%.

Dog Food Sales -- By Volume (Tons)

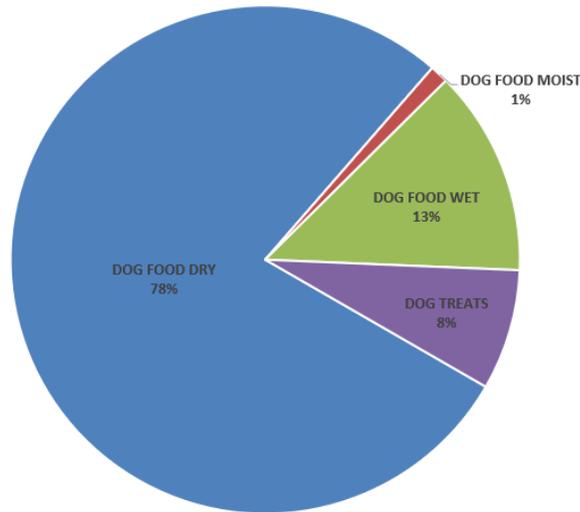


Figure 28, Dog Food Sales – By Volume (Tons)

Dog Food Sales -- By Value

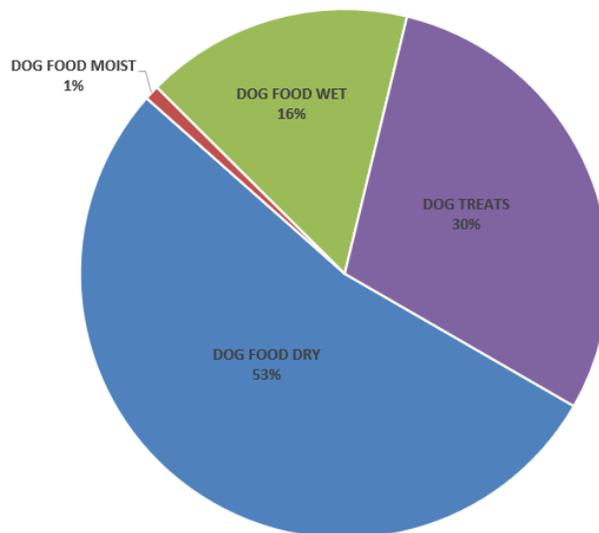


Figure 29, Dog Food Sales – By Value

Ingredient Analysis

From the purchased Nielsen data, there were 18,197 cat food records and 40,966 dog food records – 59,163 in total. However, some of them shared the same Universal Product Code (UPC) and some had identical ingredients, form, etc., but are packaged in different sizes or quantities. Controlling for UPC and size, among all pet food products, 633 unique cat food products and 1,369 unique dog food products were selected for further analysis, which accounts for 95% by volume of total pet food products in the Nielsen data. Thus, these unique pet food products were assigned as our “study objects.”

Among the study objects, 19.6% of cat food products and 24.9% of dog food products were identified as “private label” according to the raw data from Nielsen. Those products didn’t have enough information, such as ingredient labels, guaranteed analysis and calorie information to evaluate ingredient quantities based on the recipe reverse engineering procedure. By following the methodological framework (step 4) described in the methodology in Appendix A, there were 65 and 177 products that were found to have approximate matches with non-private label food products for cat and dog food products, respectively. Therefore, the size of study objects for cat and dog food products went down to 574 and 1,235, which caused the estimated coverage by volume to be reduced from 95% to 88% and 95% to 90% for cat and dog food products, respectively.

Standardizing of Pet Food Ingredients

To have a good understanding of pet food ingredients, some associated ingredients were combined, and names were standardized. For example, “apple” and “apples,” “beefhide” and “beef hide,” and “soybean oil” and “soy oil,” etc. Then, a statistical method, called text mining was applied to visually extract patterns and prevalence. This process demonstrates the frequency with which each standardized food ingredient shows up on product packages.

As shown in Figure 30 and Figure 31, the larger the font size of the words or phrases the more frequently (not necessarily total use of) an ingredient shows up on the product ingredient panels. Chicken and chicken related food ingredients, such as “chicken meal,” “chicken fat,” and “chicken by-product meal,” etc., are present most often for both cat and dog food products.

Chicken, meat by-product meal and liver are the top three commonly used animal related food ingredients; and corn gluten meal, wheat gluten and brewers rice are the top three most commonly used plant related food ingredients for cat food products.

For dog food products, chicken, chicken fat and chicken meal are the top three most commonly used animal ingredients; and flaxseed, peas and carrots are the top three most commonly used plant ingredients. Of note, while these “word clouds” indicate the frequency of these items showing up in various products, they do not necessarily represent volumes.

Among all the 542 standardized ingredients, 280 of them were aggregated into nutrient groups such as animal protein, animal fat, plant protein, plant carbohydrate, specialty, etc. These nutrient groups were defined by the three organizations and the distribution of nutrient groups are shown in Figure 32. Animal protein related ingredients made up the majority of the total ingredients, followed by specialty crop ingredients, shown as Fruits and Vegetables in Figure 32, such as apples, blueberries, peas, spinach, etc.

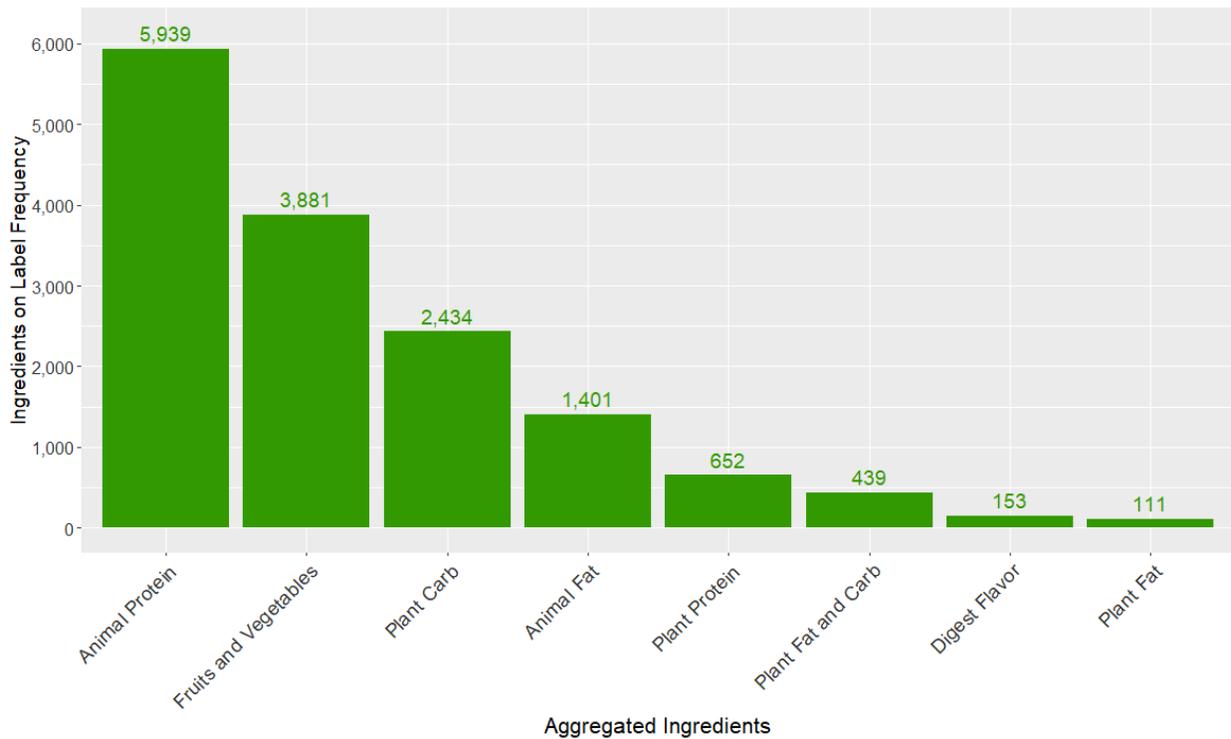


Figure 32, Distribution of Food Ingredients in Nutrient Groups

Ingredient Quantities

After the recipe reverse engineering was applied to all sampled products, the prevalence distributions of ingredients’ inclusion rates, based on the corresponding placements, for all **subsegments** were calculated. According to the distributions, approximate recipes for the non-sampled products under each subsegment were estimated. After all the recipes were reverse engineered, the equivalent sales data from Nielsen were utilized to determine the quantities of each ingredient for a given pet food product.⁴

⁴ Data contained in all results in this “Ingredient Analysis” section of the report, represents the total volumes and values included in the purchased Nielsen data. Nielsen claims this data represents 68.3% of the industry total. If one were to estimate the national total, it could be calculated by dividing results by 0.683 or multiplying them by 1.465 (1/0.683). See Appendix B, Ingredient List and Categorization Used for Upstream Analysis for adjusted “top line” estimates.

Tree map charts, such as shown in Figure 34, and bar charts (i.e., Figure 35) show the summary of pet food ingredient quantities under different nutrient groups. In a tree map chart, a larger size of the squares/rectangles represents a higher amount of the corresponding ingredient. There are 164 ingredients shared by both cat and dog foods. Total pet foods, cat foods and dog foods are denoted using orange, blue and green colors in the bar charts, respectively. The complete version of cat and dog food ingredient quantities for all aggregated ingredient groups can be explored with an interactive, online visualization tool [here](#).

Total

Shown below in Figure 33, total cat and dog food ingredient allocations are based on the number of pets by state which shows the distribution of pet food ingredients **as consumed**. Due to large pet populations, the leading states for pet food consumption include Texas, California and Florida. Individual ingredients by state can be seen in the online visualization tool.

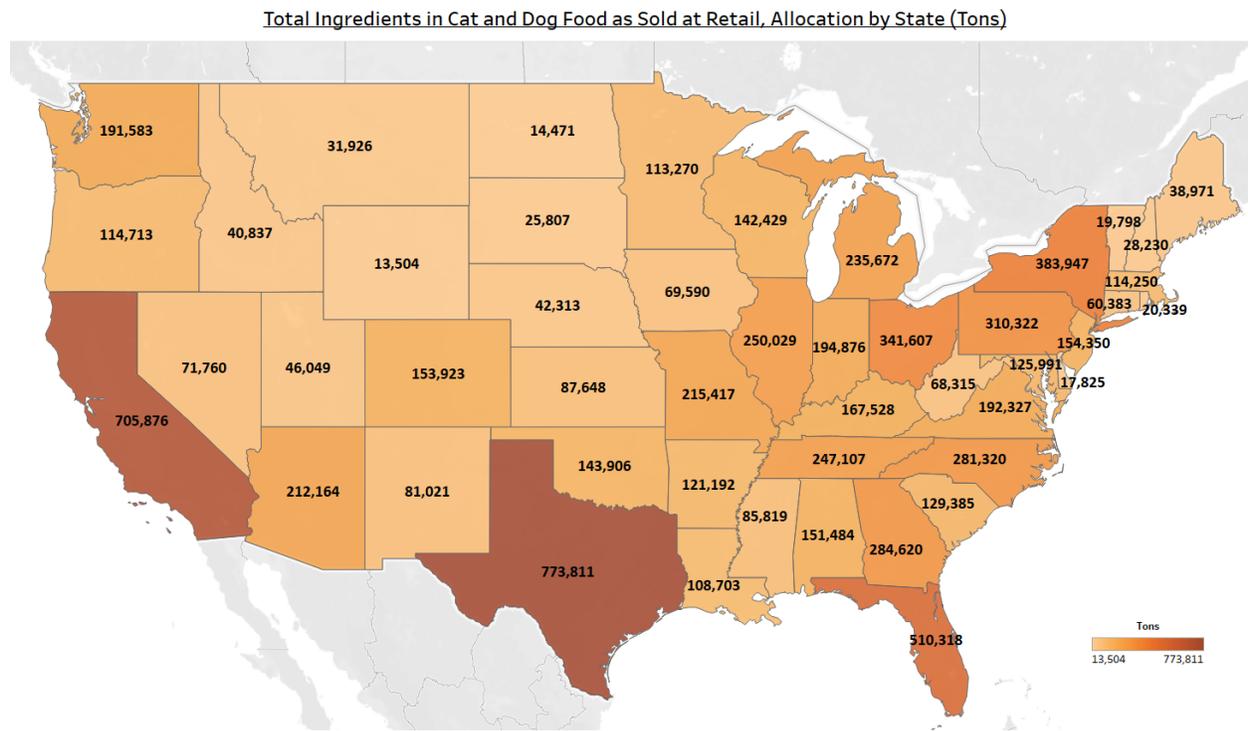


Figure 33, Total Ingredients in Cat and Dog Food as Sold at Retail, Allocation by State

Furthermore, these ingredients can be broken down by various nutrient groups. Figure 34 and Figure 35 show summary quantities of total pet food ingredients that belong to the “animal protein” nutrient group. Chicken is the lead ingredient with 584,098⁵ tons used for total pet food products during the study period, followed by meat and bone meal, and chicken by-product meal, with 533,253 tons and 362,828 tons, respectively.

⁵ This tonnage here is different than the chicken ‘as bought’ volume, 854,988 tons, under the upstream analysis section, due to the water content changing during food manufacture processing. Note that the 854,988 tons of chicken is the raw chicken as purchased. While the 584,098 tons of chicken is the “chicken” as an ingredient exists in finished pet foods as sold at retail, i.e. the moisture has been removed during the manufacture processing. Therefore, Ingredients such as chicken, and other meats and grains are purchased at higher moisture contents than the finished product, the ingredient quantities ‘as bought’ need to be adjusted for the moisture that is removed in the process of making the finished pet food product.

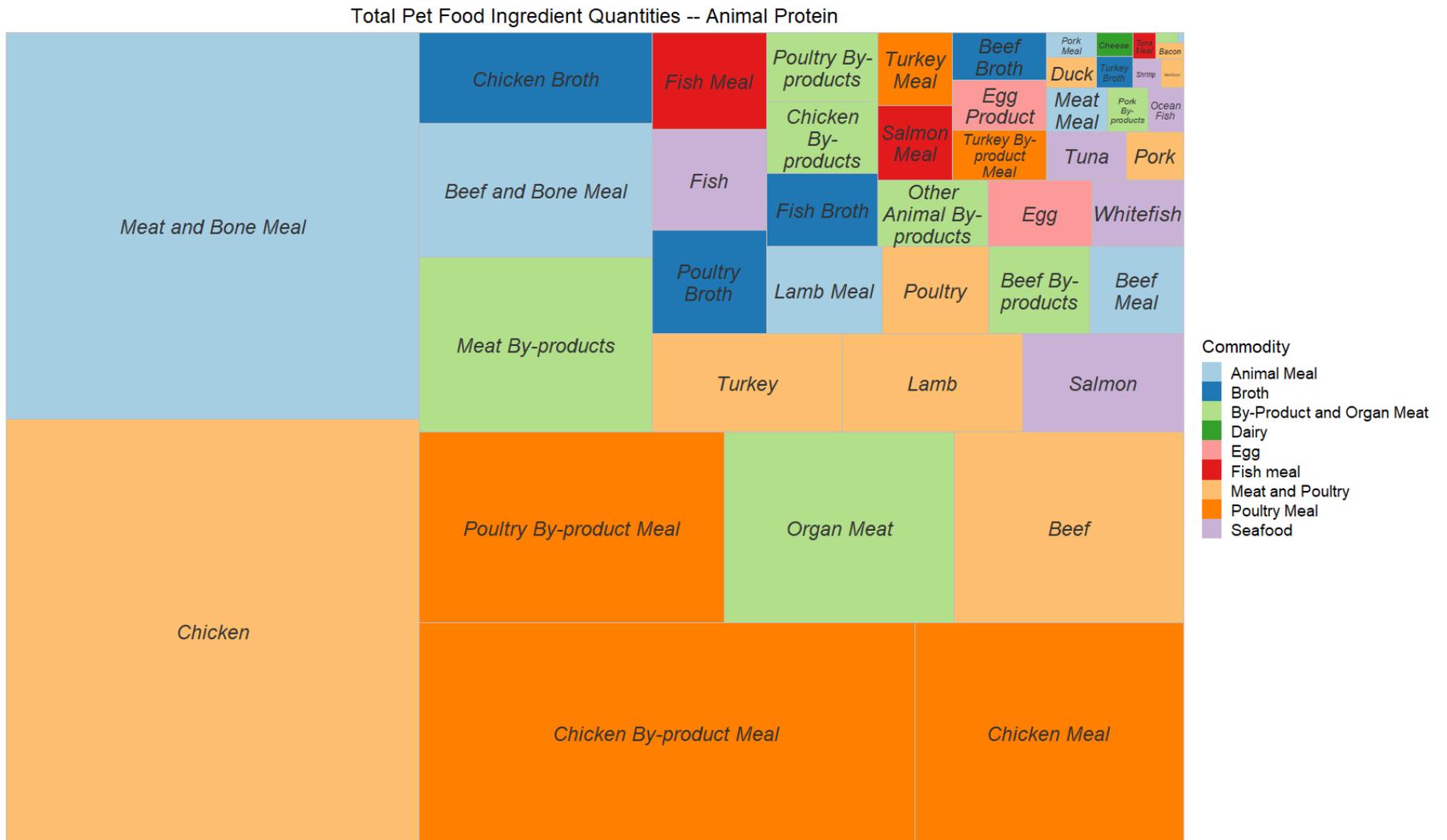


Figure 34, Animal Protein Quantities by Commodity Type (Total)

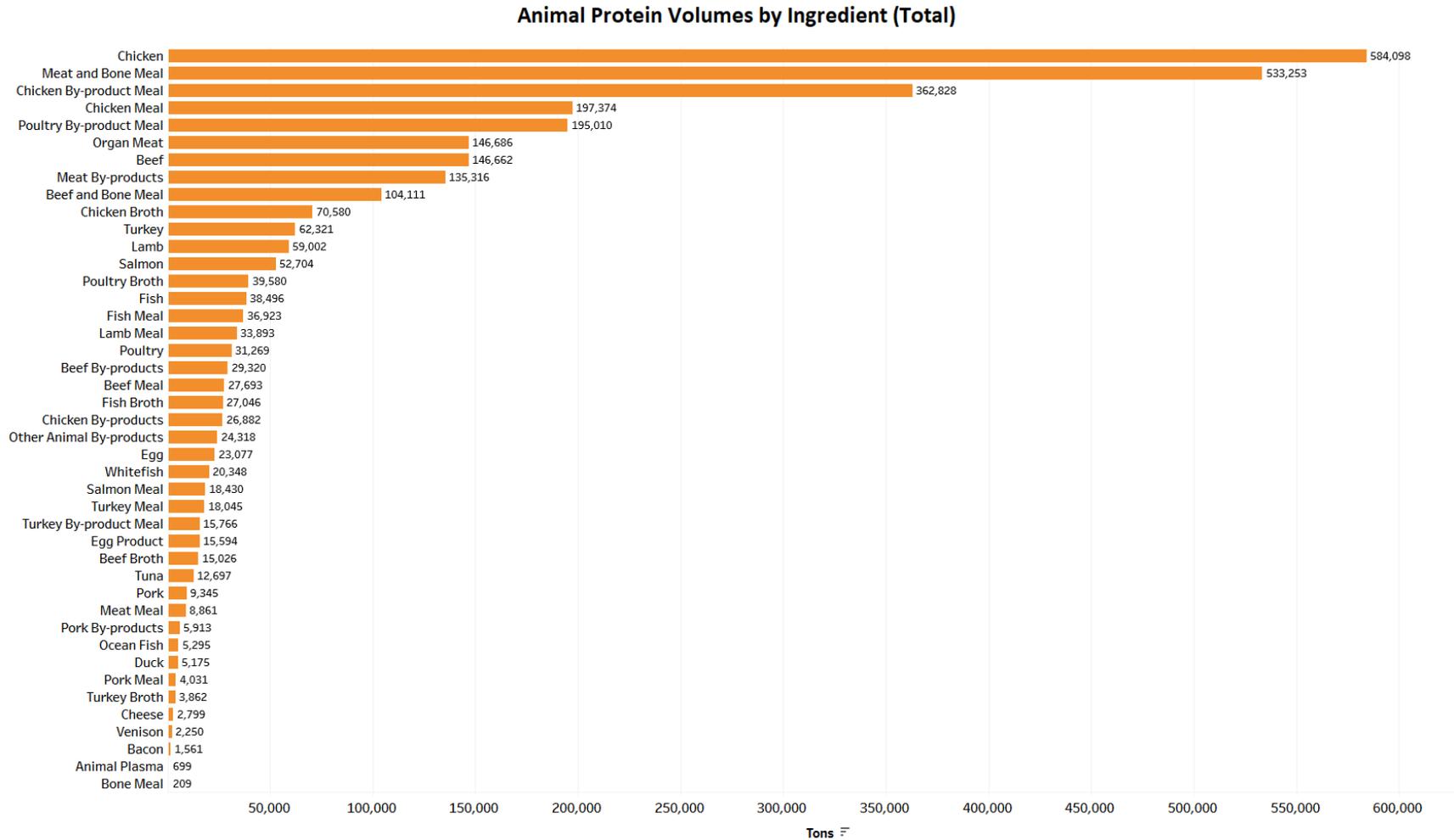


Figure 35, Animal Protein Volumes by Ingredient (Total)

Figure 36 and Figure 37 show summary quantities of total pet food ingredients that belong to the “animal fat nutrient” group. Beef fat is the main animal fat ingredient used in pet foods with 147,456 tons used during the study period, followed by animal fat ingredients and chicken fat, with 104,509 tons and 48,569 tons, respectively.

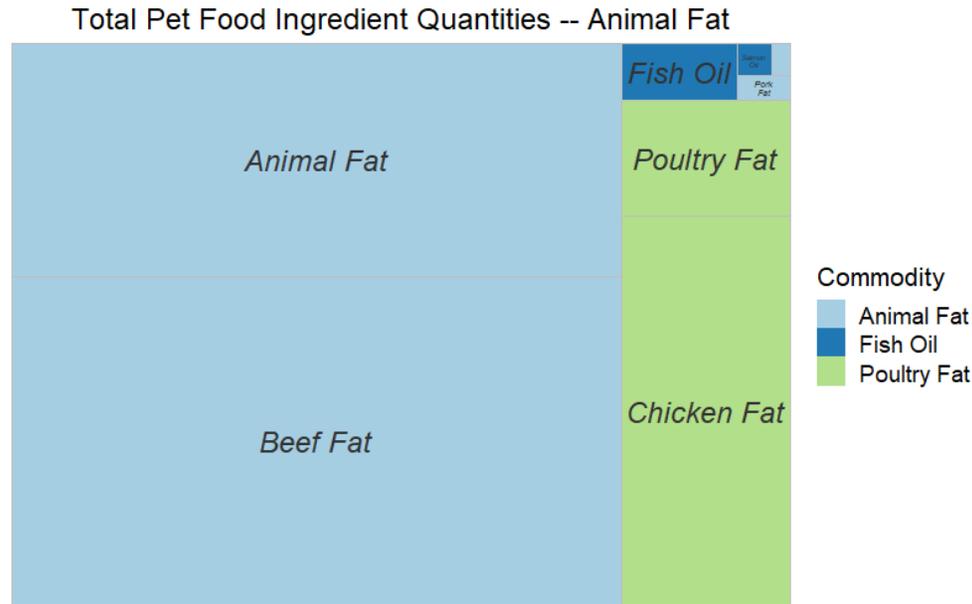


Figure 36, Animal Fat Quantities by Commodity Type (Total)

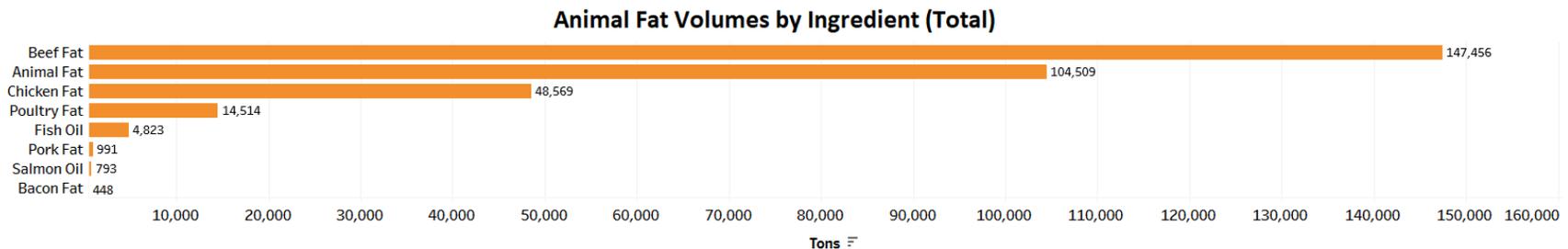


Figure 37, Animal Fat Volumes by Ingredient (Total)

Figure 38 and Figure 39 show summary quantities of total pet food ingredients that belong to plant related nutrient groups, which are “plant carbohydrates” and “plant protein.” Corn is the dominant ingredient, with 1,283,674 tons used for pet food products. Corn gluten meal and soybean meal are the second and third largest ingredients, with 476,649 tons and 427,155 tons, respectively.

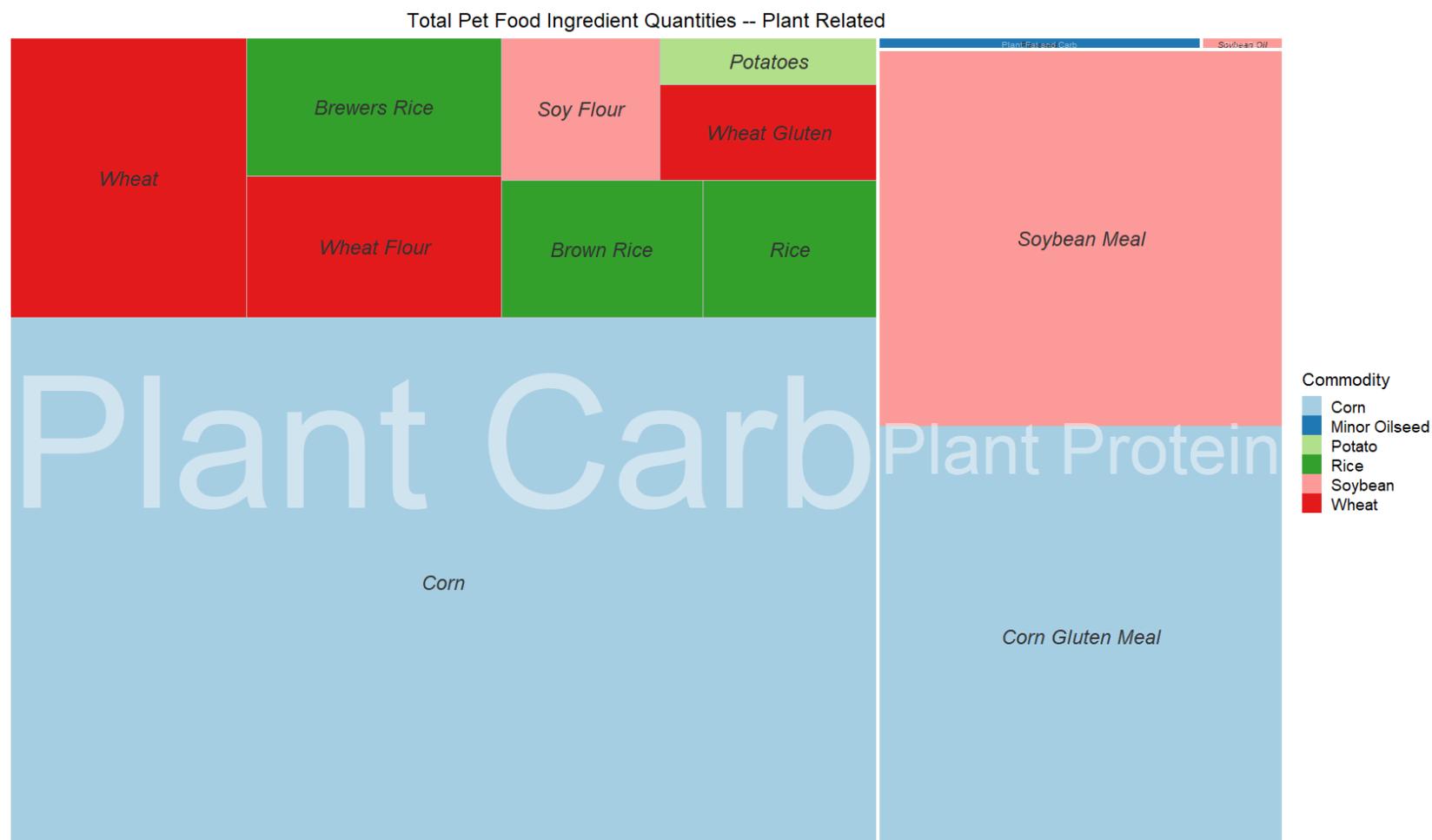


Figure 38, Plant Related Aggregations Quantities by Commodity Type (Total)

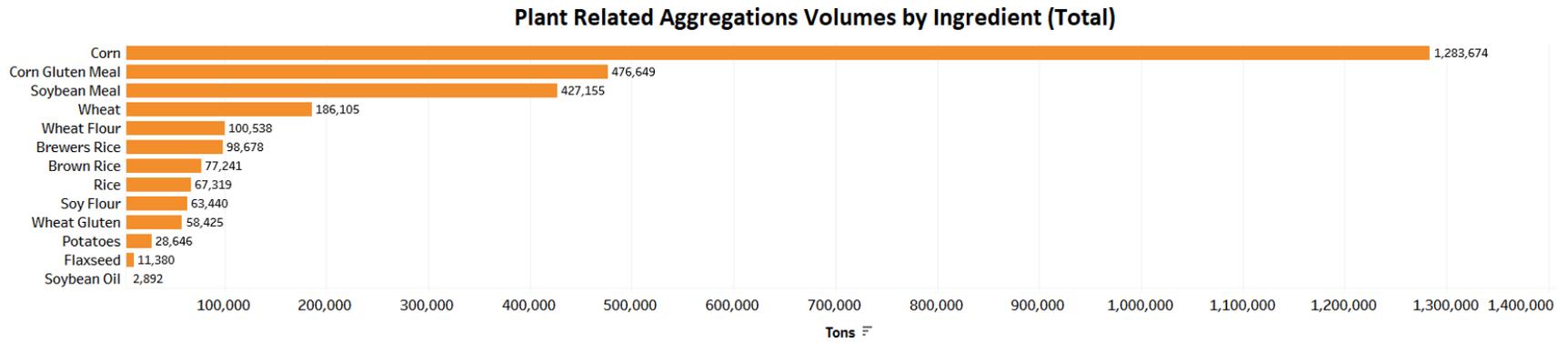


Figure 39, Plant Related Aggregations Volumes by Ingredient (Total)

Figure 40 and Figure 41 show the summary quantities of total pet food ingredients that belong to the “specialty crop” category, as defined by the participating organizations. Peas are the leading ingredient with 101,273 tons used for pet food products during our study period, followed by beet pulp and sweet potatoes, with 41,655 tons and 22,818 tons, respectively.

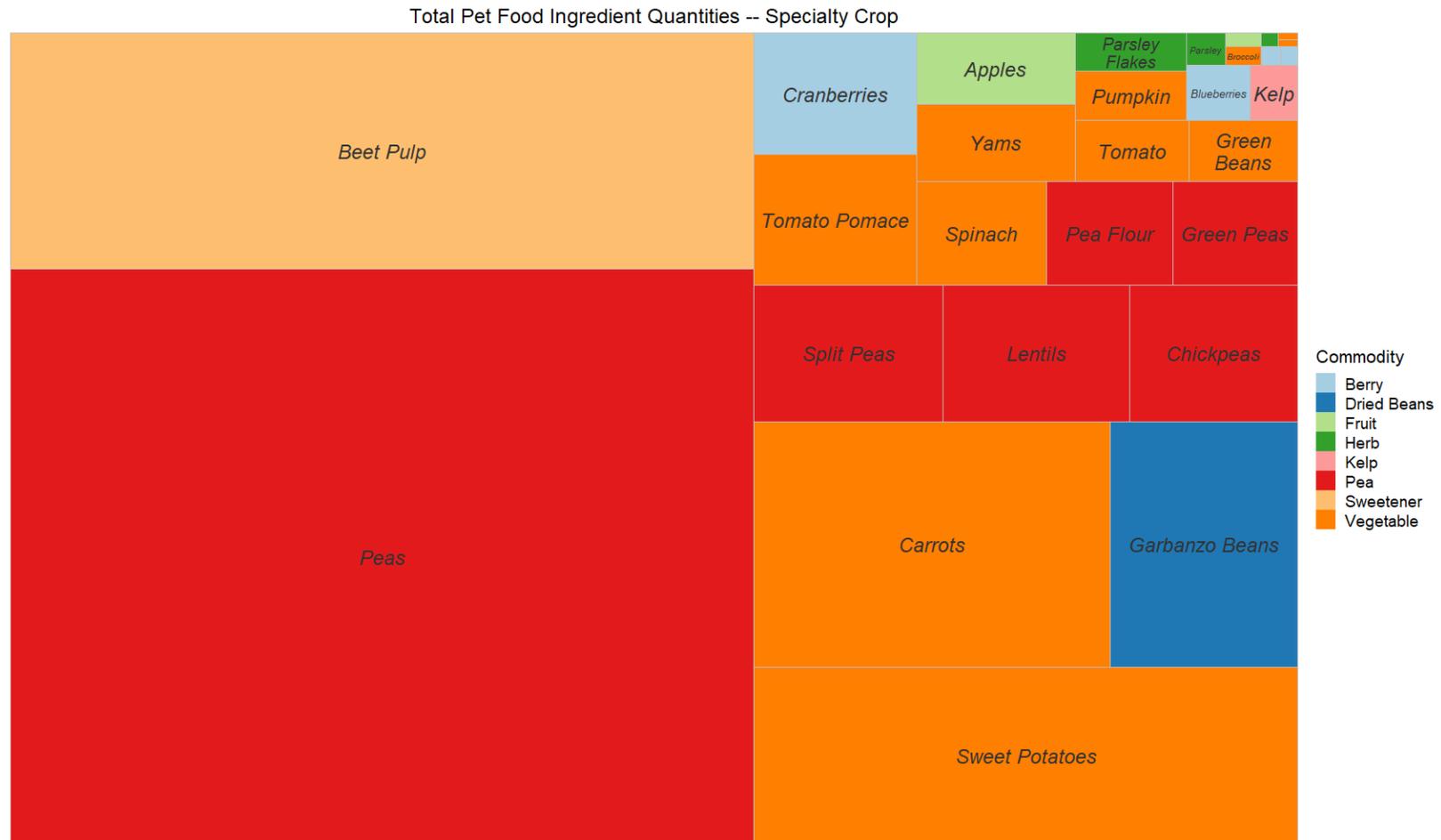


Figure 40, Specialty Crop Quantities by Commodity Type (Total)

Specialty Crop Volumes by Ingredient (Total)

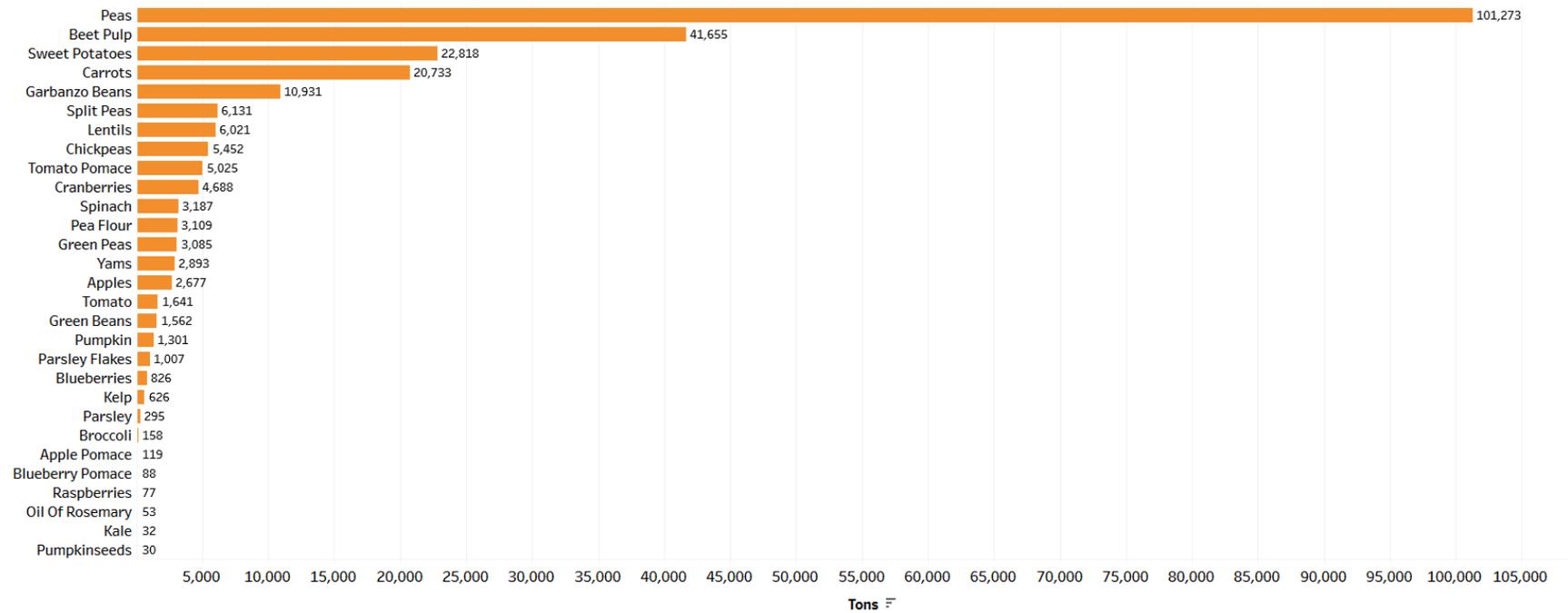


Figure 41, Specialty Crop Volumes by Ingredient (Total)

Cats

Shown below in Figure 42, total cat food ingredient allocations are based on the number of cats by state which shows the distribution of pet food ingredients **as consumed**. Due to large pet populations, the leading states for cat food consumption include Texas, California and Florida. Individual ingredients by state can be seen in the online visualization tool [here](#).

Cat Food Ingredient Allocation by State

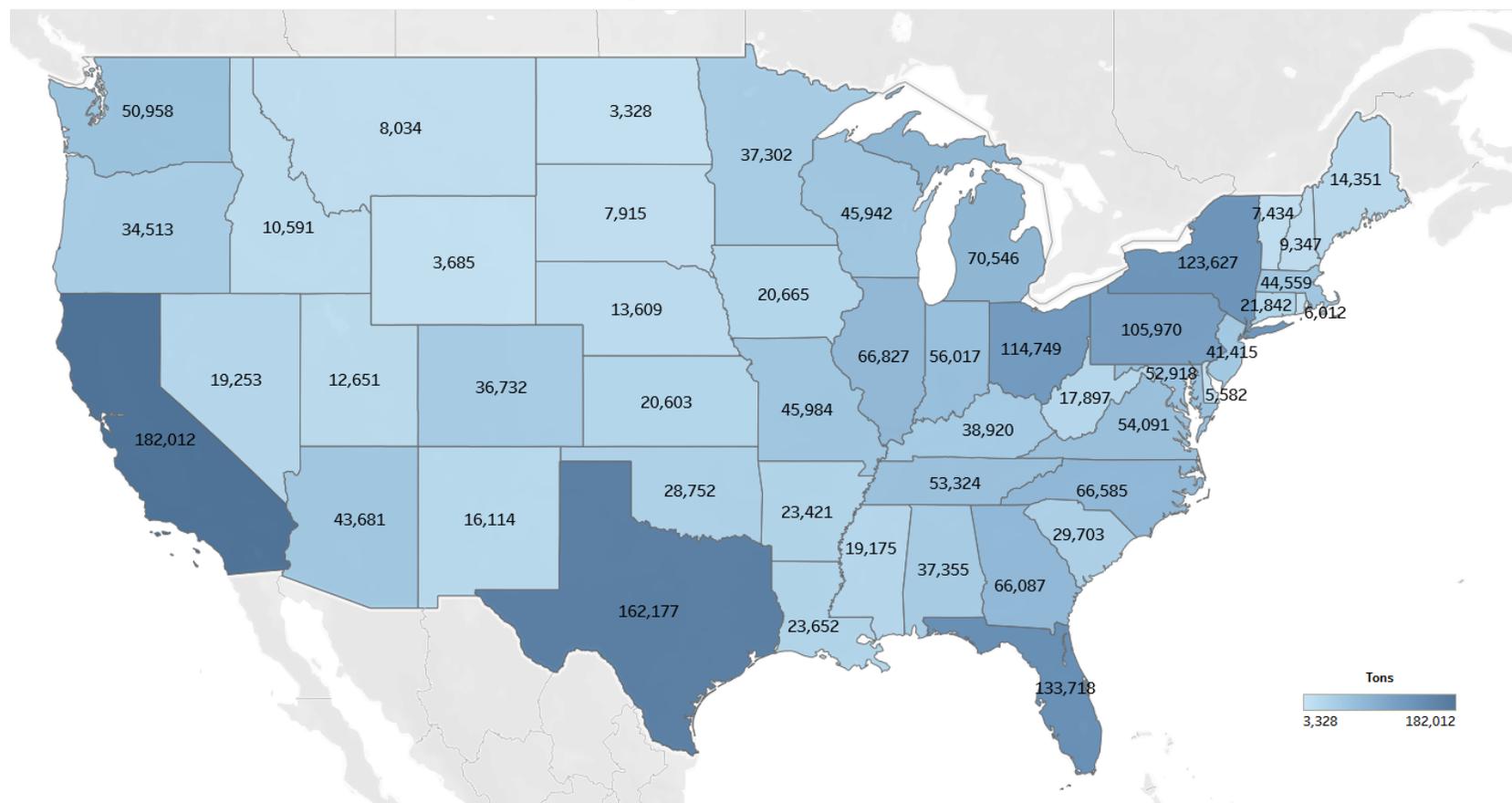


Figure 42, Total Ingredients in Cat Food as Sold at Retail, Allocation by State

Furthermore, these ingredients can be broken down by various nutrient groups. Figure 43 and Figure 44 show summary quantities of cat food ingredients that belong to the “animal protein” nutrient group. Chicken by-product meal is the lead ingredient with 161,028 tons used for cat foods during the study period, followed by chicken and poultry by-product meal, with 113,731 tons and 103,207 tons, respectively.

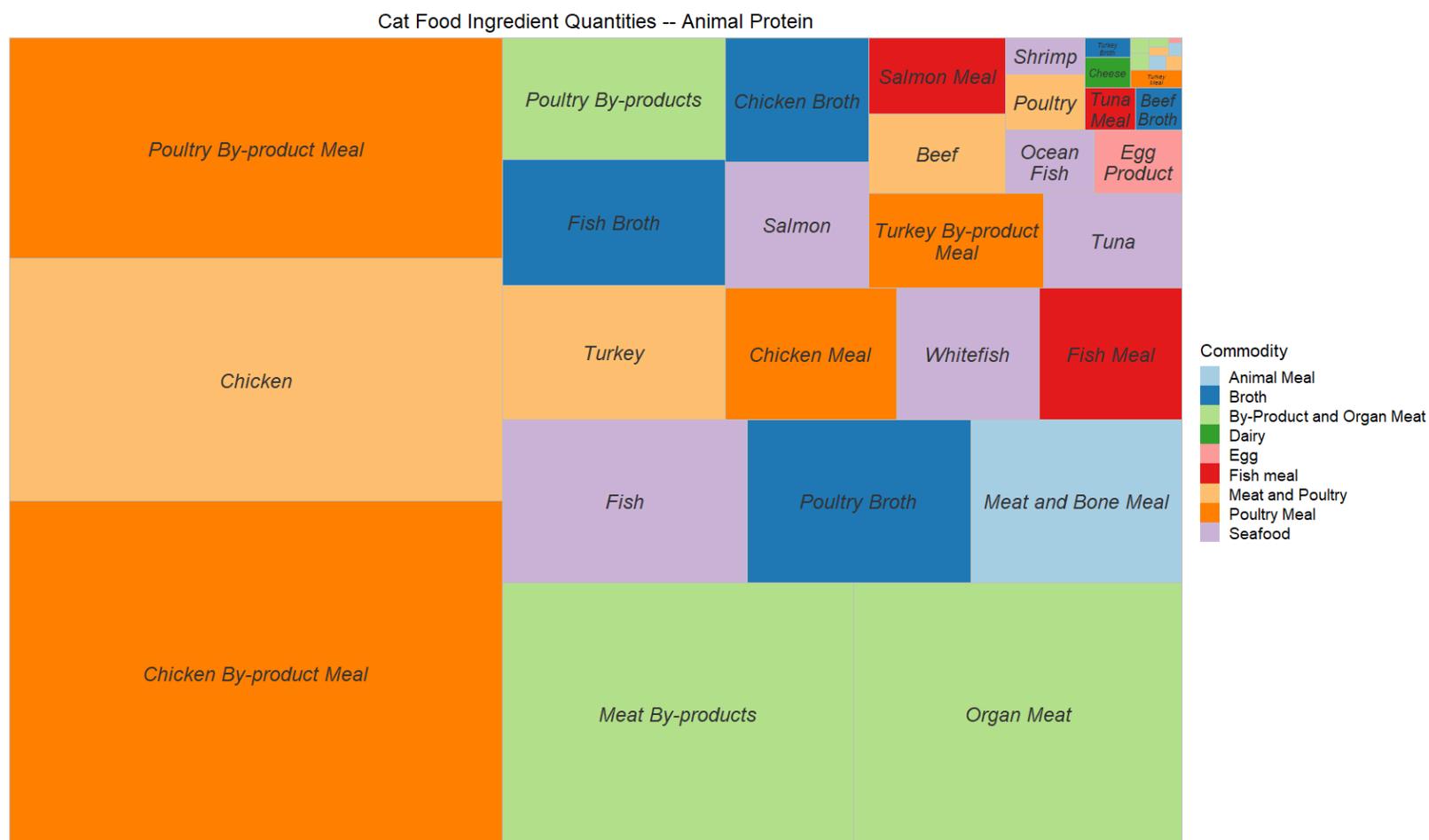


Figure 43, Animal Protein Quantities by Commodity Type (Cats)

Animal Protein Volumes by Ingredient (Cats)

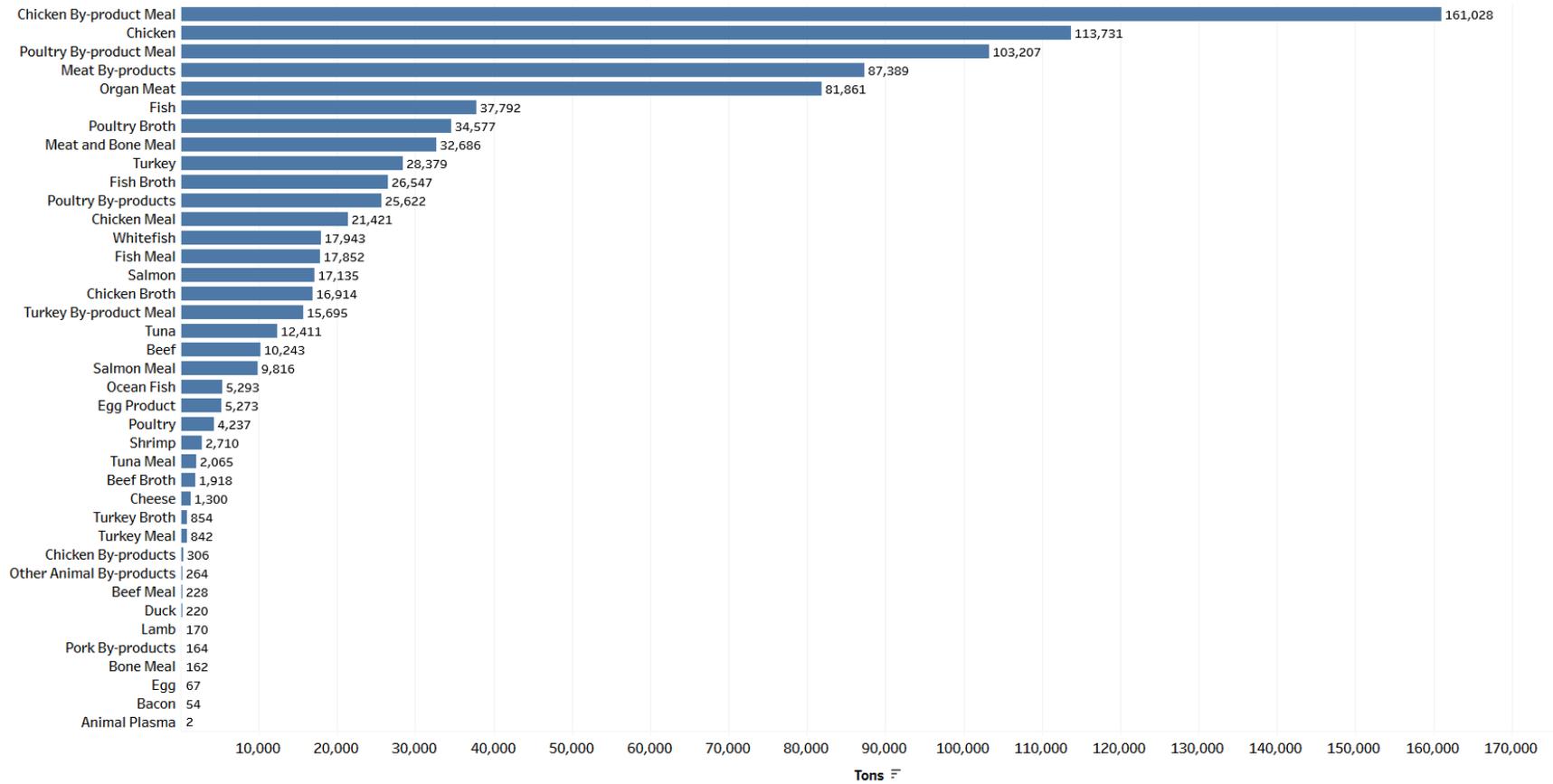


Figure 44, Animal Protein Volumes by Ingredient (Cats)

Figure 45 and Figure 46 show summary quantities of cat food ingredients that belong to the “animal fat” nutrient group. Generic animal fat is the top animal fat choice used in cat foods with 24,992 tons used during the study period, followed by beef fat and chicken fat, with 23,851 tons and 6,301 tons, respectively.

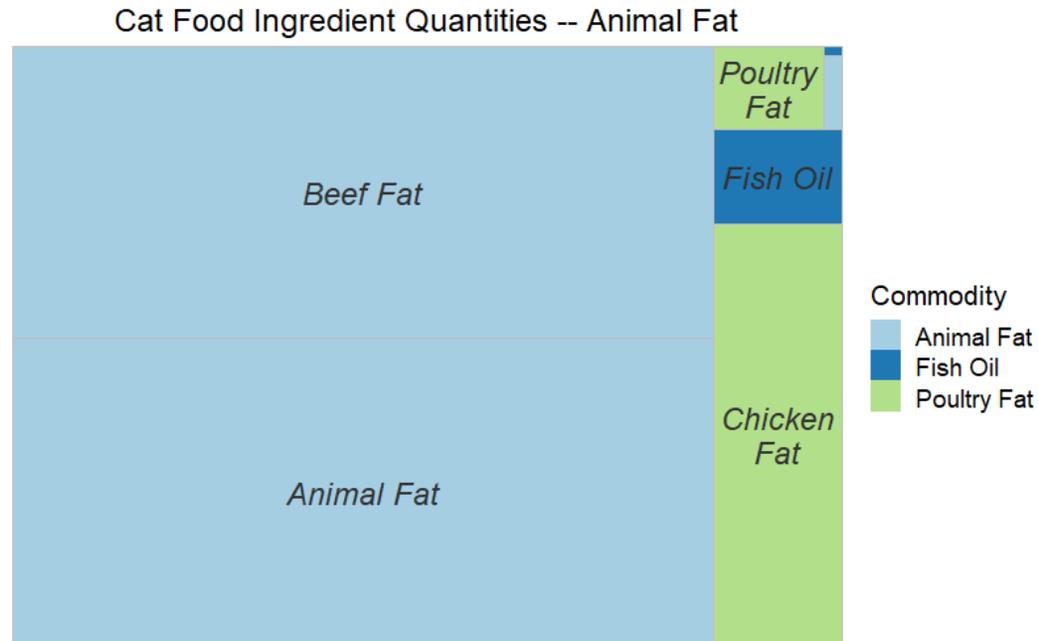


Figure 45, Animal Fat Quantities by Commodity Type (Cats)

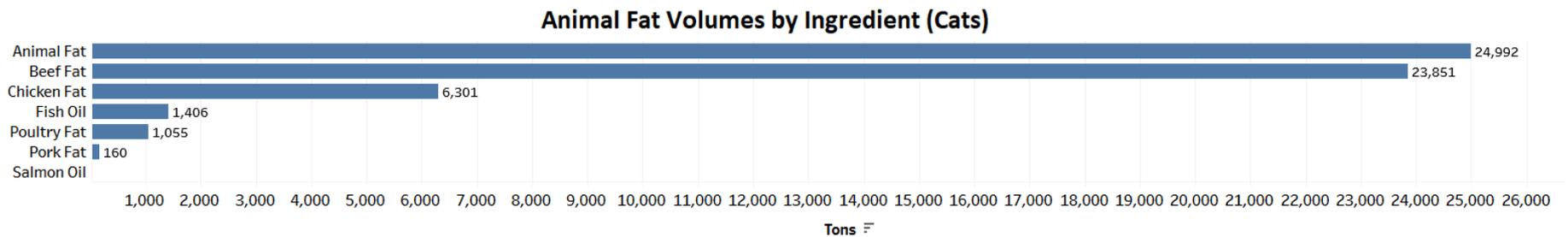


Figure 46, Animal Fat Volumes by Ingredient (Cats)

Figure 47 and Figure 48 show summary quantities of cat food ingredients that belong to plant-related nutrient groups, which are “plant protein” and “plant carbohydrate”. Corn is the top ingredient under all plant related nutrient groups, with 291,858 tons used for cat foods. Corn gluten meal and soybean meal are the second and third largest ingredients under “plant protein” and “plant carbohydrate” nutrient groups, with 241,296 tons and 82,404 tons, respectively.

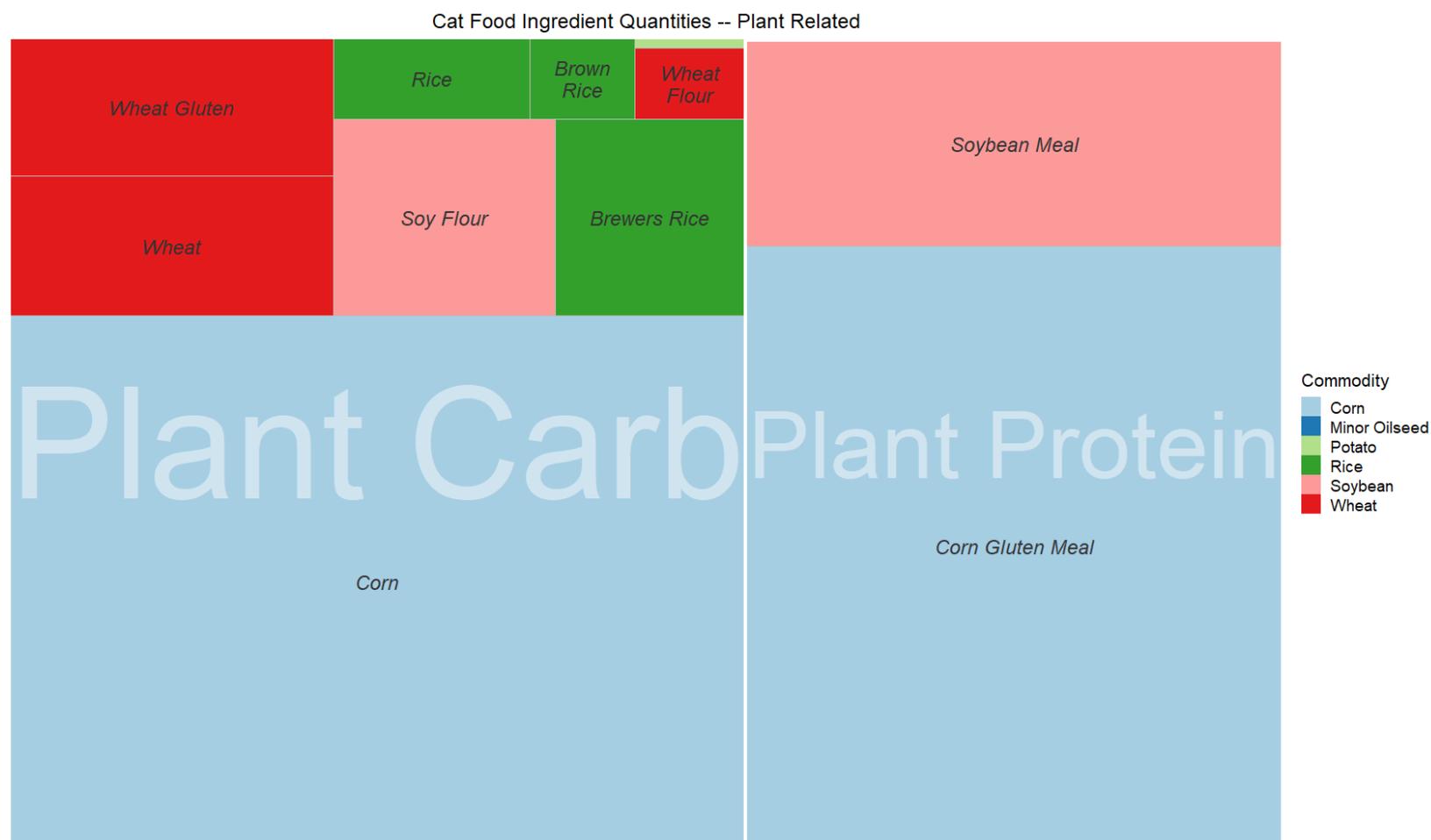


Figure 47, Plant Related Aggregations Quantities by Commodity Type (Cats)

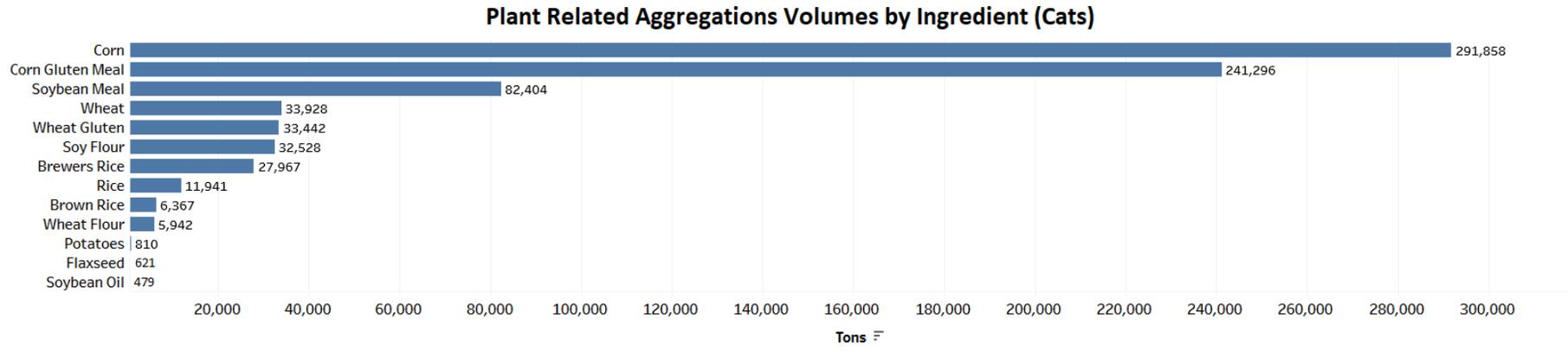


Figure 48, Plant Related Aggregations Volumes by Ingredient (Cats)

Figure 49 and Figure 50 show summary quantities of cat food ingredients that belong to the “specialty crop” category, as defined by organizations. Peas are the leading ingredient with 5,569 tons used for cat foods during the study period, followed by beet pulp and carrots, with 4,199 tons and 1,278 tons, respectively.

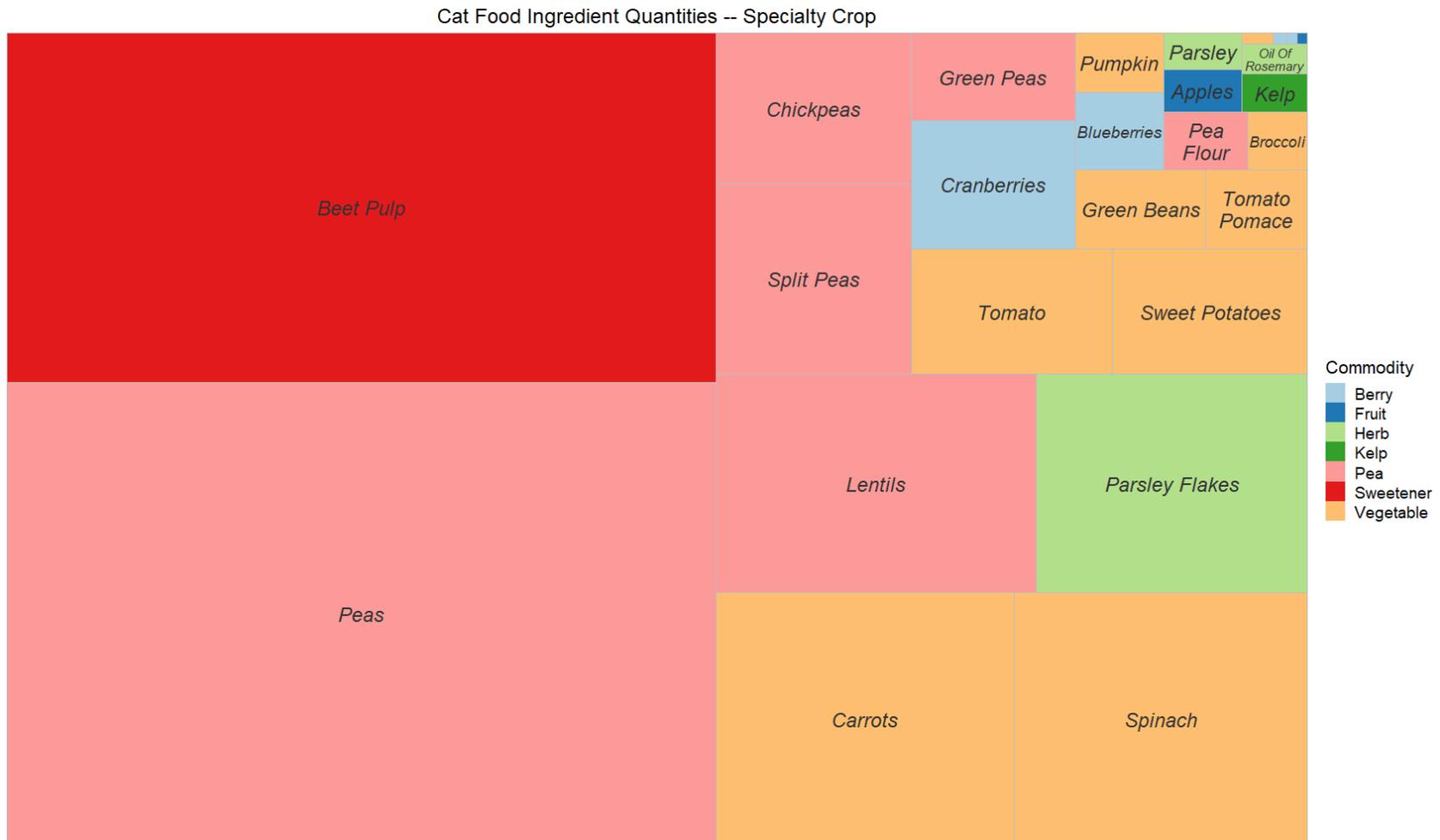


Figure 49, Specialty Crop Quantities by Commodity Type (Cats)

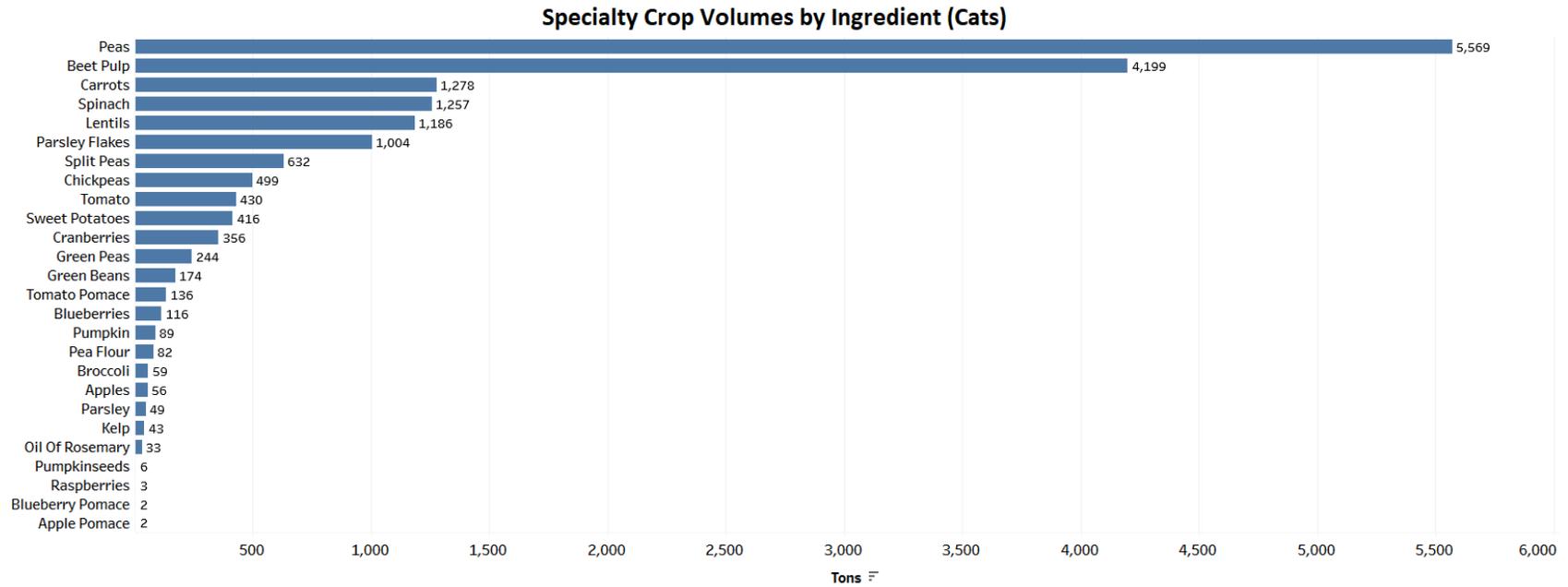


Figure 50, Specialty Crop Volumes by Ingredient (Cats)

Furthermore, these ingredients can be broken down by various nutrient groups. Figure 52 and Figure 53 show summary quantities of dog food ingredients that belong to the “animal protein” nutrient group. Meat and bone meal is the lead ingredient with 500,567 tons used for dog food products during our study period, followed by chicken and chicken by-product meal, with 470,367 tons and 201,800 tons, respectively.

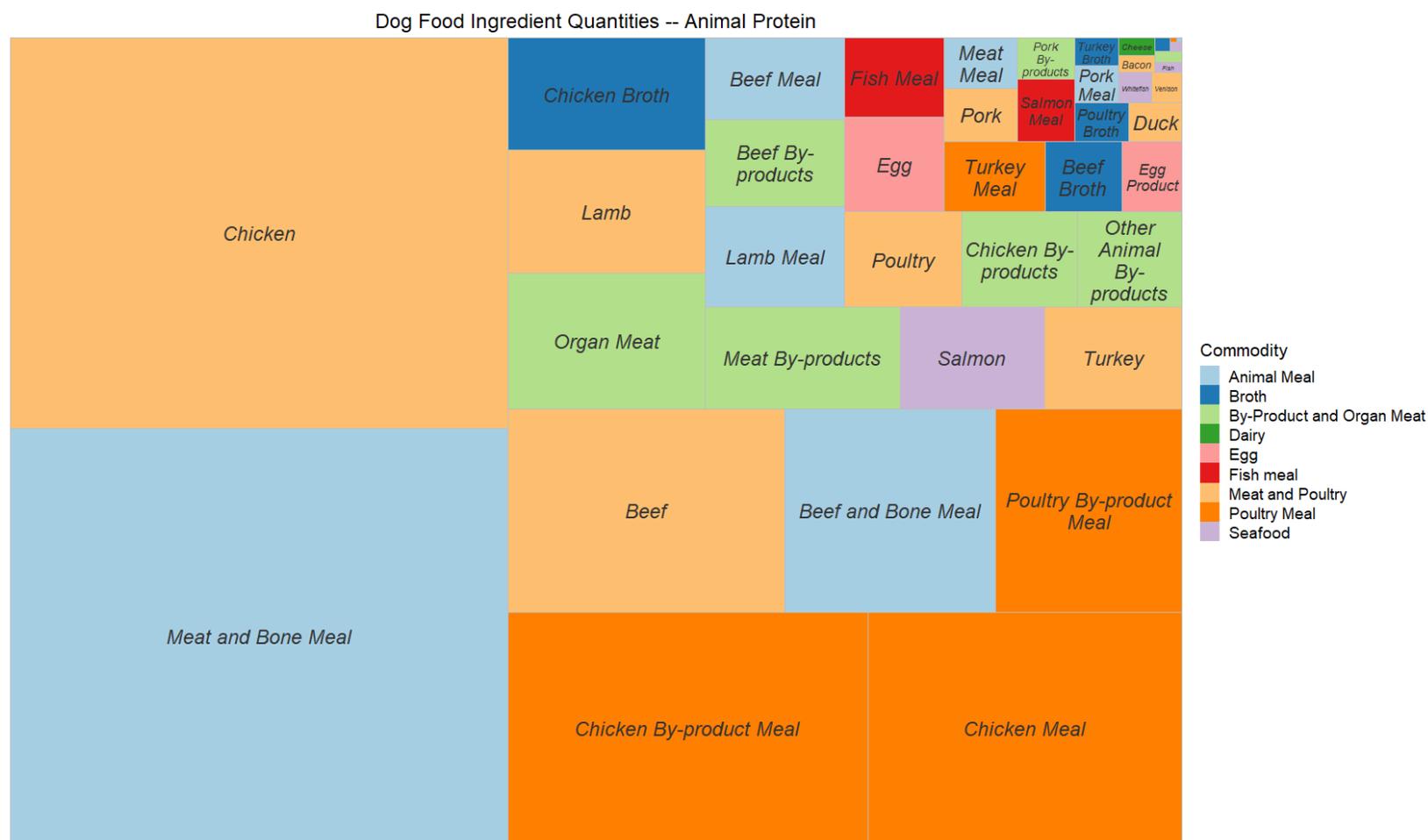


Figure 52, Animal Protein Quantities by Commodity Type (Dogs)

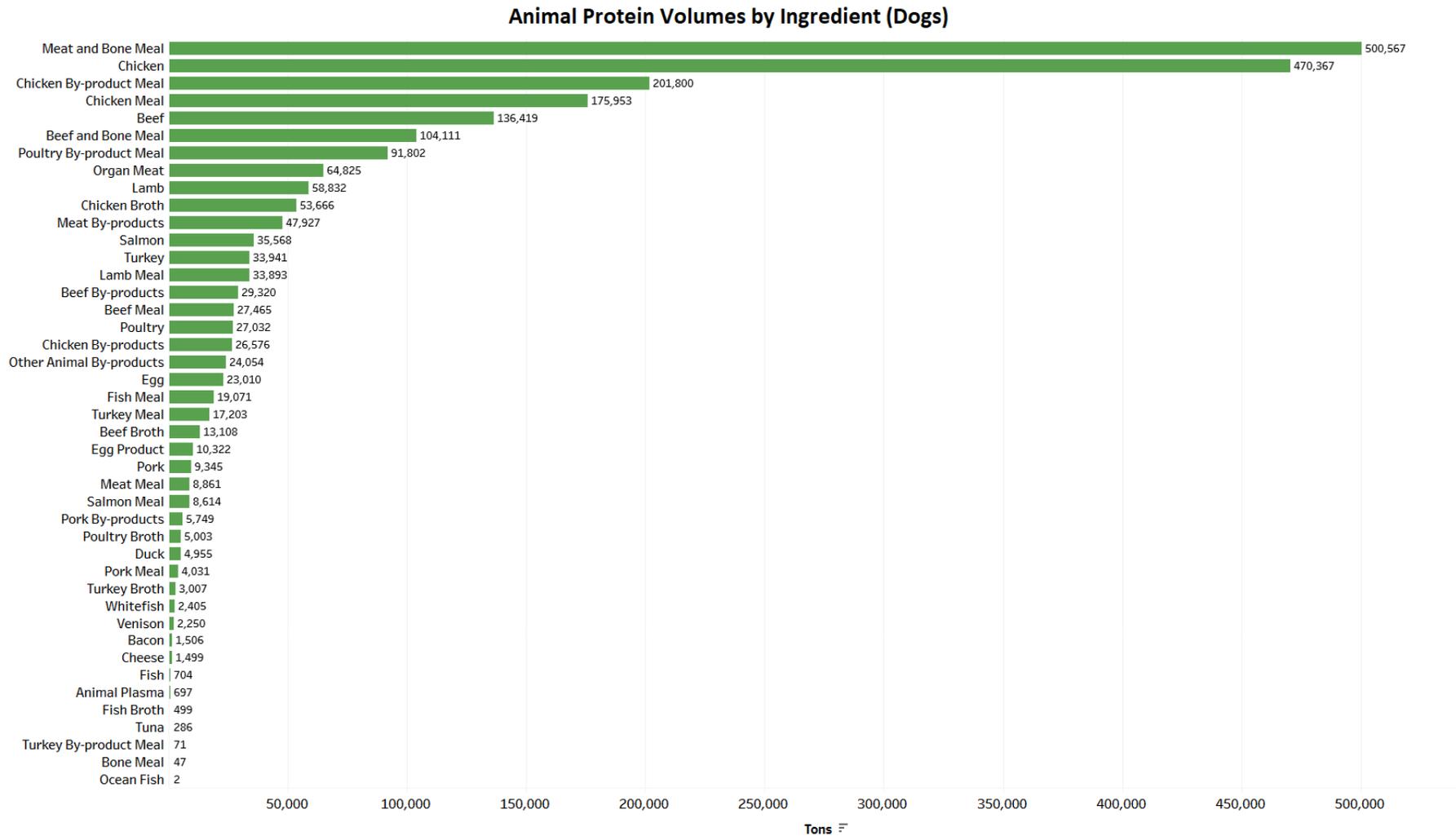


Figure 53, Animal Protein Volumes by Ingredient (Dogs)

Figure 54 and Figure 55 show summary quantities of dog food ingredients that belong to the “animal fat” nutrient group. Beef fat is the lead ingredient, with 123,605 tons used for dog foods, followed by animal fat, with 79,518 tons, and chicken fat, with 42,268 tons.

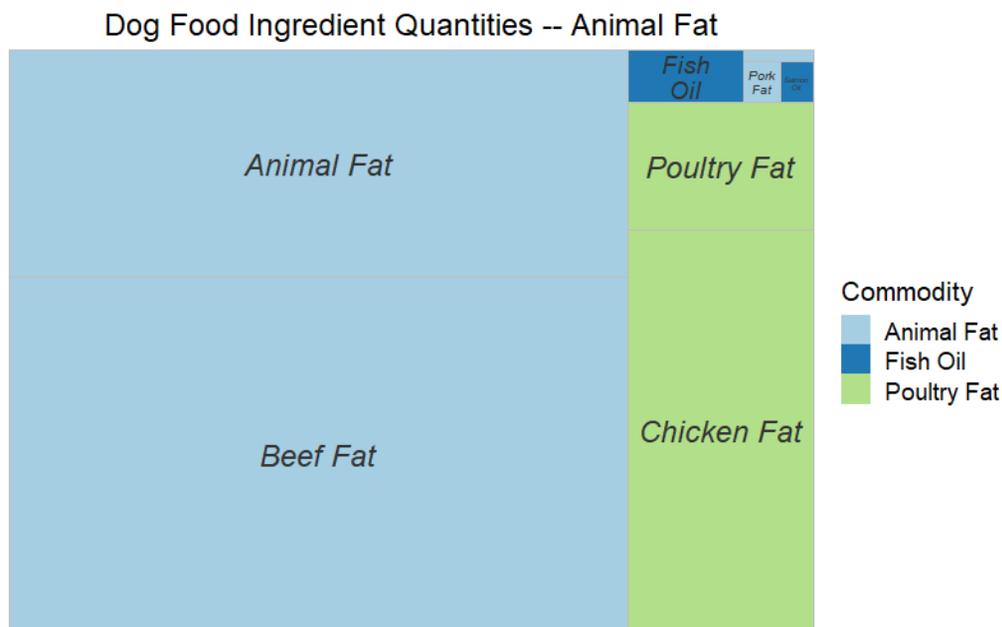


Figure 54, Animal Fat Quantities by Commodity Type (Dogs)

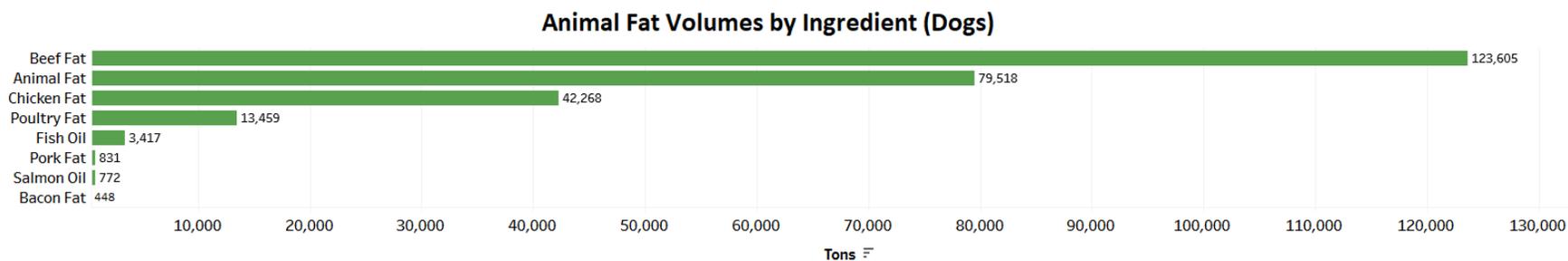


Figure 55, Animal Fat Volumes by Ingredient (Dogs)

Figure 56 and Figure 57 show summary quantities of dog food ingredients that belong to the plant related aggregation nutrient groups (plant carb and plant protein groups). Corn is the top ingredient under all plant related aggregated nutrient groups and it is the largest ingredient compared with all food ingredients for dog food products. There are 991,816 tons of corn used for dog foods, followed by soybean meal and corn gluten meal, with 344,751 tons and 235,353 tons, respectively.

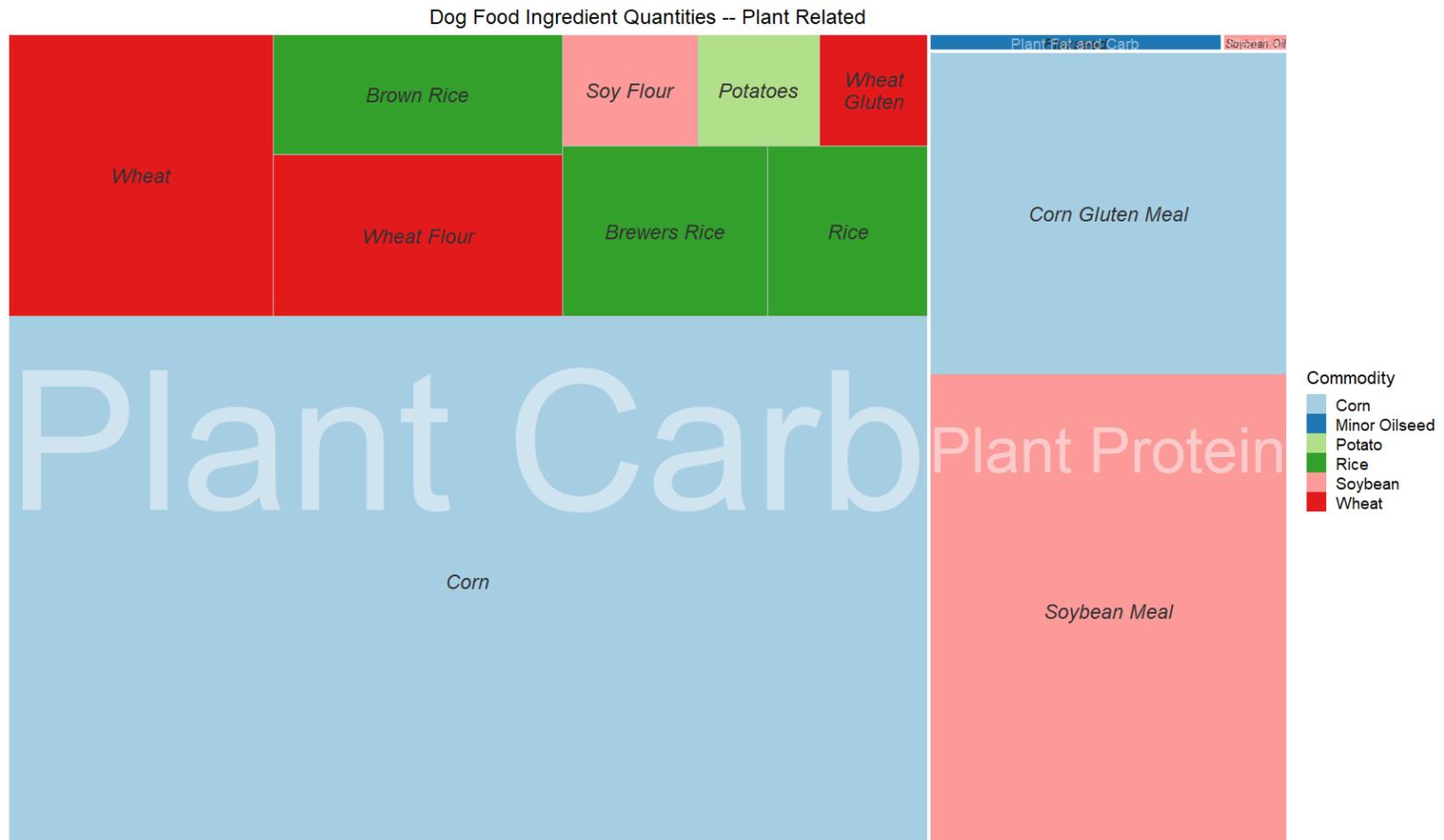


Figure 56, Plant Related Aggregations Quantities by Commodity Type (Dogs)

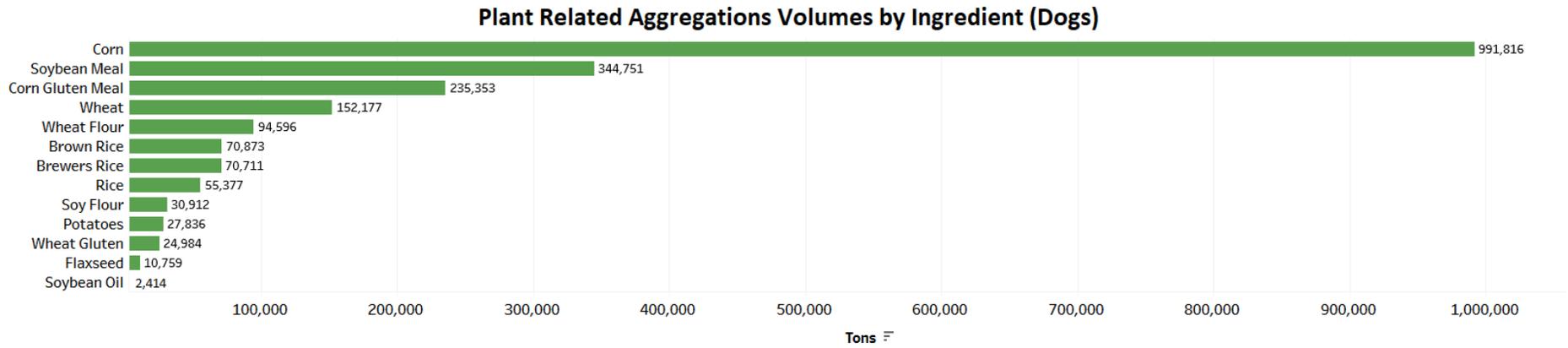


Figure 57, Plant Related Aggregations Volumes by Ingredient (Dogs)

Figure 58 and Figure 59 show summary quantities of dog food ingredients identified as specialty by organizations. Peas are the top ingredient under this category, with 95,704 tons used for dog foods, followed by beet pulp, with 37,456 tons, and sweet potatoes, with 22,403 tons.

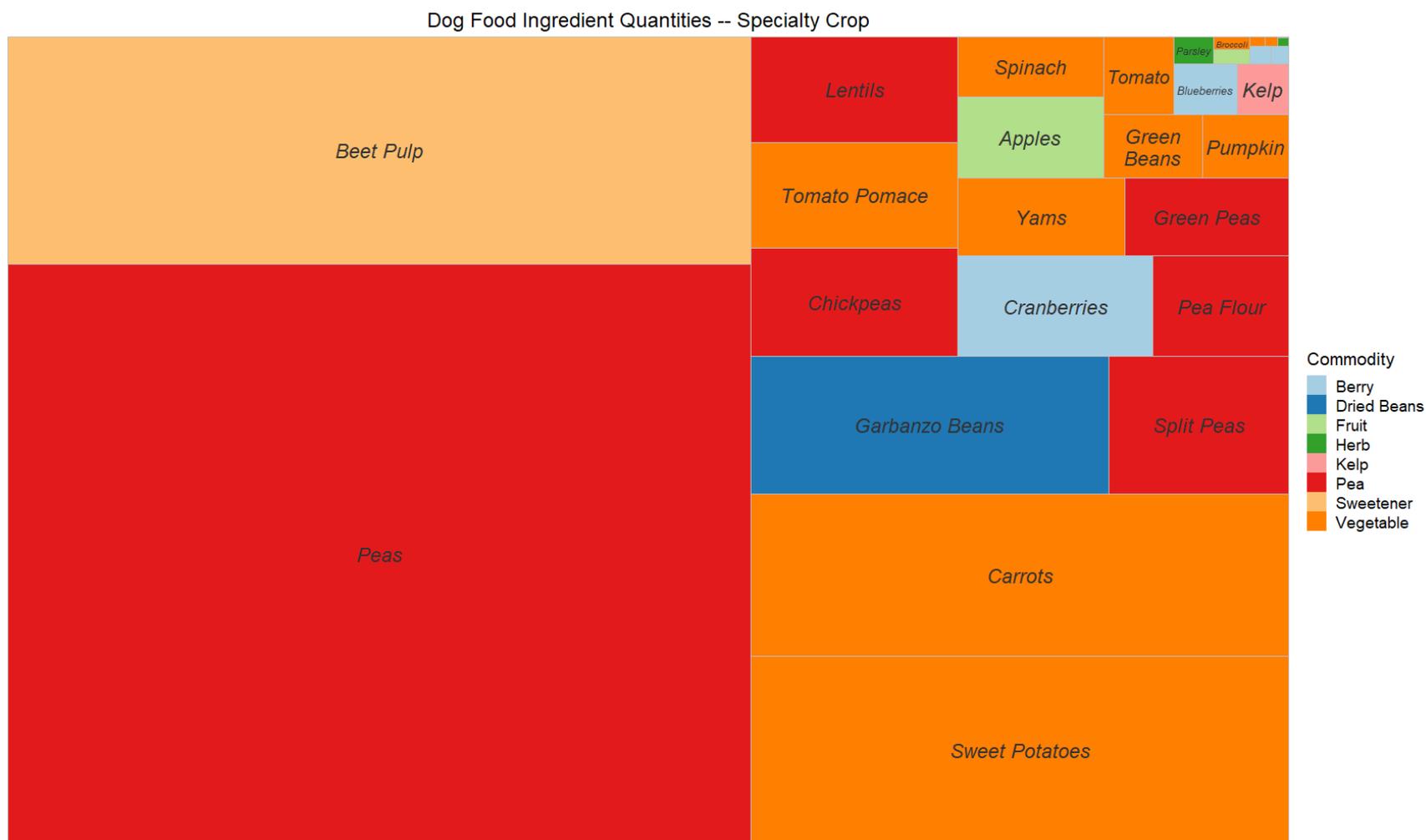


Figure 58, Specialty Crop Quantities by Commodity Type (Dogs)

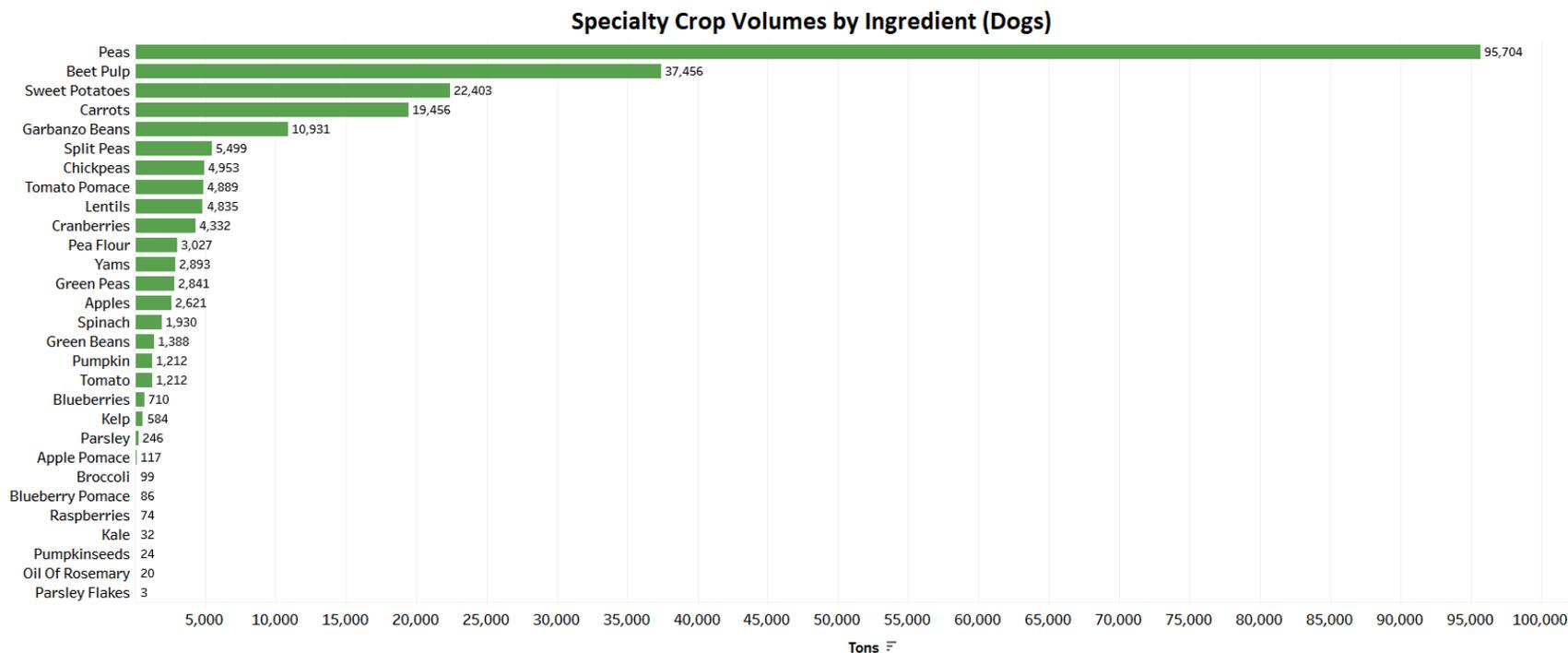


Figure 59, Specialty Crop Volumes by Ingredient (Dogs)

Appendix A, Methodology

Methodology adopted to complete the related research falls into four categories; additional details for each follow:

1. Data acquisition
2. Sales analysis
3. Ingredient analysis
4. Upstream volumes and values

Data Acquisition

Nielsen was used to capture SKU/UPC level data in six sales channels for sales of cat and dog foods nationally for the 52 weeks immediately prior to purchase (June 2019). Many aspects of the sales were provided, which allowed classification of the pet foods to take place. Details related to the data purchase are listed below. Both Option A and Option B were purchased by funding organizations.

(OPTION A) Syndicated Nielsen Data: Brand and Item Ranks (Brand and SKU Level Granularity)

| | |
|-----------------|---|
| Markets: | Total U.S. xAOC Total Petsmart, Total Petco Total Petsense Total Pet Vahu and Pet Supermarket |
| Category: | Cat Food, Dog Food (includes treats) |
| Standard Facts: | \$. \$YA, \$ % Change, \$ Share, Units, Units YA, Units % Change Units Share, EQ Vol, EQ Vol YA, EQ Vol % Chg YA, Avg Price, Avg EQ Price, %ACV, Sales/Million (Velocity), Sales/Point of Distribution (Velocity) |
| Periods: | Latest 52 weeks |
| Delivery: | Excel Format – e-mail |

(OPTION B) Pet Specialty Data: Brand and Item Ranks (Top 30 Brands and Sku)

| | |
|-----------------|--|
| Markets: | Total Pet Retail Neighborhood Pet Super Store |
| Category: | Cat Food, Dog Food (includes treats). Item detail includes UPC, Weight, Item Text |
| Standard Facts: | \$. \$YA, \$ % Change, \$ Share, Units, Units YA, Units % Change Units Share, Lb Vol, Lb Vol YA, Lb. Vol % Chg YA, Avg Price, Avg Lb. Price, Weighted Distribution, |
| Periods: | Latest 52 weeks |
| Delivery: | Excel Format – e-mail |

Syndicated Data- This term refers to the data source being based on Nielsen's definition of the category, not based on any retailer's definition of the category, or any Custom definition that may have been created through any manufacturer's "Custom hierarchy". In layman's terms, you are getting what Nielsen considers Dog Food and Cat Food. (Treats included)

Total U.S. xAOC - Total U.S. xAOC is our total FMCG Measurement. xAOC specifically stands for eXpanded All Outlets Combined. This is the aggregate of all retail Grocery Stores, Drug Stores, Mass Merchandisers (Target, Walmart, Kmart, Shopko, Etc.), Club Stores (Sam's & Bj's - No Costco), Dollar Stores and Deca Military outlets. This is a comprehensive view of total Mass Market Sales

Pet Specialty Data- this is reference to our new GFK acquisition and partnership which gives us access to independent and neighborhood Pet retail data. This includes your local pet stores.

Below is a list of the fact definitions.

- \$ = Total dollars sold at retail
- \$YA = Total dollars sold a year ago
- \$%Change = Percentage change from a year ago
- \$Share = Share of dollars sales for the entire category of pet food
- Units = Total number of units sold at retail (single package/UPC sold)
- Units YA = Units sold a year ago
- Units%Change = Percentage change from a year ago
- Units Share = Share of units for the entire category of pet food
- EQ Volume = Total equalized units sold. (Based on Oz's or Lbs)
- EQ Volume YA = Total equalized units sold a year ago (Based on Oz's or Lbs)
- Average Price = The average price per unit
- Average EQ Price = Average equalized unit price. (Based on Oz or Lbs)
- %ACV = Percentage of All Commodity Volume of the products sold in the chosen market. This is a weighted distribution metric by volume of store.
- Sales/Millions = Velocity metric, indicating how fast a product moves with equalized distribution. For every million that goes across registers, \$/MM tells what goes to this item\
- Sales/Points of Distribution = Velocity metric- Does the same as above, but instead of basing it on the all commodity volume of where an item is distributed, it is equalizing for distribution based on % of All Commodity Volume Exposure.

Sales Analysis

With the rich dataset purchased from Nielsen, summary statistics were desired to better understand the overall pet food market. This analysis was best handled from a volume and value standpoint. Within the data are standardized units of measure for volumes (weight) and value (\$). Due to how the data was provided by Nielsen, results can be summarized in several ways. Because it offers the most insight into characteristics related to sales, we have chosen to present results here according to "sub-category". Other ways in which data could be summarized include:

- Brand
- Flavor
- Product size
- Protein presence
- Target group
- Presence of a veterinarian claim
- Presence of an organic claim
- Form (bits, chunks, kibble, etc.)
- Value (\$), current, year ago and % change
- Volume, current year ago and % change
- Units, current year ago and % change
- Average unit price

Volume

The following steps were taken to determine the volume of cat and dog foods:

1. Combined all data from all six sales channels
 - a. Petco
 - b. Petsense
 - c. Petsmart
 - d. PetValue
 - e. Supermarket
 - f. AOC (all other channels)
2. Summarize data using standardized (by package sizes and weight) volumetric measure ("EQ Volume")
3. Summarize by key variables, such as
 - a. Brand
 - b. Flavor
 - c. Subcategory (wet, dry, etc.)
 - d. Product size
 - e. Protein presence
 - f. Target group
 - g. Vet claim
 - h. Organic claim
 - i. Form (bits, chunks, kibble, etc.)
 - j. Volume, current year ago and % change
 - k. Units, current year ago and % change
 - l. Average unit price

4. Create tables and charts as appropriate

Value

The following steps were taken to determine the value of cat and dog foods:

1. Combined all data from all six sales channels
2. Summarize data using standardized (by package sizes and weight) value measure (“\$”)
3. Summarize by key variables, such as
 - a. Brand
 - b. Flavor
 - c. Subcategory (wet, dry, etc.)
 - d. Product size
 - e. Protein presence
 - f. Target group
 - g. Vet claim
 - h. Organic claim
 - i. Form (bits, chunks, kibble, etc.)
 - j. Value (\$), current, year ago and % change
 - k. Average unit price
4. Create tables and charts as appropriate

Ingredient Analysis

The most important component of this project was the development of methodology to calculate ‘as sold’ ingredient weights and quantities for all cat and dog food products contained in the purchased Nielsen data. This was accomplished by taking the following summarized steps; additional detail for the most critical portion (recipe reverse engineering) of methodology follows:

1. By species (cat and dog), combine six sales channels within purchased Nielsen data and remove duplicates (by UPC and package size).
2. Determine which UPC’s represented 95% (by volume) for cat and dog foods.
3. Conduct online research for each product to obtain the corresponding ingredient panel, guaranteed analysis and calorie information.
4. Identify the products labeled as “private label”, defined by the original Nielsen data, to find approximate matches to non-private label products. This was done using the following variables, also defined by the Nielsen data, in descending order of importance:
 - a. Species: cat or dog
 - b. Food types: dry food, wet food, and treat; moist for dog food products only
 - c. Target group ages
 - d. Protein presence claim

- e. Strategic ingredient presence claim
 - f. Organic claim
 - g. Veterinarian claim
 - h. Form
5. Extract all the ingredients from pet food ingredient panels, refine (standardize) ingredient names, assign corresponding ingredient panel placement position and summarize the total frequency of each refined ingredient.
 6. Obtain prioritized ingredient list from research funding organizations.
 7. Categorize/aggregate the prioritized ingredients into nutrient groups, such as animal protein, animal fat, plant protein, plant carbohydrate, etc.
 8. Complete pet food recipe reverse engineering:
 - a. Create a database for all standardized ingredients, including their nutrient facts and national level annual average prices.
 - b. Based on the database, apply recipe reverse engineering techniques on sampled products.
 - Sampled products were randomly selected by species, food categories (three for cat foods and ten for dog foods) and dominant ingredients.
 - c. Apply the distributions for the ingredient inclusion rates based on the corresponding placement in non-sampled products.
 9. Combine estimated ingredient inclusion rates from Step 8 for all standardized ingredients, with the sales data from Nielsen, to calculate quantities of each standardized ingredient for a given pet food product.
 10. By UPC, factor up total volumes by percent coverage within Nielsen data.
 11. Summarize the total quantities for standardized ingredients and construct data files, plots and other visualization tools.

Recipe Reverse Engineering

To estimate the quantities of food ingredients 'as sold' for all pet food products, our recipe reverse engineering program was applied. The methodology behind this program is as follows:

1. Achieve all the guaranteed analysis and calories by using the ingredients shown on the ingredient panel for a given food product.
2. At the same time, maintain a relative low-cost level for the formulation while maintaining ingredient panel order.

Due to time limitations, applying the recipe reverse engineering on all the pet food products was not feasible. Therefore, a statistical methodology was developed to apply the recipe reverse engineering on representative samples to determine "prevalence distributions" for ingredient placements and ingredients. These sampled result distributions were then applied to

non-sampled products. To be more accurate, random samples were selected under **subsegments**, depending on different scenarios:

1. Food categories, defined by Nielsen data:
 - a. For cat food products, three categories were considered: dry food, wet food and treats.
 - b. For dog food products, ten categories were considered: dry food, wet food, moist food, biscuit, dental, frozen, jerky, rawhide, refrigerated and soft treat.
2. Dominant ingredients, in this case, the first three ingredients were called the dominant ingredients:
 - a. Within each food category, classified subgroups based on the first ingredients, chicken, beef, grains, broth, etc.
 - b. For each subgroup, determined and categorized **subsegments** according to the combinations and relationships of the three dominant ingredients.

Therefore, **27 subsegments** for cat food products and **69 subsegments** for dog food products were established. Within each **subsegment**, representative sample(s) were randomly selected. Overall, there were 199 samples (approximately 35%) for cat food products and 529 sampled products (approximately 43%) for dog foods.

To have a clearer view of the ingredient quantities in the summary plots, one more aggregation step on the ingredient name was completed. For instance, all livers, hearts and lungs were classified as “organ meat;” “carrots,” “dehydrated carrots,” and “dried carrots” as “carrots;” and all other animal related food ingredients with less than ten occurrences were combined, such as “other animal by-products.” This aggregation was done after the recipe reverse engineering to avoid miscalculation, for a given pet food product.

Upstream Volumes and Values

The first step in quantifying upstream quantities is to adjust ingredient quantities that were determined on an ‘as sold’ basis for moisture content. For example, the average moisture content of dry dog food is approximately 10% moisture. Ingredients such as grains and meats are purchased at higher moisture contents than the finished product, so ingredient quantities ‘as bought’ need to be adjusted for the moisture that is removed in the process of making the finished pet food product. This was done using the following steps:

1. Identify types of pet food products in need of moisture content adjustment:
 - Dry dog food
 - Dog treats
 - Dry cat food
 - Cat treats

- No ingredient quantity adjustments due to moisture characteristics were applied to ingredients used in moist or wet dog food or wet cat food
2. Average moisture content of the finished products used for this adjustment were:
 - Dry dog food (10%)
 - Dog treats (15%)
 - Dry cat food (10%)
 - Cat treats (10%)
 3. Using moisture content of the major ingredients that were developed as part of the ingredient analysis database in “Ingredient Analysis Step 8.a., the quantity of raw ingredients was adjusted for the dry pet food products by the formula:

$$\frac{(\text{As Sold Ingredient Amount} * (1 - \text{Moisture of Pet Food}))}{(1 - \text{Moisture of the Raw Ingredient})}$$

4. Estimate prices of raw ingredients. Prices were collected from a variety of sources including:
 - [USDA - AMS Market News](#)
 - [USDA NASS Crop Values 2018 Summary](#)
 - [USDA 2018 Poultry Production and Value Summary](#)
 - [USDA Market News - Fruits](#)
 - [USDA Market News - Dairy](#)
 - [FeedStuffs - Grains and Ingredients](#)
 - [FeedStuffs - Livestock and Poultry](#)
 - [Univ of Missouri AgEBB By-Products](#)
 - [FeedForLess.com](#)
 - [Alibaba.com Feed Products](#)
5. Prices were converted to \$/cwt and then to \$/ton.
6. Determine value of adjusted raw material ingredient amounts.
 - Adjusted raw ingredient amounts (in tons) were multiplied times the price (\$/ton)
7. Aggregate more than 1,200 specific ingredients into 359 ingredient categories.
8. Categorize 359 ingredients into seven sub-categories and into groups within the sub-categories:
 - Rendered meals: animal meals, fish meal and poultry meal
 - Slaughter/rendering materials: animal fat, poultry fat, by-product and organ meat and meat and poultry
 - Farm and mill-based ingredients: alfalfa, barley, berry, corn, dairy, dried beans, egg, fruit, herb, Mediterranean, minor oilseed, nut, oats, other, other grain, pea

and lentil, peanut, potato, rice, root, soybean, sweetener, tropical (palm and coconut), vegetable and wheat

- Fishery: sea products and seafood
- Mineral and other: fiber and mineral
- Water
- Broth

9. Estimate aggregated tonnage and value for each of the seven sub-categories.
10. Estimates of state-level “as-bought” ingredients were calculated based on each state’s share of direct output from pet food manufacturing sales (from the 2016 analysis that DIS conducted for IFEEDER) multiplied times the U.S. total ingredient purchases as factored up to U.S. totals. The **average pet food ingredients purchased (tons)** was calculated by dividing the state’s **total pet food ingredients purchased** by the number of **pet food manufacturing facilities** in each state.
11. The **average value of pet food ingredients purchased (dollars)** was calculated by dividing **total value of pet food ingredients purchased (dollars)** by the number of **pet food manufacturing facilities** in each state.
12. State-level factors were calculated for **indirect output based on ingredient purchases** by dividing indirect output estimates from the 2016 study by the direct output for dog and cat manufacturing from the 2016 IFEEDER study. This factor was then multiplied against each state’s share of **total value of pet food ingredients purchased** to estimate the state’s level of **indirect output based on ingredient purchases**.
13. **Indirect value added based on ingredient purchases** is a measure of the value that is added to farm and commodity handling inputs as those ingredients are sold to pet food manufacturers. This variable was calculated by dividing the estimate of indirect value added for each state from the 2016 IFEEDER study by direct output and then multiplying that factor time each state’s **total value of pet food ingredients purchased**.
14. **Average indirect output per mill based on ingredient purchases** was calculated by dividing each state’s total **indirect output based on ingredient purchases** by the number of **pet food manufacturing facilities** in each state.
15. **Average direct value added per mill based on ingredient purchases** was calculated by dividing each state’s total **direct value added based on ingredient purchases** by the number of **pet food manufacturing facilities** in each state.

Appendix B, Ingredient List and Categorization Used for Upstream Analysis

This list was reduced from the original 361 standardized ingredient list due to ingredients that were very close in composition and form. For example, water and “water sufficient for processing” were combined as “water.” This affected a total of eight ingredients.

| Ingredient | Product Type | Commodity Type |
|---------------------|---------------------|---------------------------|
| Alfalfa | Farm and Mill-based | Mill Feed |
| Alfalfa Leaf | Farm and Mill-based | Mill Feed |
| Alfalfa Meal | Farm and Mill-based | Mill Feed |
| Algae | Fishery | Other Fish |
| Almond Oil | Farm and Mill-based | Vegetable Oil |
| Althea Root | Farm and Mill-based | Root |
| Anchovies | Fishery | Other Fish |
| Animal Fat | Meat and Poultry | Animal Fat |
| Animal Liver Flavor | Meat and Poultry | By-Product and Organ Meat |
| Animal Plasma | Meat and Poultry | By-Product and Organ Meat |
| Apple Pomace | Farm and Mill-based | Fruit and Vegetable |
| Apples | Farm and Mill-based | Fruit and Vegetable |
| Avocado | Farm and Mill-based | Fruit and Vegetable |
| Avocado Oil | Farm and Mill-based | Vegetable Oil |
| Bacon | Meat and Poultry | Meat and Poultry |
| Bacon Broth | Broth | Other Broth |
| Bacon Fat | Meat and Poultry | Animal Fat |
| Bakery Product | Farm and Mill-based | Mill Feed |
| Bananas | Farm and Mill-based | Fruit and Vegetable |
| Barley | Farm and Mill-based | Whole Grain |
| Barley Flour | Farm and Mill-based | Mill Feed |
| Barley Grass | Farm and Mill-based | Mill Feed |
| Barley Malt Syrup | Farm and Mill-based | Mill Feed |
| Beef | Meat and Poultry | Meat and Poultry |
| Beef Broth | Broth | Beef Broth |
| Beef By-products | Meat and Poultry | By-Product and Organ Meat |
| Beef Fat | Meat and Poultry | Animal Fat |
| Beef Meal | Rendered | Animal Meal |
| Beet Powder | Farm and Mill-based | Sweetener |
| Beet Pulp | Farm and Mill-based | Mill Feed |
| Beets | Farm and Mill-based | Fruit and Vegetable |
| Bison | Meat and Poultry | Meat and Poultry |
| Black Beans | Farm and Mill-based | Fruit and Vegetable |
| Blackberries | Farm and Mill-based | Fruit and Vegetable |

| | | |
|--------------------------|---------------------|---------------------------|
| Blueberries | Farm and Mill-based | Fruit and Vegetable |
| Blueberry Pomace | Farm and Mill-based | Fruit and Vegetable |
| Bone Meal | Rendered | Animal Meal |
| Brewers Dried Yeast | Farm and Mill-based | Mill Feed |
| Brewers Rice | Farm and Mill-based | Mill Feed |
| Brewers Rice Flour | Farm and Mill-based | Mill Feed |
| Broccoli | Farm and Mill-based | Fruit and Vegetable |
| Brown Kelp | Fishery | Other Fish |
| Brown Rice | Farm and Mill-based | Whole Grain |
| Brown Sugar | Farm and Mill-based | Sweetener |
| Burdock Root | Farm and Mill-based | Root |
| Butternut Squash | Farm and Mill-based | Fruit and Vegetable |
| Calcium Carbonate | Mineral and Other | Mineral |
| Calcium Lactate | Mineral and Other | Mineral |
| Cane Sugar | Farm and Mill-based | Sweetener |
| Canola Meal | Farm and Mill-based | Mill Feed |
| Canola Oil | Farm and Mill-based | Vegetable Oil |
| Carrots | Farm and Mill-based | Fruit and Vegetable |
| Cassava Root Flour | Farm and Mill-based | Mill Feed |
| Celery | Farm and Mill-based | Fruit and Vegetable |
| Cellulose | Mineral and Other | Mineral |
| Chard | Farm and Mill-based | Fruit and Vegetable |
| Cheddar Cheese | Farm and Mill-based | Dairy and Egg |
| Cheddar Cheese Powder | Farm and Mill-based | Dairy and Egg |
| Cheese | Farm and Mill-based | Dairy and Egg |
| Cheese Powder | Farm and Mill-based | Dairy and Egg |
| Cheese Product | Farm and Mill-based | Dairy and Egg |
| Cherries | Farm and Mill-based | Fruit and Vegetable |
| Chia Seed | Farm and Mill-based | Whole Grain |
| Chicken | Meat and Poultry | Meat and Poultry |
| Chicken and Turkey Broth | Broth | Other Broth |
| Chicken Broth | Broth | Chicken Broth |
| Chicken By-product Meal | Rendered | Poultry Meal |
| Chicken By-products | Meat and Poultry | By-Product and Organ Meat |
| Chicken Fat | Meat and Poultry | Poultry Fat |
| Chicken Meal | Rendered | Poultry Meal |
| Chickory Root | Farm and Mill-based | Root |
| Chickpea Flour | Farm and Mill-based | Fruit and Vegetable |
| Chickpeas | Farm and Mill-based | Fruit and Vegetable |
| Chicory | Farm and Mill-based | Root |
| Chicory Root | Farm and Mill-based | Root |

| | | |
|------------------------------|---------------------|---------------------------|
| Chicory Root Inulin | Farm and Mill-based | Root |
| Cinnamon | Farm and Mill-based | Fruit and Vegetable |
| Citrus Pulp | Farm and Mill-based | Fruit and Vegetable |
| Coconut | Farm and Mill-based | Fruit and Vegetable |
| Coconut Flour | Farm and Mill-based | Mill Feed |
| Coconut Oil | Farm and Mill-based | Vegetable Oil |
| Cod | Fishery | Cod |
| Collard Greens | Farm and Mill-based | Fruit and Vegetable |
| Corn | Farm and Mill-based | Whole Grain |
| Corn Distillers Dried Grains | Farm and Mill-based | Mill Feed |
| Corn Flour | Farm and Mill-based | Mill Feed |
| Corn Germ Meal | Farm and Mill-based | Mill Feed |
| Corn Gluten Feed | Farm and Mill-based | Mill Feed |
| Corn Gluten Meal | Farm and Mill-based | Mill Feed |
| Corn Grits | Farm and Mill-based | Mill Feed |
| Corn Meal | Farm and Mill-based | Mill Feed |
| Corn Oil | Farm and Mill-based | Vegetable Oil |
| Corn Starch | Farm and Mill-based | Mill Feed |
| Corn Sugar | Farm and Mill-based | Sweetener |
| Corn Syrup | Farm and Mill-based | Mill Feed |
| Crab | Fishery | Other Fish |
| Crab Meal | Rendered | Other Fish |
| Cracked Pearled Barley | Farm and Mill-based | Mill Feed |
| Cracked Wheat | Farm and Mill-based | Mill Feed |
| Cranberries | Farm and Mill-based | Fruit and Vegetable |
| Cranberry Pomace | Farm and Mill-based | Fruit and Vegetable |
| Cultured Milk | Farm and Mill-based | Dairy and Egg |
| Cultured Skim Milk | Farm and Mill-based | Dairy and Egg |
| Dehydrated Alfalfa Meal | Farm and Mill-based | Mill Feed |
| Dicalcium Phosphate | Mineral and Other | Mineral |
| Digest Flavor | Meat and Poultry | By-Product and Organ Meat |
| Dried Alfalfa | Farm and Mill-based | Mill Feed |
| Dried Alfalfa Meal | Farm and Mill-based | Mill Feed |
| Dried Brewers Yeast | Farm and Mill-based | Mill Feed |
| Dried Cane Molasses | Farm and Mill-based | Sweetener |
| Dried Yeast | Farm and Mill-based | Mill Feed |
| Duck | Meat and Poultry | Meat and Poultry |
| Egg | Farm and Mill-based | Dairy and Egg |
| Egg Powder | Farm and Mill-based | Dairy and Egg |
| Egg Product | Farm and Mill-based | Dairy and Egg |
| Egg Shell Membrane | Farm and Mill-based | Dairy and Egg |

| | | |
|------------------------------|---------------------|---------------------------|
| Egg Whites | Farm and Mill-based | Dairy and Egg |
| Expeller Pressed Canola Oil | Farm and Mill-based | Vegetable Oil |
| Fava Beans | Farm and Mill-based | Fruit and Vegetable |
| Fennel | Farm and Mill-based | Fruit and Vegetable |
| Fenugreek Seed | Farm and Mill-based | Fruit and Vegetable |
| Fish | Fishery | Other Fish |
| Fish Broth | Broth | Fish Broth |
| Fish Meal | Rendered | Fish meal |
| Fish Oil | Fishery | Other Fish |
| Flaxseed | Farm and Mill-based | Whole Grain |
| Flaxseed Meal | Farm and Mill-based | Mill Feed |
| Flaxseed Oil | Farm and Mill-based | Vegetable Oil |
| Fresh Bartlett Pears | Farm and Mill-based | Fruit and Vegetable |
| Fructose | Farm and Mill-based | Sweetener |
| Garbanzo Beans | Farm and Mill-based | Fruit and Vegetable |
| Gelatin | Meat and Poultry | By-Product and Organ Meat |
| Glycerin | Farm and Mill-based | Mill Feed |
| Grain Distillers Dried Yeast | Farm and Mill-based | Mill Feed |
| Grains | Farm and Mill-based | Whole Grain |
| Green Beans | Farm and Mill-based | Fruit and Vegetable |
| Green Lipped Mussels | Fishery | Other Fish |
| Green Peas | Farm and Mill-based | Fruit and Vegetable |
| Guar Gum | Farm and Mill-based | Fruit and Vegetable |
| Ham | Meat and Poultry | Meat and Poultry |
| High Fructose Corn Syrup | Farm and Mill-based | Sweetener |
| Hominy Feed | Farm and Mill-based | Mill Feed |
| Honey | Farm and Mill-based | Sweetener |
| Hydrogenated Corn Syrup | Farm and Mill-based | Mill Feed |
| Hydrolyzed Chicken Liver | Meat and Poultry | By-Product and Organ Meat |
| Hydrolyzed Soy Protein | Farm and Mill-based | Soy Product |
| Imitation Crab Meat | Fishery | Other Fish |
| Juniper Berries | Farm and Mill-based | Fruit and Vegetable |
| Kale | Farm and Mill-based | Fruit and Vegetable |
| Kelp | Fishery | Other Fish |
| Kelp Meal | Fishery | Other Fish |
| Lamb | Meat and Poultry | Meat and Poultry |
| Lamb and Chicken Broth | Broth | Other Broth |
| Lamb Broth | Broth | Other Broth |
| Lamb Meal | Rendered | Animal Meal |
| Lecithin | Farm and Mill-based | Soy Product |
| Lentil Fiber | Farm and Mill-based | Mill Feed |

| | | |
|--------------------------------|---------------------|---------------------------|
| Lentil Flour | Farm and Mill-based | Fruit and Vegetable |
| Lentils | Farm and Mill-based | Fruit and Vegetable |
| Lettuce | Farm and Mill-based | Fruit and Vegetable |
| Linseed | Farm and Mill-based | Whole Grain |
| Liver Broth | Broth | Other Broth |
| Locust Bean Gum | Farm and Mill-based | Fruit and Vegetable |
| Long Grain Rice | Farm and Mill-based | Whole Grain |
| Mackerel | Fishery | Other Fish |
| Maize | Farm and Mill-based | Whole Grain |
| Malted Barley | Farm and Mill-based | Mill Feed |
| Malted Barley Extract | Farm and Mill-based | Mill Feed |
| Malted Barley Flour | Farm and Mill-based | Mill Feed |
| Maple Flavored Syrup | Farm and Mill-based | Sweetener |
| Meat And Bone Meal | Rendered | Meat and Bone Meal |
| Meat Broth | Broth | Other Broth |
| Meat By-products | Meat and Poultry | By-Product and Organ Meat |
| Meat Meal | Rendered | Animal Meal |
| Menhaden Oil | Fishery | Other Fish |
| Milk | Farm and Mill-based | Dairy and Egg |
| Millet | Farm and Mill-based | Whole Grain |
| Minerals | Mineral and Other | Mineral |
| Modified Food Starch | Farm and Mill-based | Mill Feed |
| Modified Rice Starch | Farm and Mill-based | Mill Feed |
| Modified Tapioca Starch | Farm and Mill-based | Mill Feed |
| Molasses Beet Pulp | Farm and Mill-based | Sweetener |
| Monterey Jack Cheese Powder | Farm and Mill-based | Dairy and Egg |
| Natural And Artificial Flavors | Mineral and Other | Mineral |
| Natural flavor | Mineral and Other | Mineral |
| Nonfat Milk | Farm and Mill-based | Dairy and Egg |
| Oat Bran | Farm and Mill-based | Mill Feed |
| Oat Fiber | Farm and Mill-based | Mill Feed |
| Oat Flour | Farm and Mill-based | Mill Feed |
| Oat Groats | Farm and Mill-based | Mill Feed |
| Oat Hulls | Farm and Mill-based | Mill Feed |
| Oat Meal | Farm and Mill-based | Mill Feed |
| Oats | Farm and Mill-based | Whole Grain |
| Ocean Fish | Fishery | Other Fish |
| Oil Of Rosemary | Farm and Mill-based | Vegetable Oil |
| Oils | Farm and Mill-based | Vegetable Oil |
| Olive Oil | Farm and Mill-based | Vegetable Oil |
| Oranges | Farm and Mill-based | Fruit and Vegetable |

| | | |
|--------------------------------------|---------------------|---------------------------|
| Organ Meat | Meat and Poultry | By-Product and Organ Meat |
| Organic Pea Protein | Farm and Mill-based | Fruit and Vegetable |
| Other Animal By-products | Meat and Poultry | By-Product and Organ Meat |
| Palm Oil | Farm and Mill-based | Vegetable Oil |
| Papain | Farm and Mill-based | Fruit and Vegetable |
| Papaya | Farm and Mill-based | Fruit and Vegetable |
| Paprika | Farm and Mill-based | Fruit and Vegetable |
| Parsley | Farm and Mill-based | Fruit and Vegetable |
| Parsley Flakes | Farm and Mill-based | Fruit and Vegetable |
| Parsnip | Farm and Mill-based | Fruit and Vegetable |
| Partially Hydrogenated Vegetable Oil | Farm and Mill-based | Vegetable Oil |
| Pasta | Farm and Mill-based | Mill Feed |
| Pea Fiber | Farm and Mill-based | Mill Feed |
| Pea Flour | Farm and Mill-based | Fruit and Vegetable |
| Pea Protein | Farm and Mill-based | Mill Feed |
| Pea Starch | Farm and Mill-based | Mill Feed |
| Peanut Butter | Farm and Mill-based | Root |
| Peanut Flour | Farm and Mill-based | Root |
| Peanut Oil | Farm and Mill-based | Vegetable Oil |
| Pearled Barley | Farm and Mill-based | Whole Grain |
| Pears | Farm and Mill-based | Fruit and Vegetable |
| Peas | Farm and Mill-based | Fruit and Vegetable |
| Pheasant | Meat and Poultry | Meat and Poultry |
| Pineapple | Farm and Mill-based | Fruit and Vegetable |
| Pinto Beans | Farm and Mill-based | Fruit and Vegetable |
| Pomegranate | Farm and Mill-based | Fruit and Vegetable |
| Pork | Meat and Poultry | Meat and Poultry |
| Pork Broth | Broth | Other Broth |
| Pork By-products | Meat and Poultry | By-Product and Organ Meat |
| Pork Fat | Meat and Poultry | Pork Fat |
| Pork Meal | Rendered | Animal Meal |
| Potassium Chloride | Mineral and Other | Mineral |
| Potato Flour | Farm and Mill-based | Fruit and Vegetable |
| Potato Product | Farm and Mill-based | Fruit and Vegetable |
| Potato Protein | Farm and Mill-based | Fruit and Vegetable |
| Potato Starch | Farm and Mill-based | Fruit and Vegetable |
| Potatoes | Farm and Mill-based | Fruit and Vegetable |
| Poultry | Meat and Poultry | Meat and Poultry |
| Poultry Broth | Broth | Poultry Broth |
| Poultry By-product Meal | Rendered | Poultry Meal |
| Poultry By-products | Meat and Poultry | By-Product and Organ Meat |

| | | |
|-------------------------|---------------------|---------------------|
| Poultry Fat | Meat and Poultry | Poultry Fat |
| Powdered Cellulose | Mineral and Other | Mineral |
| Psyllium Seed Husk | Farm and Mill-based | Mill Feed |
| Pumpkin | Farm and Mill-based | Fruit and Vegetable |
| Pumpkinseeds | Farm and Mill-based | Fruit and Vegetable |
| Quinoa | Farm and Mill-based | Whole Grain |
| Quinoa Seed | Farm and Mill-based | Whole Grain |
| Raspberries | Farm and Mill-based | Fruit and Vegetable |
| Red Peppers | Farm and Mill-based | Fruit and Vegetable |
| Rice | Farm and Mill-based | Whole Grain |
| Rice Bran | Farm and Mill-based | Mill Feed |
| Rice Flour | Farm and Mill-based | Mill Feed |
| Rice Hulls | Farm and Mill-based | Mill Feed |
| Rice Pasta | Farm and Mill-based | Mill Feed |
| Rice Starch | Farm and Mill-based | Mill Feed |
| Rice Syrup | Farm and Mill-based | Mill Feed |
| Rolled Oats | Farm and Mill-based | Mill Feed |
| Rosehips | Farm and Mill-based | Fruit and Vegetable |
| Rosemary | Farm and Mill-based | Fruit and Vegetable |
| Rye | Farm and Mill-based | Whole Grain |
| Rye Flour | Farm and Mill-based | Mill Feed |
| Salmon | Fishery | Salmon |
| Salmon Meal | Rendered | Fish meal |
| Salmon Oil | Fishery | Other Fish |
| Salt | Mineral and Other | Mineral |
| Scrambled Egg | Farm and Mill-based | Egg |
| Sea Cucumber | Fishery | Other Fish |
| Seabass | Fishery | Other Fish |
| Seaweed Meal | Fishery | Other Fish |
| Sesame Oil | Farm and Mill-based | Vegetable Oil |
| Sesame Seeds | Farm and Mill-based | Whole Grain |
| Shrimp | Fishery | Other Fish |
| Shrimp Meal | Fishery | Other Fish |
| Skim Milk | Farm and Mill-based | Dairy and Egg |
| Sole | Fishery | Other Fish |
| Sorghum | Farm and Mill-based | Whole Grain |
| Soy Flakes | Farm and Mill-based | Soy Product |
| Soy Flour | Farm and Mill-based | Soy Product |
| Soy Grits | Farm and Mill-based | Soy Product |
| Soy Protein Concentrate | Farm and Mill-based | Soy Product |
| Soy Protein Isolate | Farm and Mill-based | Soy Product |

| | | |
|------------------------|---------------------|---------------------|
| Soybean Germ Meal | Farm and Mill-based | Soy Product |
| Soybean Hulls | Farm and Mill-based | Soy Product |
| Soybean Meal | Farm and Mill-based | Soy Product |
| Soybean Mill Run | Farm and Mill-based | Soy Product |
| Soybean Oil | Farm and Mill-based | Soy Product |
| Spearmint | Farm and Mill-based | Fruit and Vegetable |
| Spinach | Farm and Mill-based | Fruit and Vegetable |
| Split Peas | Farm and Mill-based | Fruit and Vegetable |
| Sugar | Farm and Mill-based | Sweetener |
| Sunflower Lecithin | Farm and Mill-based | Mill Feed |
| Sunflower Oil | Farm and Mill-based | Vegetable Oil |
| Sunflower Seed Meal | Farm and Mill-based | Mill Feed |
| Sunflower Seeds | Farm and Mill-based | Whole Grain |
| Swede | Farm and Mill-based | Fruit and Vegetable |
| Sweet Potato Flour | Farm and Mill-based | Fruit and Vegetable |
| Sweet Potatoes | Farm and Mill-based | Fruit and Vegetable |
| Swiss Cheese Powder | Farm and Mill-based | Dairy and Egg |
| Tapioca | Farm and Mill-based | Root |
| Tapioca | Farm and Mill-based | Root |
| Tapioca Flour | Farm and Mill-based | Mill Feed |
| Tapioca Starch | Farm and Mill-based | Root |
| Textured Soy Protein | Farm and Mill-based | Soy Product |
| Tomato | Farm and Mill-based | Fruit and Vegetable |
| Tomato Pomace | Farm and Mill-based | Fruit and Vegetable |
| Tomato Puree | Farm and Mill-based | Fruit and Vegetable |
| Tricalcium Phosphate | Mineral and Other | Mineral |
| Tuna | Fishery | Tuna |
| Tuna Broth | Broth | Broth |
| Tuna By-product | Fishery | Other Fish |
| Tuna Meal | Rendered | Fish meal |
| Turkey | Meat and Poultry | Meat and Poultry |
| Turkey Broth | Broth | Poultry Broth |
| Turkey By-product Meal | Rendered | Poultry Meal |
| Turkey Meal | Rendered | Poultry Meal |
| Vegetable Broth | Broth | Other Broth |
| Vegetable Glycerin | Farm and Mill-based | Fruit and Vegetable |
| Vegetable Oil | Farm and Mill-based | Vegetable Oil |
| Vegetable Pomace | Farm and Mill-based | Fruit and Vegetable |
| Vegetables | Farm and Mill-based | Fruit and Vegetable |
| Venison | Meat and Poultry | Meat and Poultry |
| Water | Water | Water |

| Water Sufficient For Processing | Water | Water |
|---------------------------------|---------------------|---------------------|
| Watercress | Farm and Mill-based | Fruit and Vegetable |
| Wheat | Farm and Mill-based | Whole Grain |
| Wheat Bran | Farm and Mill-based | Mill Feed |
| Wheat Flour | Farm and Mill-based | Mill Feed |
| Wheat Germ | Farm and Mill-based | Mill Feed |
| Wheat Germ Meal | Farm and Mill-based | Mill Feed |
| Wheat Gluten | Farm and Mill-based | Mill Feed |
| Wheat Middlings | Farm and Mill-based | Mill Feed |
| Wheat Mill Run | Farm and Mill-based | Mill Feed |
| Wheat Starch | Farm and Mill-based | Mill Feed |
| Whey | Farm and Mill-based | Dairy |
| White Rice | Farm and Mill-based | Whole Grain |
| Whitefish | Fishery | Other Fish |
| Whole Grain Corn | Farm and Mill-based | Whole Grain |
| Whole Navy Beans | Farm and Mill-based | Fruit and Vegetable |
| Wild Boar | Meat and Poultry | Meat and Poultry |
| Wild Rice | Farm and Mill-based | Whole Grain |
| Xanthan Gum | Farm and Mill-based | Sweetener |
| Yams | Farm and Mill-based | Fruit and Vegetable |
| Yeast Culture | Farm and Mill-based | Mill Feed |
| Yellow Peas | Farm and Mill-based | Fruit and Vegetable |
| Zucchini | Farm and Mill-based | Fruit and Vegetable |

Appendix C, Guaranteed Analysis for Pet Food Products

Cat food products were categorized into three types: dry food, wet food and treats. In addition to the three for cats, moist food for dog food products was added.

From Figure 60 to Figure 63 illustrates the guaranteed analysis for cat food products, by brand and owner and by different food types. A few key variables and associated ranges include:

- The guaranteed minimum crude protein ranges from:
 - 21% to 42% for dry food
 - 5.5% to 18% for wet food
 - 3.4% to 30% for treats
- The guaranteed minimum crude fat ranges from:
 - 9% to 21.2% for dry food
 - 0.1% to 7% for wet food
 - 0.1% to 17% for treats
- The maximum crude fiber guarantee ranges from:
 - 1.1% to 6% for dry food
 - 0.5% to 3.8% for wet food
 - 0.4% to 4.5% for treats

From Figure 64 to Figure 67 illustrate the guaranteed analysis for dog food products by brand and owner and by different food types. A few key variables and associated ranges include:

- The minimum crude protein guarantee ranges from:
 - 17% to 58% for dry food
 - 13% to 18% for moist food
 - 5% to 18% for wet food
 - 3% to 73% for treats
- The guaranteed minimum crude fat ranges from:
 - 7% to 20% for dry food
 - 7% to 8% for moist food
 - 2% to 8% for wet food
 - 0.2% to 16% for treats
- The maximum crude fiber guarantee ranges from:
 - 2% to 11% for dry food
 - 2% to 3% for moist food
 - 1% to 2% for wet food
 - 0.1% to 10% for treats

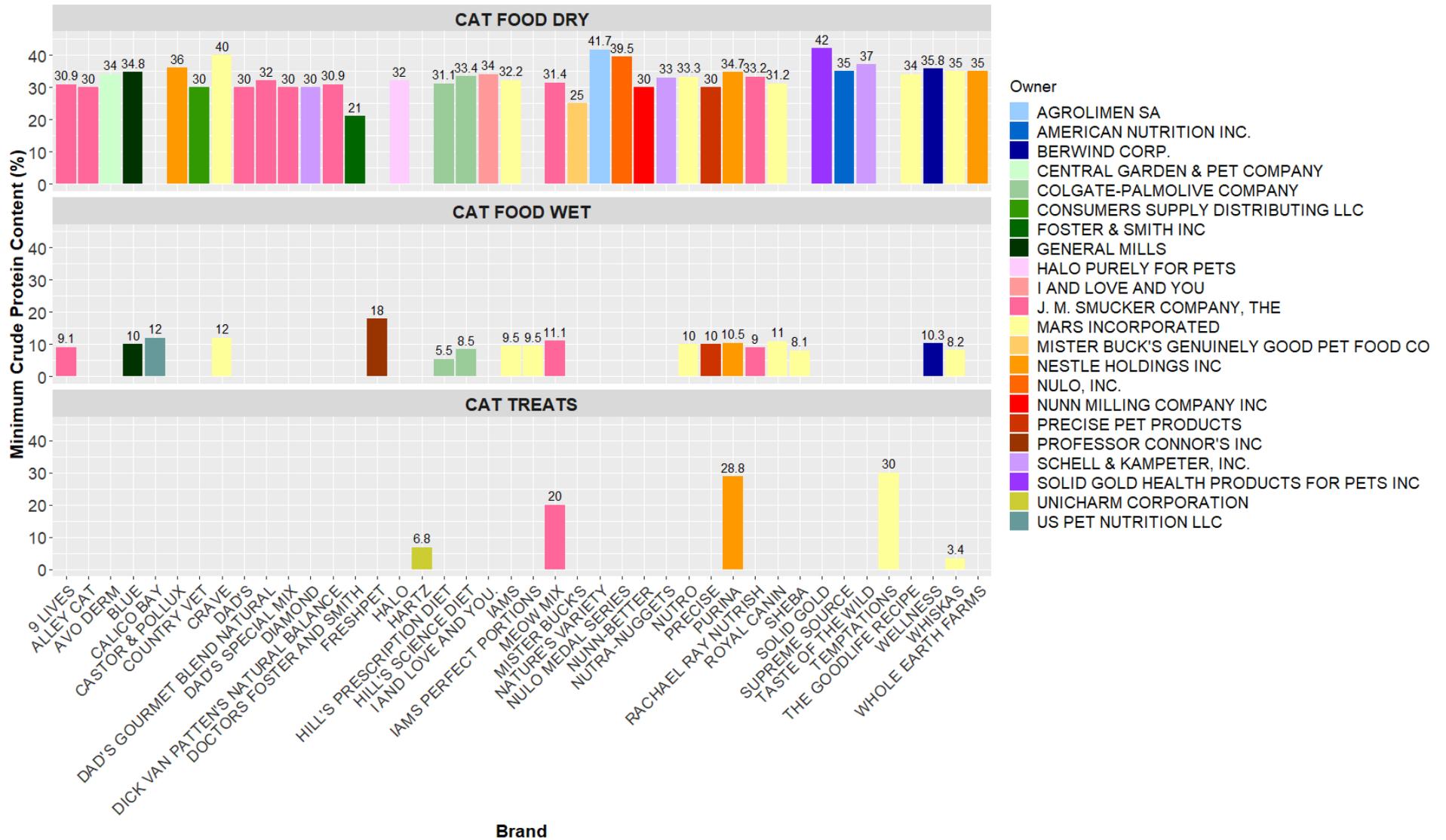


Figure 60, Minimum Crude Protein Content in Cat Food Products

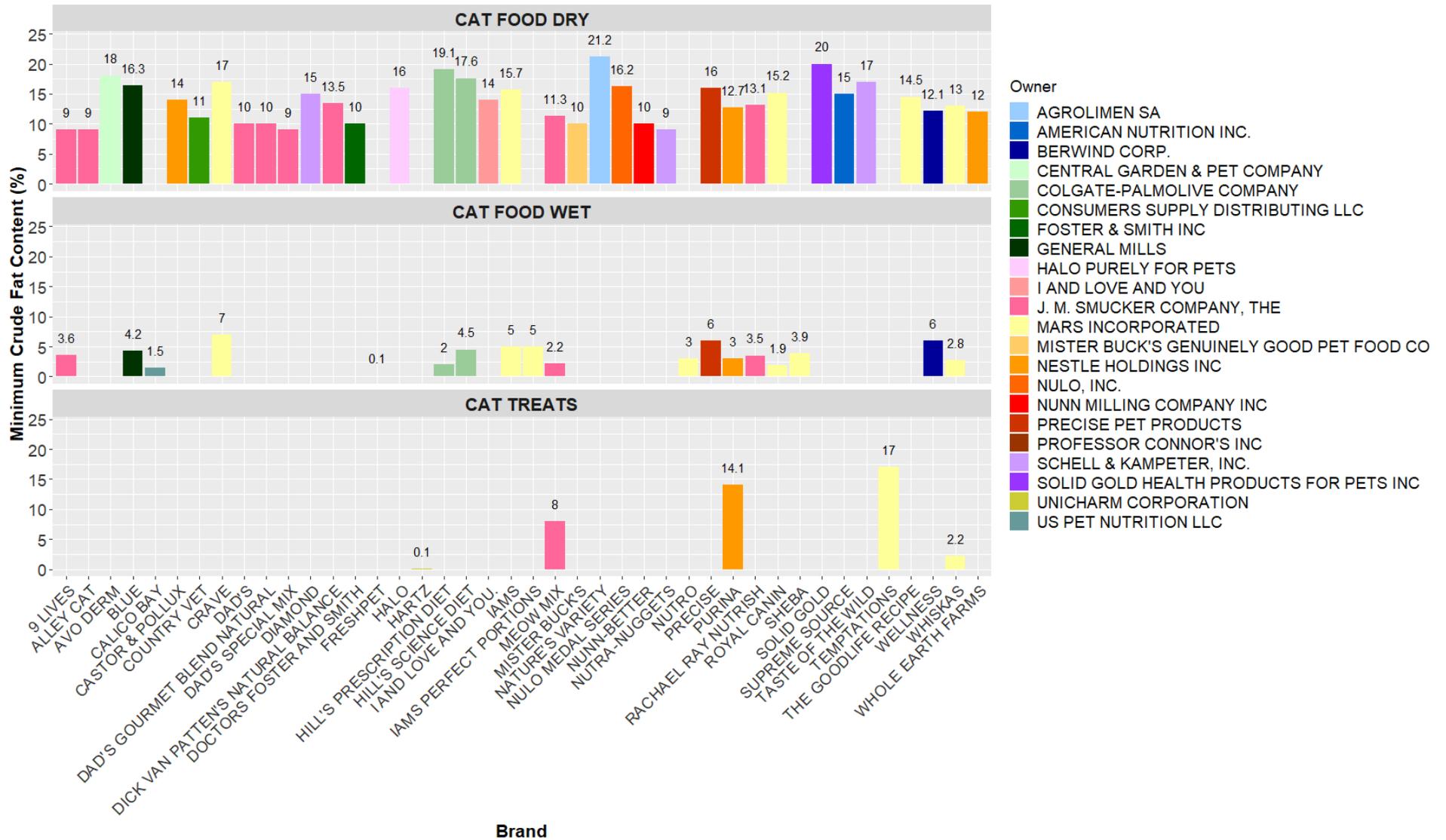


Figure 61, Minimum Crude Fat Content in Cat Food Products

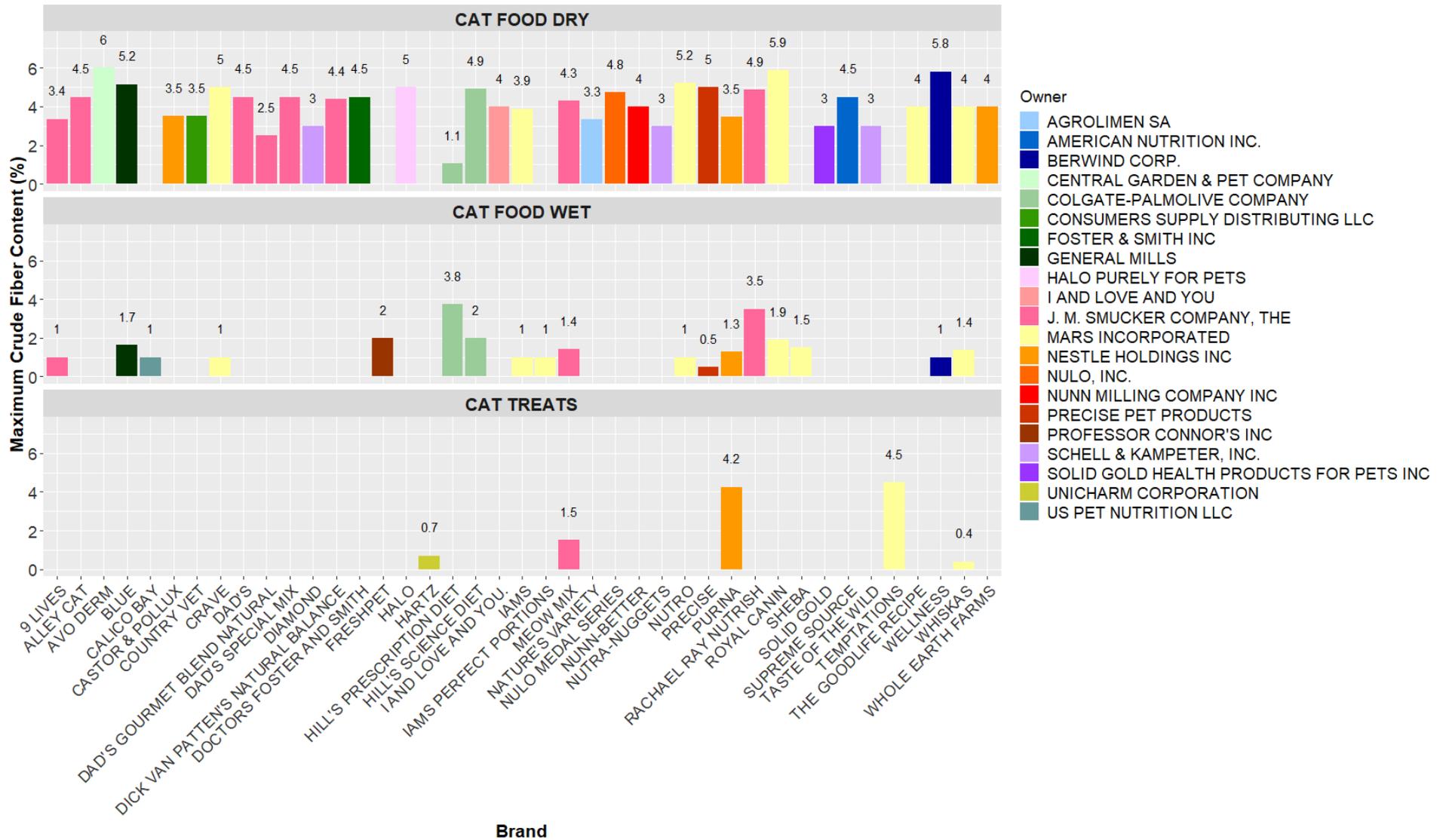


Figure 62, Maximum Crude Fiber Content in Cat Food Products

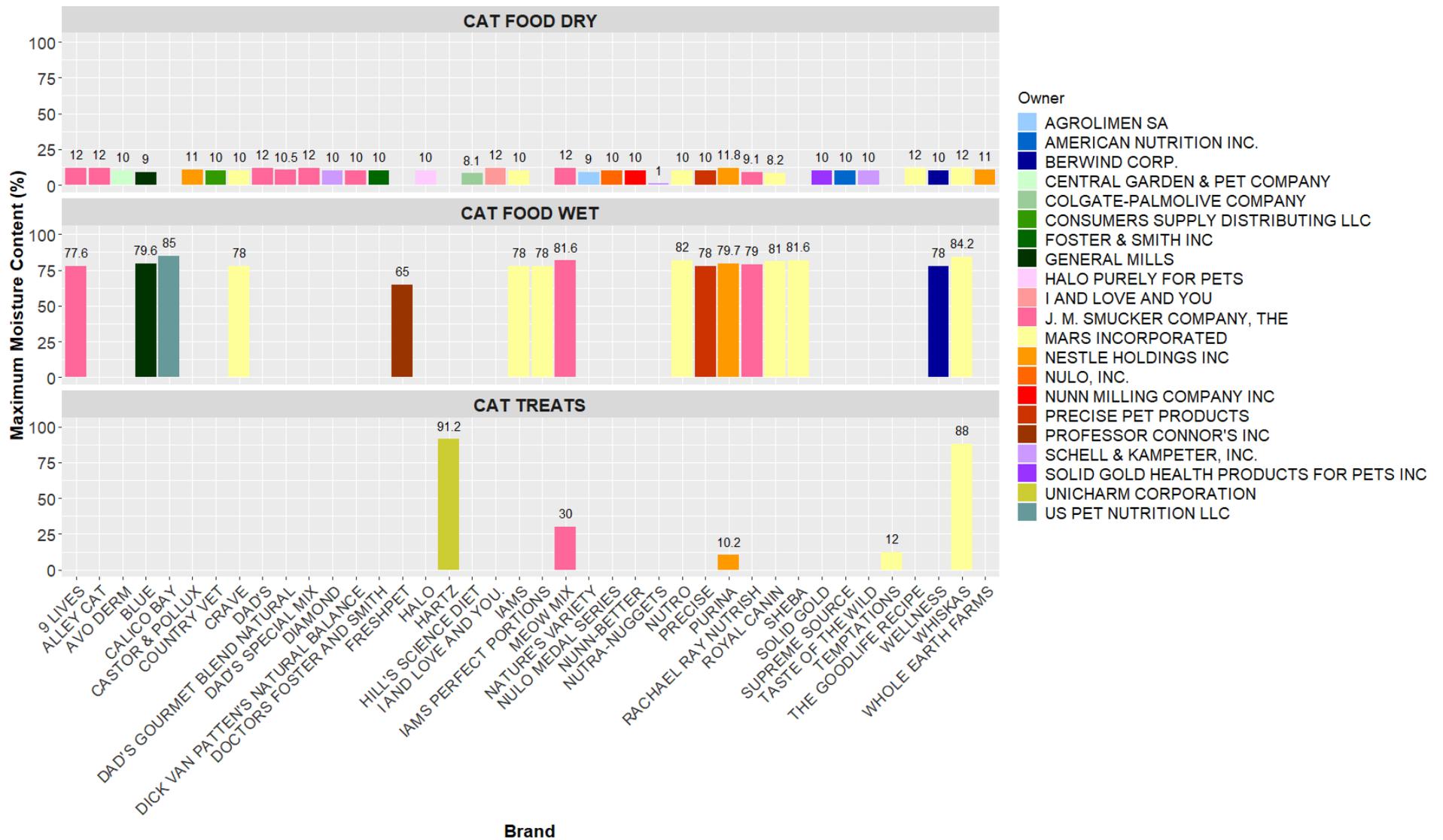
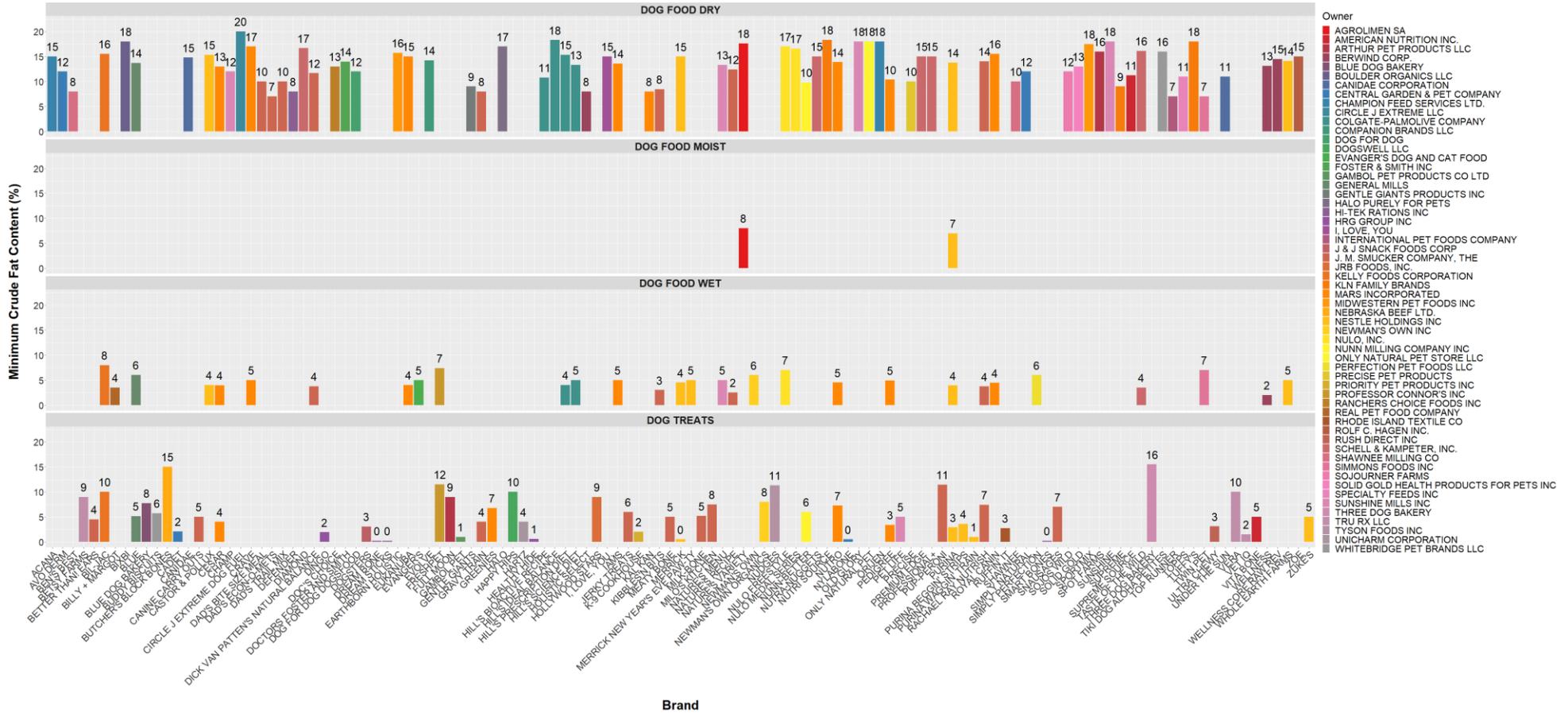


Figure 63, Maximum Moisture Content in Cat Food Products



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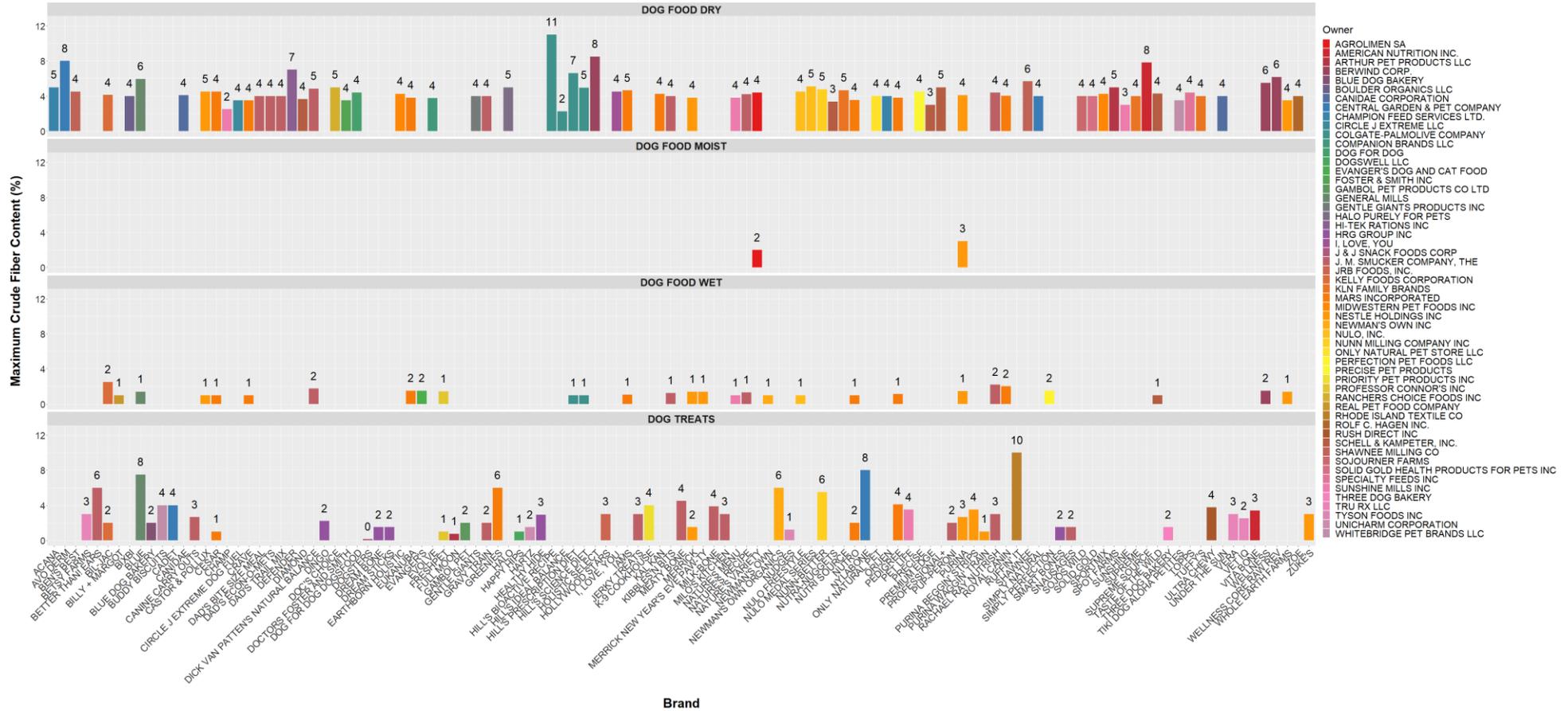


Figure 66, Maximum Crude Fiber Content in Dog Food Products

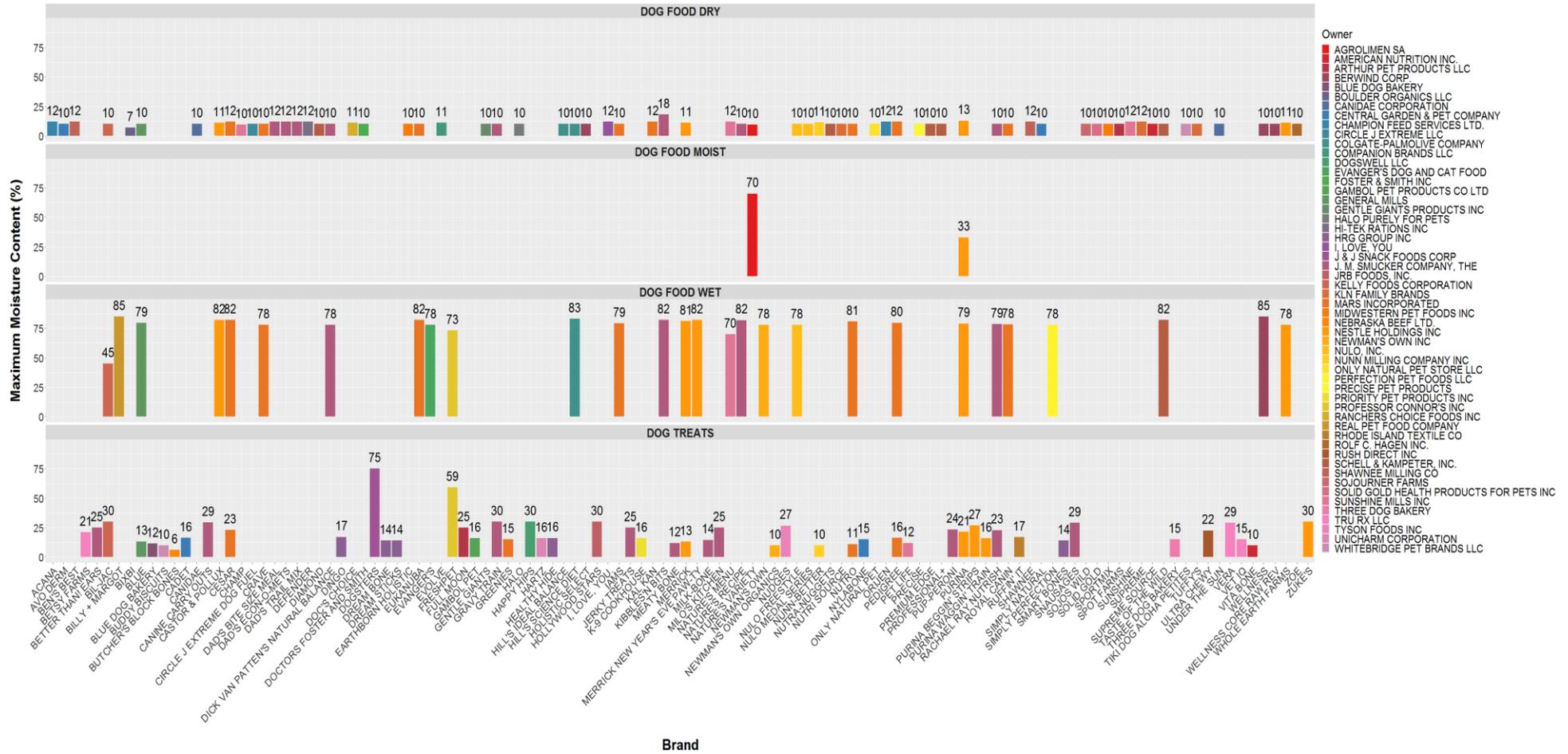


Figure 67, Maximum Moisture Content in Dog Food Products

Appendix D, Total Reported Retail Volume vs. Calculated Ingredient Volume

Note on pet food ingredient analysis: Because the additives, such as preservatives, flavors and colors, etc., are not considered in this project, there is a difference between the product sales volume and total ingredient volume. Within the reverse engineering procedure used, only the food ingredients were calculated. The average weight percentage of calculated ingredients was 85% and 88% for cat and dog foods, respectively. The difference between the tonnage calculated from the Nielsen data and our ingredient data is 13%. Below is a dry dog food example.

Food ingredients: turkey meal, peas, chickpeas, sweet potatoes, potatoes, poultry fat, dried beet pulp, salmon oil, dried seaweed meal, dried chicory root, carrots, blueberries, cranberries, spinach, parsley and pomegranates.

Additives: natural flavor, dicalcium phosphate, salt, calcium carbonate, betaine, choline chloride, potassium chloride, vitamin E supplement, zinc oxide, zinc proteinate, ferrous sulfate, manganous oxide, vitamin A supplement, D-calcium pantothenate, niacin, riboflavin, copper sulfate, manganese proteinate, thiamine mononitrate, calcium iodate, pyridoxine hydrochloride, vitamin D-3 supplement, copper proteinate, folic acid, biotin, sodium selenite, vitamin B-12 supplement, cobalt carbonate and rosemary extract.

Summary: For this example, the food ingredients represented 85.2% of the total product weight while the additives were 14.8% of the total product weight based on the reverse engineering calculation.

Appendix E, Additional Ingredient Volume and Value Detail

Table 14, U.S. Total Pet Food Ingredients from Farm and Mill-based

| U.S. Total Pet Food Ingredients from Farm and Mill-based | | |
|--|------------------|------------------------|
| Item | Tons | \$ Value |
| Corn | 1,958,061 | \$438,558,151 |
| Soybean | 548,882 | \$190,318,933 |
| Wheat | 412,472 | \$178,521,422 |
| Rice | 330,651 | \$131,019,084 |
| Pea | 206,459 | \$126,162,404 |
| Vegetable | 97,582 | \$78,447,053 |
| Egg | 51,639 | \$77,651,578 |
| Dairy | 43,513 | \$34,816,254 |
| Barley | 110,920 | \$28,349,288 |
| Other Grain | 21,767 | \$15,725,864 |
| Root | 71,212 | \$15,169,664 |
| Minor Oilseed | 23,341 | \$12,015,102 |
| Sweeteners | 45,291 | \$11,669,647 |
| Potato | 37,575 | \$10,285,547 |
| Oats | 40,503 | \$9,670,739 |
| Berry | 10,558 | \$8,930,910 |
| Fruit | 8,310 | \$7,130,601 |
| Coconut/Palm Products | 2,542 | \$5,469,760 |
| Dried Beans | 12,797 | \$5,143,446 |
| Yeast | 3,668 | \$5,056,287 |
| Peanut | 428 | \$2,058,732 |
| Herb | 1,550 | \$1,245,329 |
| Alfalfa | 2,881 | \$1,151,382 |
| Tree Oil | 93 | \$281,178 |
| Nut | 2 | \$30,670 |
| Total Farm and Mill-based | 4,042,698 | \$1,394,879,026 |
| Note: Data factored up from Nielsen Data to represent National Data | | |
| Note: Commodity Type of all ingredients Items are listed in the Appendix | | |

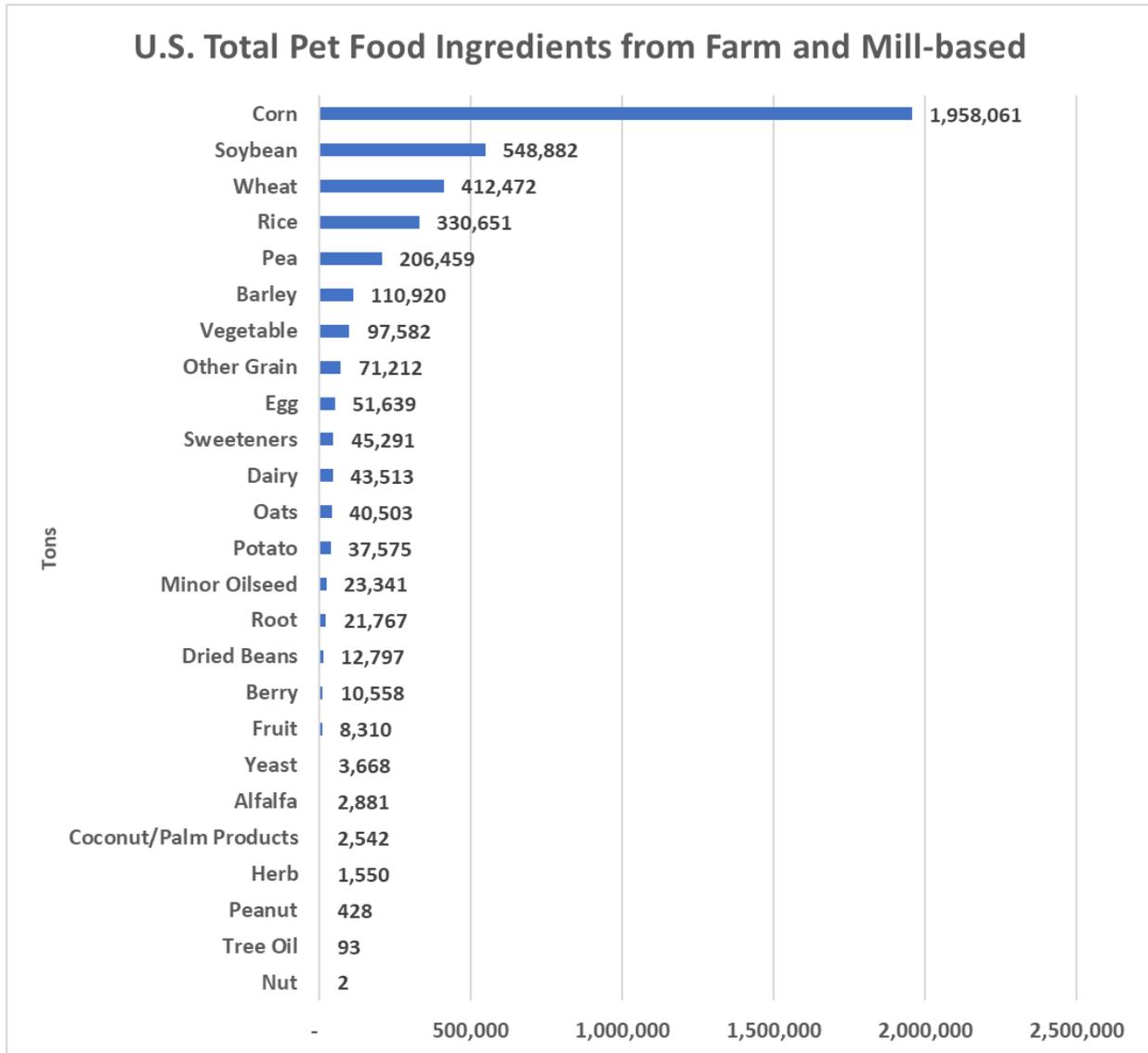


Figure 68, U.S. Total Pet Food Ingredients from Fam and Mill-based

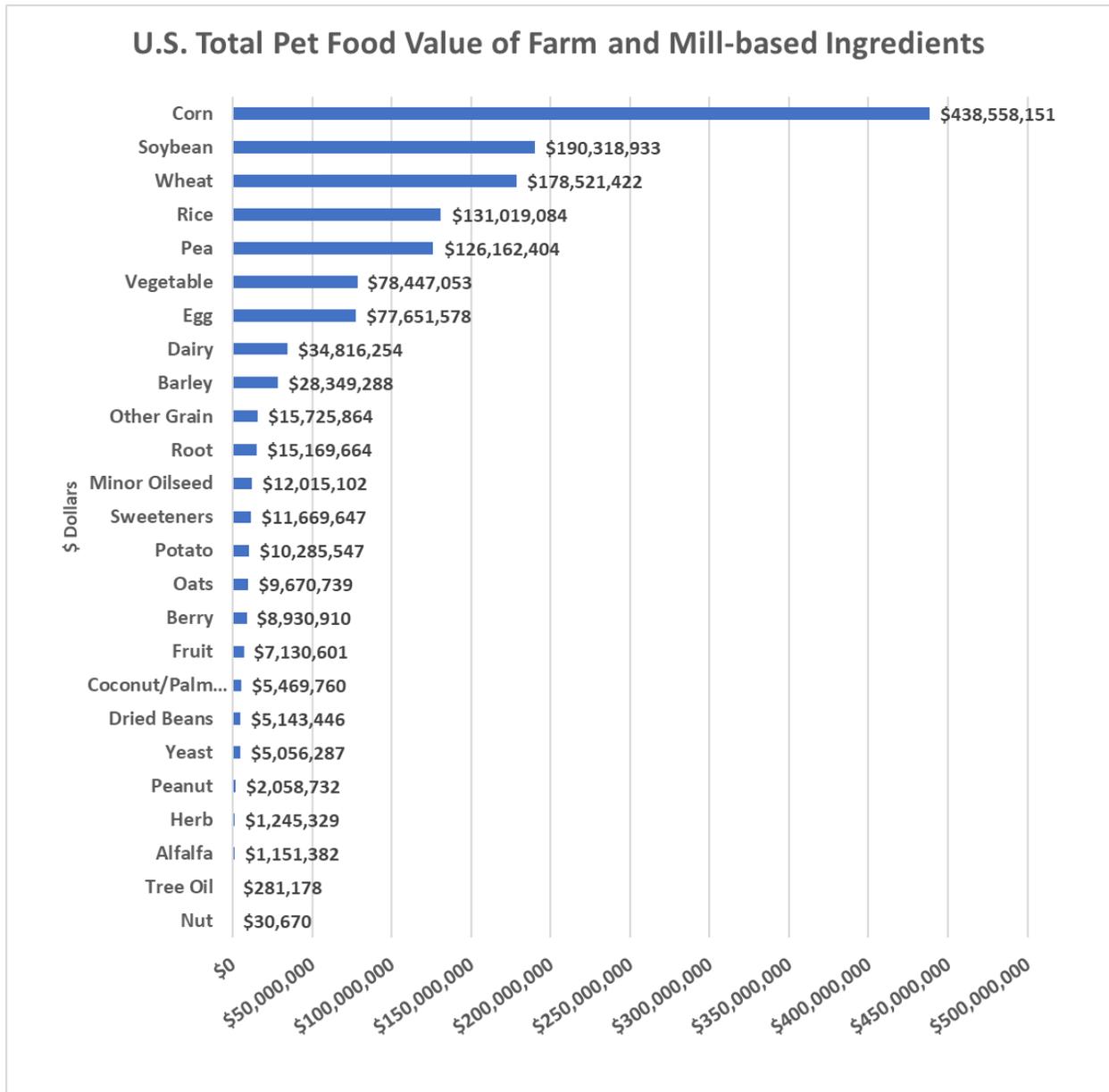


Figure 69, U.S. Total Pet Food Value of Farm and Mill-based Ingredients

Table 15, U.S. Total Pet Food Ingredients from Fishery – Detail

| U.S. Total Pet Food Ingredients from Fishery | | |
|--|----------------|----------------------|
| Item | Tons | \$ Value |
| Salmon | 87,495 | \$429,521,196 |
| Fish | 40,492.5 | \$107,855,746 |
| Tuna | 14,472 | \$101,301,814 |
| Cod | 10,270 | \$88,692,469 |
| Whitefish | 29,052 | \$85,416,069 |
| Fish Oil | 4,388 | \$39,491,687 |
| Salmon Oil | 714.7 | \$14,912,966 |
| Shrimp | 3,206 | \$10,181,473 |
| Sole | 596 | \$5,159,797 |
| Ocean Fish | 5,556 | \$3,529,509 |
| Crab | 119 | \$2,224,579 |
| Mackerel | 601 | \$1,765,853 |
| Seaweed Meal | 440 | \$1,099,322 |
| Seabass | 78 | \$771,452 |
| Kelp | 1,012 | \$734,720 |
| Anchovies | 103 | \$379,842 |
| Tuna By-product | 18 | \$63,323 |
| Sea Cucumber | 0 | \$26,779 |
| Brown Kelp | 5 | \$9,957 |
| Algae | 42 | \$4,151 |
| Imitation Crab Meat | 4 | \$4,051 |
| Kelp Meal | 6 | \$2,993 |
| Green Lipped Mussels | 0 | \$1,969 |
| Menhaden Oil | 2 | \$1,647 |
| Total Fishery Ingredients | 198,671 | \$893,153,362 |
| Note: Data factored up from Nielsen Data to represent National Data | | |
| Note: Commodity Type of all ingredients Items are listed in the Appendix | | |

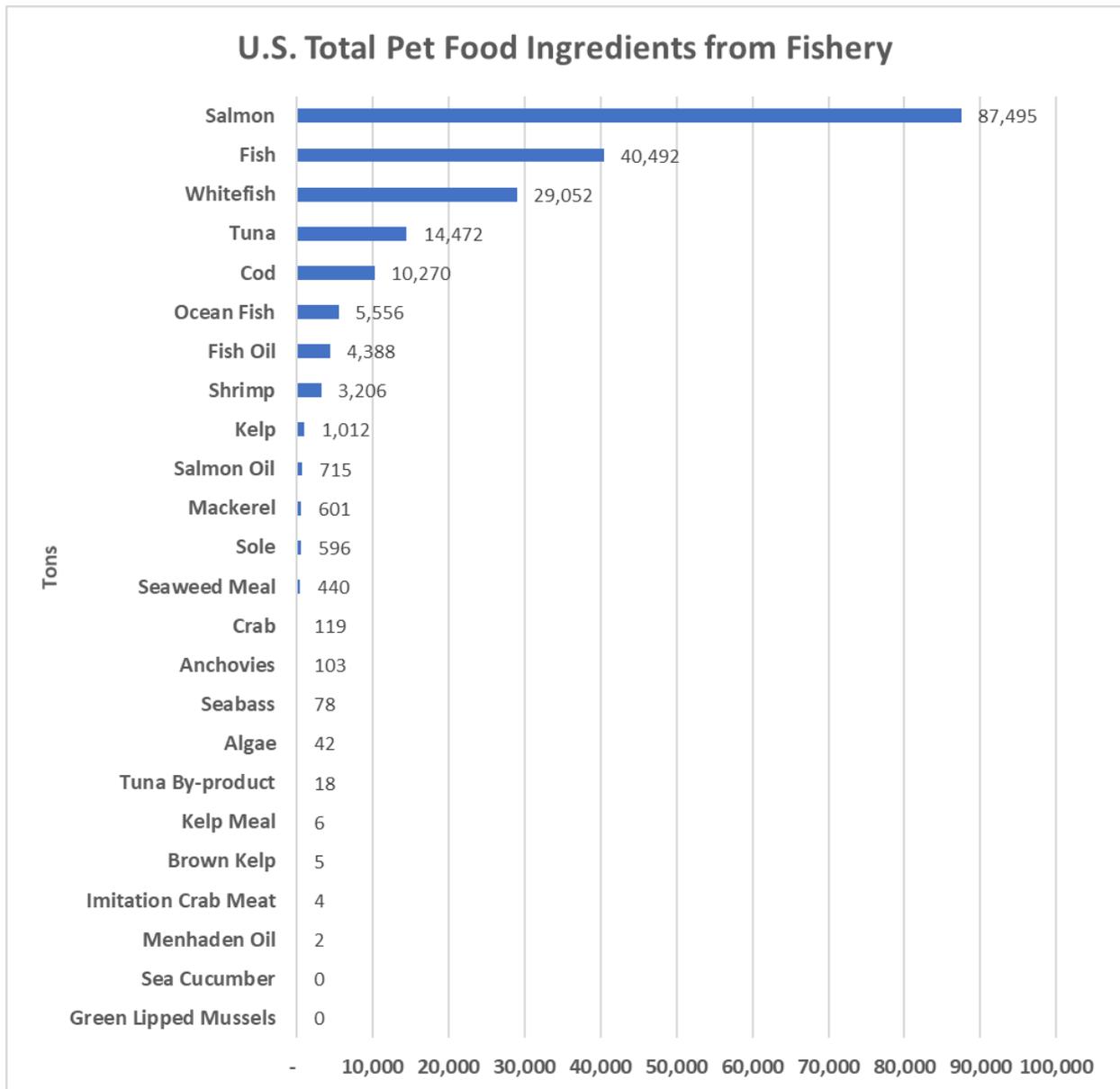


Figure 70, U.S. Total Pet Food Ingredients from Fishery – Detail

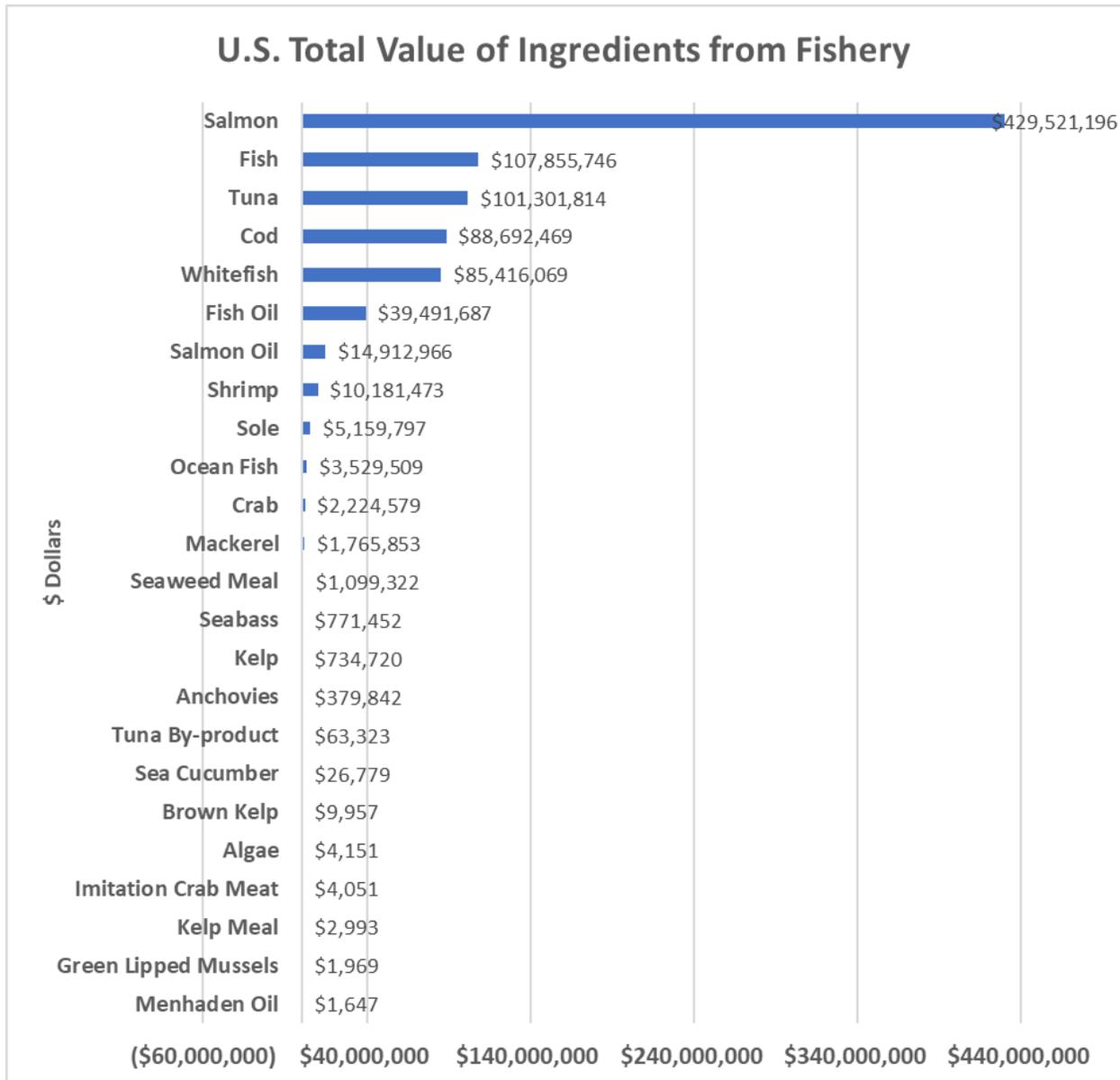


Figure 71, U.S. Total Value of Ingredients from Fishery – Detail

Table 16, U.S. Total Pet Food Ingredients from Broth

| U.S. Total Pet Food Ingredients from Broth | | |
|---|----------------|----------------------|
| Item | Tons | \$ Value |
| Chicken Broth | 70,563 | \$352,812,987 |
| Beef Broth | 39,580 | \$197,900,124 |
| Poultry Broth | 27,046 | \$135,229,749 |
| Fish Broth | 15,018 | \$75,091,496 |
| Bacon Broth | 3,954 | \$19,772,272 |
| Chicken and Turkey Broth | 3,862 | \$19,309,039 |
| Meat Broth | 1,857 | \$9,286,090 |
| Turkey Broth | 1,407 | \$7,033,779 |
| Tuna Broth | 1,053 | \$5,266,299 |
| Lamb Broth | 897 | \$4,484,386 |
| Lamb and Chicken Broth | 650 | \$3,252,489 |
| Vegetable Broth | 569 | \$2,843,107 |
| Pork Broth | 207 | \$1,033,818 |
| Liver Broth | 188 | \$939,879 |
| Total Broth Ingredients | 166,851 | \$834,255,514 |
| Note: all broth valued at \$250/cwt | | |
| Note: Data factored up from Nielsen Data to represent National Data | | |

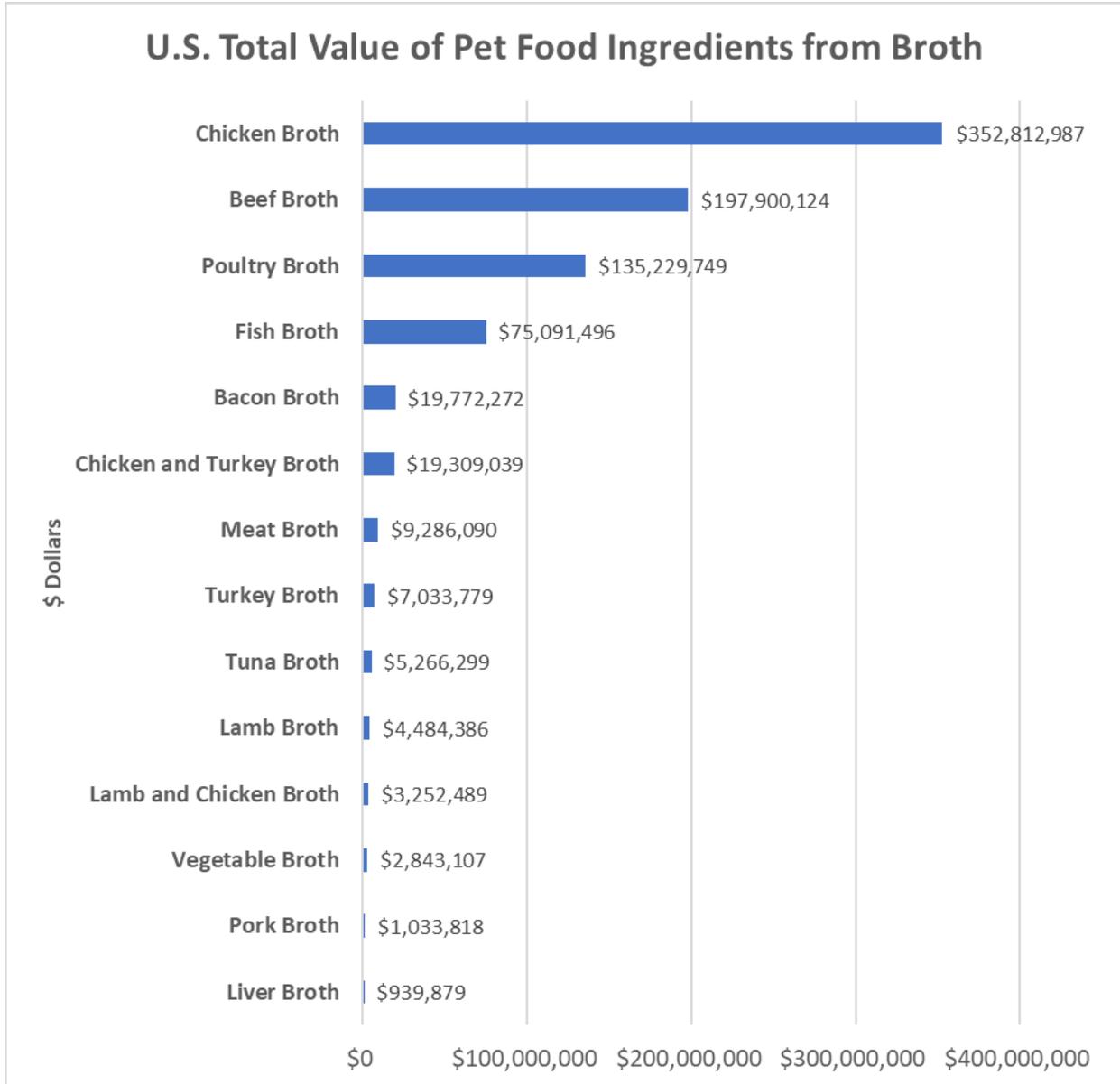


Figure 72, U.S. Total Value of Pet Food Ingredients from Broth