10 Largest Dog & Cat Food 2015 Global Markets

<table>
<thead>
<tr>
<th>Country</th>
<th>US $ Million</th>
<th>2010-2015 CAGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>23,060</td>
<td>4.7</td>
</tr>
<tr>
<td>Brazil</td>
<td>5,857</td>
<td>6.2</td>
</tr>
<tr>
<td>Japan</td>
<td>4,435</td>
<td>0.2</td>
</tr>
<tr>
<td>France</td>
<td>4,219</td>
<td>1.6</td>
</tr>
<tr>
<td>UK</td>
<td>4,171</td>
<td>1.1</td>
</tr>
<tr>
<td>Germany</td>
<td>3,970</td>
<td>2.3</td>
</tr>
<tr>
<td>Italy</td>
<td>2,380</td>
<td>1.3</td>
</tr>
<tr>
<td>Russia</td>
<td>2,161</td>
<td>8.7</td>
</tr>
<tr>
<td>Canada</td>
<td>1,691</td>
<td>3.1</td>
</tr>
<tr>
<td>Australia</td>
<td>1,675</td>
<td>1.9</td>
</tr>
</tbody>
</table>

10 Fastest Growing 2015 Markets Dog & Cat Food

<table>
<thead>
<tr>
<th>Country</th>
<th>US $ Million</th>
<th>2010-2015 CAGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>82</td>
<td>13.8</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>28</td>
<td>9.8</td>
</tr>
<tr>
<td>Russia</td>
<td>2,161</td>
<td>8.7</td>
</tr>
<tr>
<td>Thailand</td>
<td>456</td>
<td>8.3</td>
</tr>
<tr>
<td>Turkey</td>
<td>220</td>
<td>8.3</td>
</tr>
<tr>
<td>Romania</td>
<td>246</td>
<td>8.2</td>
</tr>
<tr>
<td>China</td>
<td>476</td>
<td>7.7</td>
</tr>
<tr>
<td>Ukraine</td>
<td>304</td>
<td>7.6</td>
</tr>
<tr>
<td>Morocco</td>
<td>57</td>
<td>7.5</td>
</tr>
<tr>
<td>Poland</td>
<td>685</td>
<td>7.5</td>
</tr>
</tbody>
</table>

USA Pet Food Market Growth

2013 $21.57 billion
2014 $22.62 billion
4.9% growth in value
50% of market share

Mars Nestle Blue Buffalo Hills

2013 Treat Market grew by 8% in value and 4% in volume

Pet Food Production Methods

1) Extruded
2) Baked
3) Dehydrated
4) Canned
5) Rawhide products
6) Frozen/refrigerated
7) Pressed/formed
**Why Extrusion?**

1) Energy efficient
2) Low cost of production
   a) Manpower
   b) Floor space
3) Continuous
4) Convenient
5) Environmentally friendly

**Extrusion Applications**

1) Animal Feeds – Companion, Domestic and Livestock
2) Human Foods
3) Pharmaceuticals
4) Industrial Products

**Animal Feeds**

1) Pet foods
2) Aquatic feeds
3) Livestock feeds
4) Exotic animal feed
5) Pasteurization and detoxification of feeds
6) Oil seeds

**Role of Extrusion in Pet Food Processing**

- Extrusion Processing
- Cook and Pasteurize

Extrusion in 1953

Extrusion Today
Four Main Areas To Evaluate/Organize an Extrusion Application Project

1) Raw Materials
2) System Configuration (Hardware)
3) Processing Conditions (Software)
4) Final Product Specifications

Processing Benefits and Challenges

Process Benefits:
- a) Microbial control
- b) Product stability
- c) Convenience
- d) Nutrient delivery
- e) Flavor & texture

Process Challenges:
- a) Raw material variation
- b) Nutrient losses
- c) Compensating fortification

Trends in Pet Food Composition

1) Grain-free diets continue to grow
2) Natural, healthy, and fresh
3) New ingredients: insect-based meals
4) Fresh meat is now more than a niche

Consumer-Driven Trends in Pet Foods

1) Increasing demand for high quality ingredients and formulas
2) “Humanization” of pets increasing
3) Focus on protein source
4) Demand for safe foods

Industry Response

1) Some movement away from rendered by-products
2) Novel animal protein sources (bison, elk, salmon, turkey, duck, kangaroo, wild boar, alligator, quail)
3) Increased focus on quality and novelty (differentiation)
4) Implementation of food safety programs

Recent FDA Study on Safety of Commercial Pet Foods

1) Products purchased from retail stores
2) Out of 480 dry expanded and soft moist pet foods (dog and cat), only 2 had pathogens (0.4% infected)
3) Out of 576 raw pet foods tested, 66 had pathogens (11.5% infected)
Survival of *Enterococcus faecium* and *Salmonella* in Pet Food Extrusion at 27.5% Moisture

![Graph showing survival of Enterococcus and Salmonella](image)

Effect of Extrusion Temperature and Water Activity on Destruction of *Salmonella* – FDA Collaboration

![Graph showing population reduction of Salmonella](image)

Single Screw or Twin Screw Extruder Design?

**Distinguishing Features**

1) 235 mm screw diameter
2) 1,000 horsepower drive
3) 15,000 – 20,000 kg/hr

750 kW Single Screw Systems

- Economy (brown and round)
  - Price; least cost formulation; <26% protein, <10% fat
  - Supermarkets and discounters

- Mid-priced
  - Price; good basic nutrition; >24% protein, >8% fat
  - Supermarkets and pet specialty stores

- Premium *
  - Price; focus on health and wellness; special diets, special ingredients
  - Pet specialty stores and vets

* Super-premium, ultra-super premium, high meat
Pet Food Complete Diet Categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Processing Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economy (brown and round)</td>
<td>Single screw</td>
</tr>
<tr>
<td>Mid-priced</td>
<td>Single screw</td>
</tr>
<tr>
<td>Premium *</td>
<td>Single and twin screw</td>
</tr>
<tr>
<td>High Meat (&gt;30% fresh meat)</td>
<td>Twin screw</td>
</tr>
</tbody>
</table>

* Super-premium, ultra-super premium

Complete Diets

1. Dry Expanded
2. Semi-moist

Semi-moist technology:
1) Commonly reserved for Treats or Complimentary Products
2) Usually not complete and balanced nutrition

View of One Line for Long Goods Pet Food Treats

- Top View
- Guillotine Cutter
- Cooling Tunnel
- Mobile Conveyor
- Twin Screw Extruder

Bacon Strip (long goods) and T-Bone Products (short goods)

Expanded Pet Food Products Cut At End of Extruder
5 Categories of Treats or Complementary Pet Foods
(Treats, Snacks, Chews)
1) Expanded Products
2) Unexpanded Products
3) Textured Meat and Vegetable Proteins for Retort-Stable Applications
4) Chews
5) Co-Extruded Products

Expanded Products
1) Usually large product size
2) Requires one extruder
3) Rates decrease as product size increases
4) Large variation in product densities
5) Handling considerations
6) Established process (may require testing to confirm rates for new shapes)

Un-Expanded Treats
1) Usually semi-moist technology
2) May require down-stream cutting (belt cutter, rotary die cutter)
3) Down-stream cutting limits rates to 500 - 1500 kg/hr
4) Single or twin screw extruder
5) Established process (may require testing to determine rates for various shapes)

Jerky Strips and Sticks
Textured meat analogues
using soy, rice, potato or grain and vegetable proteins and meat
**Process Description for TMP**

1) Twin screw extruder
2) Meat slurry pumped into preconditioner or extruder barrel
3) Final product texture having rapid rehydration and retort stable characteristics

**Marketing Appeal for TMP (Textured Meat Proteins)**

Taking fresh/frozen low end animal protein parts and combining with small amounts of vegetable proteins to restructure via TX extrusion into simulated high end cuts of muscle meat - like beef or pork roast and chicken breasts.

**Chews: Injection-Molded Products**

1) Two-step process
2) Extrude pellets which are later injection-molded
3) Requires twin screw extruder
4) Can use protein or starch as matrix

**Example Products**

**Chews: Direct Extruded**

1) Product may be co-extruded
2) Requires twin screw
3) Product size usually quite large
4) Dental care attributes
5) Usually soft moist

**Co-Extruded Treats**
Filled Pet Food Products

Three Pet Food Categories

<table>
<thead>
<tr>
<th>1) Complete Diets</th>
<th>2) Treats or Complimentary Products</th>
<th>3) Engineered Ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Expanded Soft Moist</td>
<td>Long Goods (cut downstream) Short Goods (usually cut at die)</td>
<td>Extruded, dried and marketed as ingredient</td>
</tr>
<tr>
<td>a) Nutritionally complete. b) Can come in many shapes, sizes, and colors. c) Positioned as standard, premium, or super premium products. d) Can contain significant levels of fresh meat</td>
<td></td>
<td>May be marketed as a pellet, chunk, granule, or meal.</td>
</tr>
</tbody>
</table>

Engineered Ingredient Process Flow

Dry Recipe
Wet Slurry
Extrusion System
Drying and Grinding
Engineered Ingredients

1) Up to 200% wet slurry content
2) Product pasteurized
3) Final product in pellet, granule or meal form
4) Final product nutritional profile tailored for specific applications
5) Slurry consists of:
   a) Animal meats or proteins
   b) Plant / fruit / vegetable processing wastes
   c) Animal processing wastes
   d) Spent Hens

Systems to Process Products with High Levels of Meat Slurries (% of the dry feed rate)

<table>
<thead>
<tr>
<th>Extrusion System</th>
<th>Maximum Level of Meat in Complete Diets</th>
<th>Maximum Level of Meat in Treat Products</th>
<th>Maximum Level of Meat in Engineered Ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Screw</td>
<td>30 - 35</td>
<td>30 - 35</td>
<td>40 - 60</td>
</tr>
<tr>
<td>Twin Screw</td>
<td>35 - 50</td>
<td>35 - 50</td>
<td>60 - 80</td>
</tr>
<tr>
<td>Thermal Twin</td>
<td>50 - 110</td>
<td>50 - 65</td>
<td>80 – 200</td>
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</table>

Survey of Manufacturing Concerns for 2013 from 249 participants

<table>
<thead>
<tr>
<th>Priority</th>
<th>First-Place Votes (%)</th>
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</thead>
<tbody>
<tr>
<td>Food Safety</td>
<td>59</td>
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<tr>
<td>Cost Control</td>
<td>27</td>
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<tr>
<td>Labor</td>
<td>11</td>
</tr>
<tr>
<td>Inspections/certifications</td>
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<tr>
<td>Sourcing &amp; materials</td>
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<tr>
<td>Automation</td>
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<tr>
<td>Water issues</td>
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<tr>
<td>Environmental concerns</td>
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<tr>
<td>Consolidation changes</td>
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</tr>
<tr>
<td>Energy concerns</td>
<td>4.4</td>
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</tbody>
</table>

Thank You!