Pet Food Safety

June 29, 2011

Trends Impacting Feed and Food Industry

1) Food safety: Challenges with contaminated ingredients and products
2) Raw material costs: Volatile ingredient markets
3) Market conditions: Current economic recession is impacting consumer buying habits
4) Energy efficiency and water conservation: Higher energy costs and concerns about water availability
5) Emissions control: Reducing odor and particulate emissions
6) Supply chain cost reductions: Shipping costs are higher
7) Automation: Reduces labor costs and assists in food safety
8) Labor costs: Uncertainties in the labor pool
9) Flexibility: Ability to react quickly to new market directions
10) Lean manufacturing: Cost cutting and improving efficiencies

Possible Food / Feed Safety Concerns

1) Animal by-products
2) Feed additives
3) Banned additives
4) GMO’s
5) Veterinarian drugs
6) Botanical impurities
7) Mycotoxins
8) Heavy metals
9) Dioxins
10) Microbes

Examples of Most Recent Issues in Food/Feed Safety with International Impact

1) BSE (CWD)
2) Dioxins
3) Melamine
4) Microbial contaminations
5) Mycotoxins

> 89% of the Public Supports more Government Regulations
> 66% Support More Funding for FDA

Pet Food Manufacturers are reacting to gain confidence of consumers and regulators:
1) Use the food chain approach to food safety
2) Requires working together in close collaboration among all groups:
   a) Industry/Associations
   b) Government
   c) Academia

Four Types of Hazards

1) Physical (foreign objects)
2) Chemical (pesticides, heavy metals, etc.)
3) Biological (bacteria, toxins, etc.)
4) Radiological
3 Requirements of Food Safety Management System

1) Management system based on the process approach and customer focus
2) GMP (Good Manufacturing Practices): programs to assist in controlling the likelihood of introducing hazards to feed products through the work environment
3) HACCP (Hazard Analysis and Critical Control Points): a program to identify all relevant hazards (some to be managed through GMP and some through the CCP’s)

(GMP = BPF, HACCP = APPCC)

Implement Food Safety Plans and Programs!

Systematic, scientific approach to food safety!

Establish the Right Culture:

1) Training: How to perform the required tasks
2) Education: Why tasks are important

GFSI
Global Food Safety Initiative
Retailer-driven group with objective to establish commonly-accepted food safety standards through guidance documents that benchmark schemes seeking compliance. Standards accepted include:

1) BRC (British Retail Consortium)
2) ISO 22000
3) SQF (Safe Quality Foods) 2000, level 2*
4) FSSC 2000
5) International Food Standard
6) GAA

*SQF appears most appropriate for Pet Food Production

Where Do We Start?
(3 requirements of Food Safety Management System)

1) Management system based on the process approach and customer focus
2) GMP: programs to assist in controlling the likelihood of introducing hazards to feed products through the work environment
3) HACCP: a program to identify all relevant hazards (some to be managed through GMP and some through the CCP’s)
Responsibility of Management: 

A) RESOURCES

1) Education/awareness of personnel
2) Personal hygiene/work environment
3) Required facilities/equipment provided
4) Control of monitoring/measuring devices
5) Maintenance programs
6) Cleaning/sanitation/pest control
7) Waste control

Responsibility of Management: 

B) OPERATIONAL

1) Handling of incoming materials
2) Prevention of cross-contamination
3) Rework
4) Production
5) Labeling of finished feed products
6) Storage
7) Transport

Responsibility of Management: 

C) SYSTEM COMPONENTS

1) Documentation
2) Traceability
3) Inspection, sampling, analysis
4) Control of non-conforming product
5) Crisis management (recalls, etc.)
6) Internal audits/third party audits

Where Do We Start? 
(3 requirements of Food Safety Management System)

1) Management system based on the process approach and customer focus
2) GMP: programs to assist in controlling the likelihood of introducing hazards to feed products through the work environment
3) HACCP: a program to identify all relevant hazards (some to be managed through GMP and some through the CCP’s)

GMP’s 
(The actual practices or procedures)

1) Construction/layout of building
2) Equipment (cleaning/maintenance)
3) Management of incoming raw materials (storage)
4) Cleaning/sanitation/pest control/personal hygiene
5) Prevention of contamination
6) Rework/waste management
7) Product withdrawal and recall

Where Do We Start? 
(3 requirements of Food Safety Management System)

1) Management system based on the process approach and customer focus
2) GMP: programs to assist in controlling the likelihood of introducing hazards to feed products through the work environment
3) HACCP: a program to identify all relevant hazards (some to be managed through GMP and some through the CCP’s)
HACCP
(Hazard Analysis and Critical Control Point)

1) Conduct a hazard analysis
2) Determine Critical Control Points (CCP)
3) Establish critical limits
4) Monitor the control of CCP’s
5) Corrective actions if controls fail
6) Verify HACCP is working
7) Document all procedures (records)

Critical Control Point (CCP)

“If a hazard needs a specific control, and there is no point further downstream in the process to reduce or eliminate it, it is a CCP.”

Critical Areas of Impact - Elements of Food Safety Program

1) Incoming raw materials
2) Processing/Manufacturing
3) Record Keeping
4) Distribution/Transportation/Feeding
5) Inspection/Audit/Corrective Action
6) Responsibilities
7) Training

Food Safety System: Incoming Raw Materials

1) Assure identity of materials (COA especially on ingredients and pkg. materials not subject to “kill step”)
2) Test for contamination
3) Receiving procedures
4) Inspection/Audit/Corrective Action
5) Inventory control
6) Written SOP’s

Use of Food Grade Anti-Microbials in Pet Foods

1) Acidulants and blends of organic acids
2) Acidic calcium sulfate (ACS) tested at 2.4% internally and in coating
3) ACS had no Salmonella detection after 13 days storage with 10^4 cfu/g inoculation after extrusion
4) Impact on palatability?

Processing/Manufacturing

1) Building and equipment design
2) Building and equipment maintenance
3) Critical Control Points in the process
4) Written SOP’s

Building and equipment must enhance sanitation and prevent cross-contamination!
Building and Equipment Design

1) Plant layout – vertical versus horizontal flow
2) Multiple rooms / isolation walls
3) Airflow control
4) Equipment/personnel traffic management
5) Segregate “wet” and “dry” areas
6) Plant location
7) Transitions

Building and Equipment Design (continued)

8) Minimize product and dust leakage, spillage, and accumulation
9) Easy access for inspection and cleaning
10) CIP versus COP
11) Capture/recycle under-processed material

Processing:
Five common critical control points

1) Proper mixing time in batch mixer
2) COA and raw material analysis (includes packaging material)
3) Establish minimum extrusion temperature
4) Establish maximum final product moisture
5) Metal detection/X-ray profiling for foreign objects in final product package

Critical Control Point

Preconditioned Feed Inoculated with 10^4 CFU Salmonella Typhimurium / gram

<table>
<thead>
<tr>
<th>Sample</th>
<th>Process moisture (%)</th>
<th>Product temperature (¹C)</th>
<th>Retention time (minutes)</th>
<th>Salmonella presence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>17.4</td>
<td>82.8</td>
<td>3.58</td>
<td>Negative</td>
</tr>
<tr>
<td>2</td>
<td>16.5</td>
<td>83.3</td>
<td>3.05</td>
<td>Negative</td>
</tr>
<tr>
<td>3</td>
<td>22.2</td>
<td>82.2</td>
<td>2.70</td>
<td>Negative</td>
</tr>
<tr>
<td>4</td>
<td>18.8</td>
<td>70.0</td>
<td>2.20</td>
<td>Negative</td>
</tr>
<tr>
<td>5</td>
<td>15.9</td>
<td>70.0</td>
<td>1.92</td>
<td>Negative</td>
</tr>
</tbody>
</table>


Continued studies to validate effectiveness of preconditioner at higher contamination levels

2008 studies indicate that a preconditioner is effective even against 10^6 CFU when operated at ≥ 22% moisture levels and temperatures > 77°C
**Pet Food Safety**

**Temperatures Required to Kill Various Classes of Microorganisms**

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Time (Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>10</td>
</tr>
<tr>
<td>60</td>
<td>20</td>
</tr>
<tr>
<td>70</td>
<td>30</td>
</tr>
<tr>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>90</td>
<td>50</td>
</tr>
<tr>
<td>100</td>
<td>60</td>
</tr>
<tr>
<td>110</td>
<td>70</td>
</tr>
<tr>
<td>120</td>
<td>80</td>
</tr>
<tr>
<td>130</td>
<td>90</td>
</tr>
<tr>
<td>140</td>
<td>100</td>
</tr>
</tbody>
</table>

**Source:** 2008, January, Dr. Daniel Fung, “Synopsis of Food Microbiology" Seminar

---

**Preconditioner and Extrusion Process**

**Extruder Barrel:**
1. 15-30 seconds time
2. 22-28% moisture
3. 120-135 °C temp
4. < 1 bar pressure

**Preconditioner:**
1. 2-3 minutes time
2. 20-25% moisture
3. 80-95 °C temp
4. < 1 bar pressure

**Typical Process Parameters**

---

**Extrusion of Pasteurized Products**

**Must Validate Effectiveness of Critical Control Point (Extrusion as Kill Step for Salmonella)**

1. R & D Scale: inoculate feed and confirm minimum temperature (CCP)
2. Production:
   a. Test presence in raw materials
   b. Record process parameters (product temperature)
   c. Test final product
3. Peer-reviewed Scientific publications
4. Processes as described above but using appropriate surrogate

---

**Critical Control Point – Product Temperature at Discharge of Extruder**

**Impact of Thermocouple Location on Product Temperature Readings**

<table>
<thead>
<tr>
<th>% Retracted</th>
<th>Product Temp (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>140</td>
</tr>
<tr>
<td>33.3</td>
<td>139</td>
</tr>
<tr>
<td>50</td>
<td>138</td>
</tr>
<tr>
<td>66.7</td>
<td>135</td>
</tr>
<tr>
<td>83.3</td>
<td>122</td>
</tr>
<tr>
<td>100</td>
<td>104</td>
</tr>
</tbody>
</table>

*0% retracted = center of product flow; 100% retracted = flush with sidewall.
**Product Temperature Sensor**

1) Extend temperature sensor at least 6mm into product stream – preferably 25mm
2) Add metal sheath to protect tip from wear
3) Insulate where sensor passes through equipment wall
4) Use duplicate sensors
5) Calibrate sensors
6) Locate behind die
7) Traceability records

**Plant and Equipment Design**

1) Isolation Walls
2) Product transfer
3) Airflow control and treatment
4) Equipment design and construction
5) Closed loop systems
6) Control systems and on-line devices

**Conveying Devices**

1) Eliminate where possible
2) Sanitary design for minimal material buildup and ease of cleaning
3) Closed loop
4) Heated air intakes and heated transfer points
Pet Food Safety

Typical Pneumatic Conveying Systems for Pet Food Products

Plant and Equipment Designs

1) Isolation Walls
2) Product transfer
3) Airflow control and treatment
4) Equipment design and construction
5) Closed loop systems
6) Recycling of under-processed materials
7) Control systems and on-line devices

Hygienic Pneumatic Conveying Systems

1) HEPA filter air intake
2) Burn-out sanitizing mode
3) Strategically located temperature sensors
4) Positive pressure at die/knife area
5) Positive pressure at sampling port
Fugitive Dust From Processing Equipment

Salmonella is a survivor – 300 days in dust!

Preconditioner Slide Gate and Dust-Tight Downspout

1) Designed to reduce waste (under-processed product)
2) Easy access for inspection and cleaning
3) Designed to minimize leakage/spillage and exhaust streams

New SS Hygienic Equipment Frames

Dryers and Coolers

1) Emissions (fugitive dust)
2) Ease of cleaning/inspection
3) Minimize product accumulation
4) Product temperature
5) Cross contamination
6) Maintenance
7) Written SOP’s

Plant and Equipment Designs

1) Isolation Walls
2) Product transfer
3) Airflow control and treatment
4) Equipment design and construction
5) Closed loop systems
6) Recycling of under-processed materials
7) Control systems and on-line devices

Extrusion
Conveyor to Dryer
Pasteurization Step
30,000 m³/hr
8400 m³/hr
Desiccant wheels
TEATED MAKEUP AND ISOLATION WALLS
Dry Area
Wet Area
Dry Area
Wet Area
30,000 m³/hr
Plant and Equipment Designs

1) Isolation Walls
2) Product transfer
3) Airflow control and treatment
4) Equipment Design and Construction
5) Closed loop systems
6) Recycling of under-processed materials
7) Control systems and on-line devices

Capturing and Containing Under-Processed Material to Prevent Re-Contamination

1) Preconditioner and Extruder Venting
2) Waste Recycling Systems (WRS)
3) Bypass valves (BPV) to prevent under-processed material going to die assembly

Closed loop systems for capturing, containing, and recycling fugitive or under-processed material

Typical preconditioner venting with escaping excess steam and recipe particulates

Before
After installation of "capture system"

Critical Control Point Displayed and Recorded

Extruder Temperature
Pet Food Safety

On-line devices to decouple personnel from direct product contact

1) On-line measurement of product technical qualities
2) Remote digital imaging

On-line Product Measurements

1) Bulk density
2) Moisture
3) Temperature
4) Photographic recognition
5) Proximate analysis
6) Presence of contaminants

Is the 3 year payback rule valid for quality assurance expenditures?

Example Safe-Guards:
On-Line NIR Measurements*

On-line NIR Analyzer
HMI Display
PLC
Batch mixer, Pellet mill, Extruder

32.2% Protein
4.2% Fiber
9.8% Moisture

7.8% Fat
5.6% Ash
11.8% Starch

Warning! Melamine Possibly Present

*From Perten

Treatment of Grains Contaminated with Mycotoxins
(Fungal toxins - origin field or storage)

1) Good agricultural practices would minimize risks
2) Testing and COA’s of incoming raw materials
3) Physical, chemical, or biological treatments of contaminated pet food have poor efficacies and are not economically viable
4) Organic and inorganic absorbents decrease effects but not allowed in EU

The Way Forward – Pet Food Safety

1) Implement Food Safety Management Systems (SOP’s, GMP’s, HACCP)
2) Supplier quality assurance program (COA’s especially for pkg. material and ingredients not subjected to elevated temperatures)
3) Establish and validate “Critical Control Points” in process
4) Plant and equipment design (to reduce and control recontamination)

Benefits of Pet Food Safety Program

1) Reduces risks
2) Decreases wastes, shrink, and customer complaints
3) Tracks and traces products
4) Lowers product liability insurance
5) Protects hard-won brand value

Source: AFIA’s Food Safety Certification Program; I6SF/SF