Raw Material Management
From Slaughtering Plant to Rendering

2018 | Jim Mann

KEMIN IS ASSURANCE
Kemin’s Involvement in Pet Food Supply Chain

The pet food manufacturing process creates multiple opportunities to influence taste.
Pet Food Quality

Nutrient Profile
Ingredient Legend Design
Ingredient Quality
Palatability Targets
Food Safety Programs

Oxidation Control
Moisture Control
Process Control and Consistency

Target Shelf Life
Moisture Migration
Packaging
Distribution
External Factors

Formulation and Design
Process
Raw Material Stabilization

• Managing Customer expectations
  • Efficacious alternatives to address consumer concerns
  • Improving ingredient quality – expect fresh, stable ingredients
  • Bring new insights and innovations to industry
  • Support safety and regulatory needs

• Managing Consumer expectations
  • Expect fresh and stable petfood
  • Concern about safety of synthetic chemical additives
  • Humanization of pets
  • Concern over animal well-being
Impact of Raw Material Degradation

- Oxidative Deterioration
  - Shelf-life reduction
- Microbial Degradation
  - Free Fatty Acids (FFA), Biogenic Amines (BA)
- Impact on Plant Operations
  - FFA increases energy costs
    - Longer cook times due to decreased heat transfer
  - Reduced efficiency
    - Increased fines
    - Reduced fat yield
  - Increased plant odor
  - Reduction in nutritive value

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Raw Material Management

• Many factors influence the quality of rendered products
  • Composition of offal
    • DAF, bone residue, blood
  • Freshness/Age of Offal (FFA, Biogenic Amines)
  • Usage of sanitizing agents – unknown effect
• Influence both oxidative and microbial quality
Role of Antioxidants

Antioxidants arrest rancidity by sacrifice themselves rather than allowing the oxidation of the fat or food nutrients.

Breaking Chain Reaction

Metallic Ions Chelator

Oxygen Scavenger

Krabbe, E. “Quality of raw materials” AMVEA Peru, 2013

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Water Activity Affects Biological Activities

Free Fatty Acids Origins

Origins:

• Triglycerides hydrolyzed by lipase enzymes coming from Bacterial contamination

• Temperature increases the lipases activity until 60°C @pH=9

Sources:
Allinsur FS 6 food grade liquid solution applied @7.5kg/t in Viscera just after evisceration.
Free Fatty Acid Control

RFS Poultry viscera treatment impact on Poultry Meal FFA (% Oleic Acid) @T0

Untreated Day 1

0.75% Allinsur FS 6 Day 2

0.75% Allinsur FS 6 Day 3

Allinsur FS 6 food grade liquid solution applied @7.5kg/t in Viscera just after evisceration

KNE #9145

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Free Fatty Acid Control

FFA (Average) % in Poultry Fat

- @4kgs Allinsur FS11 /t of viscera: 2.9
- @5kgs Allinsur FS11 /t of viscera: 2.7
- No treatment: 4.1

FFA (Average) % in Poultry Meal

- @4kgs Allinsur FS11 /t of viscera: 5.0
- @5kgs Allinsur FS11 /t of viscera: 4.8
- No treatment: 6.9

KN 160007855 -7820 -7926
## Free Fatty Acid Control

### Free Fatty Acid Levels in Poultry Fat

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Reduction in FFA</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 kg/MT Allinsur™ FS-11</td>
<td>29%</td>
</tr>
<tr>
<td>5 kg/MT Allinsur™ FS-11</td>
<td>34%</td>
</tr>
<tr>
<td>7.5 kg/MT Allinsur™ FS-6</td>
<td>46%</td>
</tr>
</tbody>
</table>

**Allinsur™ treatment added to viscera prior to rendering**

**CLS KN 160007855, 7820, 7926**
**CLS KNE 9145**

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Amino Acid Precursors and Biogenic Amines

- Can be catalyzed by endogenous or bacterial amino acid decarboxylases
- Cadaverine, Putrescine, and Tyramine are primary biogenic amines (Histamine in fish)
- Categorized as either vasoactive or psychoactive
  - Vasoactive amines include tyramine
  - Psychoactive amines include histamine, putrescine, & cadaverine

<table>
<thead>
<tr>
<th>Parent Amino Acid</th>
<th>Biogenic Amine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Histidine</td>
<td>Histamine</td>
</tr>
<tr>
<td>Lysine</td>
<td>Cadaverine</td>
</tr>
<tr>
<td>Tyrosine</td>
<td>Tyramine</td>
</tr>
<tr>
<td>Tryptophan</td>
<td>Tryptamine</td>
</tr>
<tr>
<td>Serine</td>
<td>Ethanolamine</td>
</tr>
<tr>
<td>Methionine</td>
<td>Spermidine/spermine</td>
</tr>
<tr>
<td>Arginine</td>
<td>Agmatine/putrescine</td>
</tr>
<tr>
<td>Phenylalanine</td>
<td>Phenethylamine</td>
</tr>
<tr>
<td>Aspartic acid</td>
<td>Beta-alanine</td>
</tr>
<tr>
<td>Glutamic acid</td>
<td>Gamma-amino butyric acid</td>
</tr>
<tr>
<td>Threonine</td>
<td>2-hydroxypopylamine</td>
</tr>
<tr>
<td>Cysteine</td>
<td>Beta-mercaptopoethylamine</td>
</tr>
<tr>
<td>Ornithine</td>
<td>Putrescine/spermidine</td>
</tr>
</tbody>
</table>

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Biogenic Amines

The Process of Biogenic Amine Production

Meat product

Free amino acids + Amino acid Descarboxylases → Biogenic amines

Toxicity

Quality index

Raw material
- Meat composition
- FAAAs
- Fat content
- pH

Microorganisms
- Enterobacteriaceae
- Pseudomonadaceae
- Micrococcaceae
- Lactic bacteria

Processing and storage conditions
- Handling
- Structural breakdown
- Time/Temperature
- Packaging
- Additives
- Curing
- Cooking

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Biogenic Amines: Important Roles

Adapted from B. ten Brink et al., “Occurrence and formation of biologically active amines in foods”, Int. J. Food Microbiol. 11 (1990) 73-74
Biogenic Amines in Chilled (4°C) Chicken Viscera vs. Storage Days and TPC

<table>
<thead>
<tr>
<th>Biogenic Amine</th>
<th>Washed Viscera (ppm)</th>
<th>Unwashed Viscera (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day 0</td>
<td>Day 3</td>
</tr>
<tr>
<td>Tyramine</td>
<td>6</td>
<td>148</td>
</tr>
<tr>
<td>Putrescine</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Cadaverine</td>
<td>1</td>
<td>96</td>
</tr>
<tr>
<td>Histamine</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Spermidine</td>
<td>42</td>
<td>47</td>
</tr>
<tr>
<td><strong>Subtotal₁</strong></td>
<td><strong>57</strong></td>
<td><strong>309</strong></td>
</tr>
<tr>
<td>Agmatine</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td>Spermine</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td><strong>Subtotal₂ + 1</strong></td>
<td><strong>34</strong></td>
<td><strong>28</strong></td>
</tr>
<tr>
<td><strong>Total BA</strong></td>
<td><strong>90</strong></td>
<td><strong>336</strong></td>
</tr>
<tr>
<td>pH</td>
<td>6.2</td>
<td>5.8</td>
</tr>
<tr>
<td>TPC (cfu/g)</td>
<td>$6 \times 10^4$</td>
<td>$2 \times 10^7$</td>
</tr>
</tbody>
</table>
Histamine Control in Poultry Viscera

Histamine (ppm) follow up in fresh untreated and treated Poultry Viscera @20°C during 72 hours
Biogenic Amine Control in Poultry Viscera

Biogenic amines (ppm) follow up in fresh untreated and treated Poultry Viscera @20°C during 48 hours

- Putrescine
- Cadaverine
- Histamine

SD-16-00078

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Biogenic Amine Control in Poultry Meal

Poultry Meal Biogenic Amines ppm

- **Putrescine ppm**: 158, 378
- **Cadaverine ppm**: 107, 259, 154
- **Histamine ppm**: 42, 24, 89
- **Spermine ppm**: 109, 108, 109
- **Spermidine ppm**: 216, 208, 205

- **4 kgs Allinsur SF11 /T of viscera**
- **5 kgs Allinsur SF11 /T of viscera**
- **Untreated viscera**
- **Maxi limit Histamine ppm**

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## Biogenic Amines in Various Meals

Mean concentration of putrescine, cadaverine, and histamine in Australian by-product meals between 1994-1997

<table>
<thead>
<tr>
<th>Sample type</th>
<th>No. of samples</th>
<th>Putrescine (range) (mg/kg)</th>
<th>Cadaverine (range) (mg/kg)</th>
<th>Histamine (range) (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish meal</td>
<td>78</td>
<td>102 (7-102)</td>
<td>220 (11-1340)</td>
<td>570 (&lt;5-1620)</td>
</tr>
<tr>
<td>Poultry meal</td>
<td>387</td>
<td>82 (7-1320)</td>
<td>121 (&lt;5-1350)</td>
<td>19 (&lt;5-167)</td>
</tr>
<tr>
<td>Meat meal</td>
<td>835</td>
<td>21 (&lt;5-695)</td>
<td>29 (&lt;5-680)</td>
<td>10 (&lt;5-258)</td>
</tr>
<tr>
<td>Feather meal</td>
<td>120</td>
<td>31 (5-267)</td>
<td>42 (&lt;5-159)</td>
<td>5 (&lt;5-90)</td>
</tr>
<tr>
<td>Blood meal</td>
<td>25</td>
<td>13 (&lt;5-223)</td>
<td>7 (&lt;5-280)</td>
<td>4 (&lt;5-36)</td>
</tr>
</tbody>
</table>

Source: den Brinker et al, 2003
Odor Issues in Rendering Plants

- Gasses generated in rendering plant include, \( \text{H}_2\text{S} \), \( \text{SO}_2 \) and \( \text{NH}_3 \), among others
- Maximum allowable concentrations for workspace have been established for these gasses
- Anecdotal evidence has demonstrated that controlling microbial degradation of rendering raw materials can have positive effect on reduction of plant odors
Allinsur FS: Possible Applications

- Viscera treatments
- Fresh meat
- Slurries, Digest
- Protein Hydrolysates
- Bone treatment
- Feathers
Allinsur FS application in Slaughterhouse

NB: Need to equip every viscera lines of the abattoir
Allinsur™ FS – Protecting the Quality of Rendering Raw Materials

- The value of controlling oxidation and microbial growth is well recognized and documented
- Poor ingredient quality (both microbial and oxidative) has been linked to quality issues in finished pet food products
  - Reduction in palatability observed in both cat and dog trials
  - Decrease in finished product shelf-life
- Reduction of FFA in fats and protein meals could increase value and marketability of rendered products
- Potential impact on pathogen control
- Maintaining quality of ingredients may reduce energy costs
- Improve shelf-life and palatability of rendered ingredients and petfood products
The Raw Material Challenge

- Biogenic amines produced from spoiled foodstuffs can negatively impact important physiological functions, depending upon levels (Histamine, Tyramine, Cadaverine, Putrecine)
- Daily long-term feeding effects of biogenic amines on reproducing females, growing puppies and kittens or ill pets unknown
  - Unknown impact of biogenic amines on animal health and allergy risk
- Potential to decrease odors originating from slaughterhouse and rendering plant
- Potential to provide energy savings in the rendering process
  - Decayed raw materials are more difficult to process
    - Reduction of heat transfer ability of fat – requiring longer cooking times
    - Increased fines decreases efficiency of presses and decreases fat yields
- Treat materials at slaughterhouse to maximize benefit
  - Dosage dependant on many factors
  - Typically 3-5 kg / MT
Kemin Has Expertise Along Entire Supply Chain

- **Food Safety**
- **Antioxidants**
- **Health & Nutrition**
- **Palatants**

**SLAUGHTERHOUSES**

**FRESH/FROZEN MEAT COLLECTION**

**RENDERING**

**PET FOOD INDUSTRY**

**DOGS & CATS**

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THANK YOU