Improving the Quality of Raw Materials
Kemin's 2019 Pet Food & Rendering Symposium | August 13, 2019
McKenna Powell, M.S. | Technical Service Associate

Kemin is Assurance
Overview

• Raw Material Preservation Overview
  • Inherent risk of raw materials- rendering and pet food manufacturing
    • Treatment with Antioxidants

• Microbial control of fat, meals, meat
  • Allinsur FS-11: material going into rendered products
  • Allinsur AN-30T: fats going on pet food surface
  • Prototype Allinsur FS-N18: rendered meals
  • Allinsur M-TC Dry: meat slurries going into pet food and treats
Raw Material Stabilization

- Managing Consumer Expectations
  - Expect fresh and stable pet food
  - Concern about safety of additives
  - Demand for clean, label friendly ingredients
- Managing Pet Food Customer Expectations
  - Efficacious alternatives to high risk ingredients
  - Improving ingredient quality – expect fresh, stable ingredients
  - Providing innovations that address consumer needs
Raw Material Stabilization

Inherent pet food ingredient risks
• Many factors influence the oxidative quality of rendered products
  • Composition of offal
  • Freshness/Age of Offal (FFA, Biogenic Amines)
  • Usage of sanitizing agents – unknown effect

Oxidation – Fats and oils require antioxidant addition to preserve quality and meet shelf-life requirements
Raw Material Antioxidant Treatment

- The higher the degree of unsaturation the greater number of double bonds
- Unsaturation increases susceptibility to oxidation
- Polyunsaturated Fatty Acids (PUFA) in animal fats and vegetable oils are more difficult to stabilize
- A higher dosage of antioxidant is required as unsaturation increases
Raw Material Antioxidant Treatment

- Untreated Naturox Premium Liquid (3000 ppm)
- Verdilox GT Liquid (3000 ppm)

OIS hours at 100°C

- Chicken Fat A
- Sunflower Oil
Raw Material Antioxidant Treatment

Peroxide Value (meq/kg sample)

- AOX Treated
- untreated

Week 1  Week 4  Week 8  Week 12
Antioxidant Meal Rates Summary

• No one size fits all
• Watch out for meals with high bone content or high iron content
• Understand the process and impact in material
• Be aware of impact of raw materials
• Tests must be applicable to sample matrix (OSI, Shelf life, PV, etc.)
• Results must be taken in context of what is normal for sample type (PV values different for different raw materials)
• Ultimate goal is to reach shelf life target in final diet
Microbial and Oxidative Control in Fats, Meals, Meat
Impact of Raw Material Degradation

Microbial Degradation
- Free Fatty Acids (FFA), Biogenic Amines (BAs)

Oxidative Deterioration
- Shelf-life reduction

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 value¹

---

© Kemin Industries, Inc. and its group of companies 2019. All rights reserved. ®™ Trademarks of Kemin Industries, Inc., U.S.A.
Free Fatty Acid Origin Rendered Material

• Triglycerides hydrolyzed by lipase enzymes coming from Bacterial contamination\(^1\)
• Temperature increases the lipases activity until 60°C @ pH = 9\(^2\)

Biogenic Amines

- Biogenic amines are organic bases of low molecular weight possessing biological activity
- Produced by decarboxylation of the corresponding free amino acid
- Can be catalyzed by endogenous or bacterial amino acid decarboxylases
- Categorized as either vasoactive or psychoactive
  - Vasoactive amines include tyramine
  - Psychoactive amines include histamine, putrescine, & cadaverine
# Amino Acid Precursors and Biogenic Amines

<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-mercaptoethylamine</td>
</tr>
<tr>
<td>Ornithine</td>
<td>Putrescine/spermidine</td>
</tr>
</tbody>
</table>
Biogenic Amines

Ruiz –Capillas. 2004

© Kemin Industries, Inc. and its group of companies 2019. All rights reserved. ®™ Trademarks of Kemin Industries, Inc., U.S.A.
Allinsur™ – Protecting the Quality of Rendering Raw Materials

• Biogenic amines can negatively impact important physiological functions, depending upon levels
• Daily long-term feeding effects of biogenic amines on reproducing females, growing puppies and kittens or ill pets unknown
• Maintaining quality of ingredients may reduce energy costs
• Reduction of FFA could increase value and marketability of rendered products
• Improve shelf-life and palatability of rendered ingredients and petfood products
Free Fatty Acid Control

<table>
<thead>
<tr>
<th>Free Fatty Acid Levels in Poultry Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 kg/MT Allinsur™ FS-11</td>
</tr>
<tr>
<td>5 kg/MT Allinsur™ FS-11</td>
</tr>
<tr>
<td>7.5 kg/MT Allinsur™ FS-11</td>
</tr>
</tbody>
</table>

**Allinsur™ treatment added to viscera prior to rendering**
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°F during 48 hours

- Untreated @t0: Putrescine 8 ppm, Cadaverine 867 ppm, Histamine 132 ppm
- Untreated @48hrs: Putrescine 5 ppm, Cadaverine 1005 ppm, Histamine 132 ppm
- 0.50% Allinsur FS-11 @ 48hrs: Putrescine 5 ppm, Cadaverine 10 ppm, Histamine 80 ppm
- 1.0% Allinsur FS-11 @ 48hrs: Putrescine 5 ppm, Cadaverine 5 ppm, Histamine 7 ppm

© Kemin Industries, Inc. and its group of companies 2019. All rights reserved. ®™ Trademarks of Kemin Industries, Inc., U.S.A.
Efficacy on Feather FFA and Biogenic Amine Control

- **Target**
  - FFA < 30% in Feather meals for aquaculture
- **Product**
  - Poultry feathers 0.3% to 0.5% Allinsur FS 6 liquid
Efficacy on Free Fatty Acids control

**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
- @Xkgs Allinsur FS11 /t of viscera: 5.0

**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
- @Xkgs Allinsur FS11 /t of viscera: 2.1
Strength of Allinsur FS-11

• 3 main Biogenic amines under control: Cadaverine, Putrescine and Histamine
• Help to Increase fresh raw material shelf life
• It will decrease Pathogen contamination
• Energy saving in Rendering process
  • Decayed raw materials are more difficult to rendered
• Easy to apply
  • Treat only sensitive raw materials
• No palatability issues
• Synthetic and Natural Prototype versions available in US
Reduction of Microbial Load - Method

- A study\(^1\) was initiated to determine the effect of a product formulation on *Salmonella* spp. (*S. typhimurium*, *S. schwarzengrund*, *S. infantis*) survival in chicken fat stored at 130 °F for up to 240 minutes.

- Chicken fat was inoculated using a three strain *Salmonella* cocktail at two different concentrations (10\(^3\) & 10\(^6\) CFU/g).

- Warm (130°F), inoculated chicken fat held under slightly agitated conditions for up to 240 minutes to mimic chicken fat load-out at a rendering facility.

- Each sample was treated with a product formulation to obtain a dose response to reduce the microbial load in the fat.
Reduction of Microbial Levels - Results

Effect of an Allinsur Formulation on Salmonella at Low Inoculum Levels ($10^3$ CFU/g)

**Effect of Prototype Formulation in varying Concentrations (ppm) on* Salmonella spp.* in Liquid Poultry Fat at 130 °F for 120 Minutes**

* S. typhimurium, S. schwarzenegger, S. infantis

![Graph showing the effect of prototype formulation on Salmonella spp.](image-url)
Reduction of Microbial Levels - Results

Effect of an Allinsur Formulation on Salmonella at High Inoculum Levels (10^6 CFU/g)

Effect of Prototype Formulation in varying Concentrations (ppm) on *Salmonella spp.* in Liquid Poultry Fat at 130 °F for 240 Minutes

* S. typhimurium, S. schwarzengrund, S. infantis
Summary

- Allinsur™ AN-30T maintains oxidative quality of fat and preserves freshness
- Secondary benefit of limiting microbial levels (cfu/g) in fat
- No observed “scorching” of fat
- Available in both synthetic and natural solutions
  - Natural options provide consumer friendly labeling
  - Natural options comply with AAFCO guidelines for natural
Raw Material Preservation

Fish Meal was treated with 3 levels of an organic acid product
  • Natural
  • Safe for plant workers
Meal Treatment Efficacy over Time

- Negative Control
- Prototype Allinsur FS-N18 0.3%
- Prototype Allinsur FS-N18 0.6%
- Prototype Allinsur FS-N18 1.2%
Meal Treatment Results

• High challenge level was reduced at different application rates
• All rates were effective, more time needed for lower rates
• Water activity impacts this as well
Meals and Water Activity

- Rendered meal was stored at various water activity ranges
- Allows comparison of natural micro death rate over time
Meal Water Activity

Log cfu/g vs Time (days at ambient)

- Lithium Chloride (0.131 ± 0.006)
- Potassium Acetate (0.252 ± 0.007)
- Potassium Carbonate (0.441 ± 0.010)
- Sodium Bromide (0.572 ± 0.023)
Water Activity Summary

- Meals with lower water activity are more difficult to treat as micro survives longer
- Raw material storage condition important to intervention efficacy
Meal Treatment Results

Nutrient and Environmental Requirements for Microbial Growth:

- Inoculation of organism (extrusion is a kill step)
- Nitrogen (protein) and energy (carbohydrate and fat) sources
- Correct temperature
- Oxygen
- “Unbound water” or a minimum $a_w$

Water Activity is the most controllable factor post-processing
Preservation of Meat Ingredients

- Meat ingredients are commonly added to kibble, treats and canned foods, as well as raw diets
- Poor quality meat ingredients have been linked to quality issues in finished pet food products
- Opportunity to provide a natural preservation system to ensure better quality meat ingredients and pet food
Meat Slurry Preservation

- Fresh Slurry poses a microbiological threat
- Biogenic amines in Fresh Slurry samples vary widely
- Frozen Meat Slurry can be effectively treated with Antioxidant
- Acid treatment alone have pro-oxidant effect
- Blend of acid and antioxidant have been shown effective at both oxidation and food spoilage control
Inhibition of Meat Spoilage Organisms

- **ALLINSUR™ M-TC Dry** contains an innovative blend of natural acids and antioxidants
  - Recommended application rate 0.75%
- **ALLINSUR™ M-TC Dry** and the Acid control microbial spoilage organisms at 0.75% application rate

**Enterobacteriacea**

**Lactic acid bacteria**

**Psychrotrophs**

- Chicken slurry shown, similar performance in Salmon and Turkey slurries
Meat Slurry Preservation-Biogenic Amines

- Chicken slurry with 0.75% treatment

![Graph showing total biogenic amines (ppm) for untreated, acid control, and ALLINSUR™ M-TC Dry samples on day 1 and day 4.](image-url)
# Meat Slurry Preservation- TBARS

<table>
<thead>
<tr>
<th>Treatment ID</th>
<th>TBARS (mg/kg)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day 1</td>
<td>Day 8</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>1.58</td>
<td>6.19</td>
<td></td>
</tr>
<tr>
<td>Acid Control</td>
<td>2.54</td>
<td>13.84</td>
<td></td>
</tr>
<tr>
<td><strong>ALLINSUR™ M-TC Dry</strong></td>
<td>1.19</td>
<td>4.75</td>
<td></td>
</tr>
</tbody>
</table>

- Chicken slurry with 0.75% treatment
Meat Slurry Preservation - Oxidation

- Fresh chicken slurry stored at 4°C
Meat Slurry Preservation - Oxidation

- Chicken Slurry following freeze/thaw cycle and stored at 4°C
Meat Slurry Preservation - Diet Shelf Life

- 23.5% Chicken Slurry
- Chicken Meal, Chicken fat
- 16% Crude Fat
- 500ppm NATUROX® Plus Dry in core, 0.75% ALLINSUR™ M-TC Dry in slurry

Peroxide values (meq/kg sample)

Time (weeks at 37°C)

© Kemin Industries, Inc. and its group of companies 2019. All rights reserved. ®™ Trademarks of Kemin Industries, Inc., U.S.A.
Summary

Application of ALLINSUR™ M-TC Dry

• Unique dual mode of action
• Prevents lipid oxidation with novel technology
• Improves pet food product shelf-life
• Provides microbial control
• Controls biogenic amine formation
• Positive impact on palatability
• Innovative approach to improving ingredient quality
Thank you!