ERGOT CONTAMINATION OF POULTRY FEED

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Background

Ergot alkaloids are secondary fungal metabolites produced by *Claviceps spp.* fungi

- Historically a human and animal disease
- Not a major concern in Western Canada, until recently
- Concern has increased in the past decade
  - Last 3-4 years: crop contamination, livestock disease
- Major economic losses
- Routine feed monitoring consequently a reality
Ergot (*Claviceps purpurea*)

Ergosine, ergocristine, ergocornine, ergocryptine, ergotamine, ergometrine

- Ergot alkaloids relevant to Western Canada

[Image of ergot grains]

https://www.grainscanada.gc.ca/wheat-ble/factor-facteur/images/ergot01_375x250.jpg
Biology of Ergot Production

- *Claviceps* spp. invade during plant flowering stage
  - June
- Invasion of all grass species, incl. brome grass
  - Ascospores attack the plant ovary
- ‘Honey Dew’ stage – first indication of infection
- Characteristic black ergot sclerotia
- Plants with longer flowering stages are more susceptible (e.g., rye)

- Common in wheat and barley
- Winter wheat less susceptible

Biology of Ergot Infection

- Certain non-grass species are resistant: canola, mustard, corn
- Grain, silage, and hay are all affected
- Pelleted rations containing screenings are a major source
- High energy grains used in chicken production (i.e., wheat, barley)
Grain Affected by Ergot

- Rye
- Triticale
- Brome grass
- Barley
- Wheat
- Sedge grass
- Hay
- Silage

Pictures by Vanessa Cowan
Why is ergot contamination increasing?

- Increased moisture during flowering
- Changing temperatures (i.e., global warming?)
- Inappropriate crop rotation
- No till or low till cultivation
- Insufficient roadside weed/grass control
Analysis of Ergot Alkaloids in Feed

• Feed analysis: Prairie Diagnostic Services
  Liquid Chromatography Mass Spectrometry (LC/MS)
  6 ergot alkaloids

<table>
<thead>
<tr>
<th>Year</th>
<th>No. Samples Tested</th>
<th>No. Samples &gt;200 ppb</th>
<th>%</th>
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<tr>
<td>2013</td>
<td>171</td>
<td>52</td>
<td>30</td>
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<tr>
<td>2014</td>
<td>964</td>
<td>518</td>
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<td>2015</td>
<td>890</td>
<td>302</td>
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<td>2016</td>
<td>1305</td>
<td>425</td>
<td>33</td>
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Geographical Distribution – Western Canada
Ergot Alkaloid Composition

• Mixtures of alkaloids
  Influenced by: region
  plant species
  fungal species
• Comparable, but not identical properties
• Feed guidelines: total alkaloid content
• Cross-contamination

https://c2.staticflickr.com/4/3350/3278751411_ff1ea448df_b.jpg
<table>
<thead>
<tr>
<th></th>
<th>Ergocornine</th>
<th>Ergocristine</th>
<th>Ergocryptine</th>
<th>Ergometrine</th>
<th>Ergosine</th>
<th>Ergotamine</th>
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<tr>
<td>Rye</td>
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<td>62</td>
<td>37</td>
<td>1</td>
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<td>Barley</td>
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<td>31</td>
<td>14</td>
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<td>Oats</td>
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<td>Corn</td>
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<td>0</td>
<td>3</td>
<td>13</td>
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<td>Triticale</td>
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<td>34</td>
<td>8</td>
<td>4</td>
<td>1</td>
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<tr>
<td>Wheat</td>
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<td>28</td>
<td>23</td>
<td>2</td>
<td>7</td>
<td>25</td>
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<tr>
<td>Brome</td>
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<td>78</td>
<td>12</td>
<td>0</td>
<td>3</td>
<td>0</td>
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</table>
Other Considerations

• Alkaloids  heat stable
  more than one year
  crop rotation implications

• Ethanol production
  Limited contamination in the ethanol
  Ergot is retained in the by-products
  Alkaloids are concentrated
  Increased bioavailability?

• Mold contamination is an unreliable indicator of alkaloid content
Diagnosis of Ergot Poisoning

- Extremely potent chemicals → effects at low concentrations
  - LC/MS
  - Interpretation based on total alkaloid content
- 100-200 ppb = acceptable

- Canadian standard = 6000-9000 ppb total ration (chicks)

- Other methods
  - Visual  5-20 sclerotia/L (1 sclerotium ≈ 30 ppb)
  - By weight  0.1-0.3% (w/w)
Difficulties in Ergot Detection & Quantification

- Variation in sclerotia size and alkaloid concentration
- Representative sampling of feed
- Interpretation influenced by ambient temperature and duration of exposure
Poultry versus other livestock

• Chickens and turkeys are relatively resistant
  • May be due to high metabolism of alkaloids
  • Differences in gut physiology

• However: higher exposure on a body weight basis
  • Approximately 2 to 5-fold (age-dependent)
General poultry considerations

- Layers not different from broilers in terms of susceptibility
- Heat stress is possible
  - Temperature controlled environments
Clinical Manifestations in Poultry

• Decreased feed consumption
• Reduced growth
• Reduced egg production
• Poor feathering
• Respiratory problems
• Reluctance to move

• Discolouration of toes
• Ischemia, gangrene (wattle, combs, face, eyelids)
Ergot Concentrations in Poultry Feed

By count or weight:
0.4 – 9.0% in feed: effects observed
< 0.3%: no effects

By alkaloid concentration:
3 ppm: effects
6-9 ppm: current standard
12 ppm: mortality
Other Concerns

- Current guidelines do not reflect temperature variable metabolism
- Food safety concerns are minimal
  - Tissue residues → none detectable in the eggs
- Withdrawal times would be short
- Grain export markets
Acknowledgements

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