Quantification of Sodium Pentobarbital Residues from Equine Mortality Compost Piles

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Equine Euthanasia

• For horses suffering incurable illness or injury
• AVMA acceptable euthanasia methods
  - Barbiturate overdose (sodium pentobarbital)
  - Gunshot to temporal lobe
  - Captive bolt to temporal lobe

Sodium Pentobarbital

• FDA added environmental warning labels
• Drug can persist in carcass tissue
• Secondary poisoning reported in domestic pets, large exotic cats, and other wildlife including bald eagles.
• Questions exist regarding environmental risk
• Can composting degrade drug residues?
Limited Research

- Pentobarbital can persist in environment (Eckel et al., 1993; Peshka et al., 2006).
- Pentobarbital can persist in equine mortality compost (Cottle et al., 2010; Schwarz et al., 2013).
- Identified need for further investigation utilizing replicated treatment and control groups.

Objectives

Observe effects of proper composting on:

1) euthanized horse carcass degradation
2) sodium pentobarbital concentration in compost material up to 367 days

Experimental Design
Experimental Design

- Six, 3.7m² (12 ft²) bins constructed
  - supported by t-posts and horse panel
- Bulking agent: hardwood chips
- 3 treatment bins (sodium pentobarbital)
- 3 control bins (gunshot)
- Whiffle balls filled with wood chips used for sampling

Materials and Methods
Bin with 0.46 m (18”) pad

Whiffle ball placement

24 balls/bin
with nylon
hay twine

Horse euthanasia

- Horses required euthanasia for health reasons
- Licensed vet humanely euthanized each horse
- Horses were weighed, sedated with 8 ml xylazine
- Treated horses: 60 ml of (390 mg/ml sodium pentobarbital)
- Control horses: anesthetized with 15 ml ketamine hydrochloride, followed by humane, precise gunshot to the temporal lobe.

This presentation is archived at:
http://www.extension.org/pages/21819/chronological-webcast-archive
Carcass covered with 0.6 m (2 ft.) of wood chips

Wood chips wetted to 50% moisture content

Sodium Pentobarbital Samples

<table>
<thead>
<tr>
<th>Sample</th>
<th>Replicates</th>
<th>Day(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>3</td>
<td>-1 and 367</td>
</tr>
<tr>
<td>Serum</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Liver</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Whiffle ball</td>
<td>3</td>
<td>7, 14, 28, 56, 84, *129, 233, and 367</td>
</tr>
</tbody>
</table>

*Turned piles at day 129 (4.3 months)
Temperature

- 2 probes per pile recording hourly
- Ambient temperature recording hourly

Results

Average daily temperature comparison with rainfall data
Carcass degradation scores

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Large amounts of flesh, hide, and hair present. Internal fluid still visible. Carcass still discernible.</td>
</tr>
<tr>
<td>2</td>
<td>Flesh, hide, and hair still present in smaller amounts. Carcass no longer discernible. No internal fluid visible.</td>
</tr>
<tr>
<td>3</td>
<td>Slight amounts of hair and hide present. Numerous large and small bones present.</td>
</tr>
<tr>
<td>4</td>
<td>No hide present. Minimal hair visible. Flesh completely degraded and only large bones present.</td>
</tr>
<tr>
<td>5</td>
<td>No flesh, hide, or hair present. Few to no large brittle bones present.</td>
</tr>
</tbody>
</table>

Bin Weight (kg) Day 129

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Day 129 Score</th>
<th>Day 367 Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>400</td>
<td>4</td>
</tr>
<tr>
<td>Treatment</td>
<td>558</td>
<td>2</td>
</tr>
<tr>
<td>Treatment</td>
<td>655</td>
<td>3</td>
</tr>
<tr>
<td>Control</td>
<td>388</td>
<td>4</td>
</tr>
<tr>
<td>Control</td>
<td>415</td>
<td>4</td>
</tr>
<tr>
<td>Control</td>
<td>651</td>
<td>3</td>
</tr>
</tbody>
</table>

Brown, 2007

Day 129 (4.3 months)
<table>
<thead>
<tr>
<th>Group</th>
<th>Day 7</th>
<th>Day 14</th>
<th>Day 28</th>
<th>Day 56</th>
<th>Day 84</th>
<th>Day 129</th>
<th>Day 233</th>
<th>Day 367</th>
<th>p-value</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tri</td>
<td>65.49</td>
<td>65.34</td>
<td>55.32</td>
<td>59.83</td>
<td>74.43</td>
<td>93.83</td>
<td>33.95</td>
<td>0.591</td>
<td>22.64</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.004</td>
<td>0.005</td>
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<tr>
<td>p-value</td>
<td>0.001</td>
<td>0.121</td>
<td>0.009</td>
<td>0.040</td>
<td>0.008</td>
<td>&lt;0.0001</td>
<td>0.134</td>
<td>&lt;0.0001</td>
<td>26.98</td>
<td></td>
</tr>
</tbody>
</table>
Sodium pentobarbital concentration (as received ppm)

<table>
<thead>
<tr>
<th>Group</th>
<th>Liver 7</th>
<th>Liver 14</th>
<th>Liver 28</th>
<th>Liver 56</th>
<th>Liver 84</th>
<th>Liver 129</th>
<th>Liver 233</th>
<th>Liver 367</th>
<th>p-value SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trt</td>
<td>54.03</td>
<td>140.10</td>
<td>35.78</td>
<td>22.49</td>
<td>48.05</td>
<td>35.85</td>
<td>46.46</td>
<td>75.52</td>
<td>25.18</td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Comparison to previous research

• Cottle et al., (2010) reported 0.008 – 3.16 ppm @180 days [grab samples; 8 horses; 50-90 ml (390 mg/ml)]
• Schwarz et al., (2013) reported 0.36 – 11.65 ppm @ 161 days [whiffle balls; 1 horse; 120 ml (390 mg/ml)]
• Current study reported 33.95 – 93.83 ppm @ 367 days [whiffle balls; 6 horses (3 reps/ea); 60 ml (390 mg/ml)]
Environmental risk?  
Good question!

Example scenario:
• Oral lethal dose for dogs: 85 mg/kg
• Anesthetic dose for dogs: 30 mg/kg
• Liver concentration of 54 ppm; 20 kg dog would need to consume 32 kg to reach lethal dose and 10 kg for anesthetic dose.
• 20 kg dog would only ingest approx. 0.5 kg since dogs consume ~2.5% of body weight

Conclusions
• Composting successfully degraded soft tissue.
• Sodium pentobarbital detected til day 367.
• No clear trend of reducing drug residues.
• Pentobarbital leached through wood chip pad.
• Findings confirm persistence of sodium pentobarbital and emphasize importance of proper carcass management of animals euthanized with barbiturate to reduce environmental impact and secondary toxicosis.

Questions?

Day 0
Day 129

To read more:
eXtension.org
Search sodium pentobarbital