What was he zencing?

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*Vet Focus Te Awamutu*

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**Introduction**

Diarrrhoea in weaned calves usually brings to mind a differential list consisting of bacterial, parasitic, viral and trace element deficiency causes. If calves have been administered prophylactic zinc, an important differential to keep in mind is zinc toxicity.

As the facial eczema seasons get longer, the duration of prophylactic zinc treatment increases, as does the risk for zinc toxicity. This can occur from overestimation of animal weights, miscalculation of the required dosage or accidental double-dosing.

This article describes a case of zinc toxicity seen in a mob of calves in Te Awamutu in March 2011.

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**Facial eczema** is a significant problem in dairy herds of New Zealand’s North Island. Its cause, sporidesmin toxicity, be prevented by supplementing with high levels of zinc (Smith and Towers 1978).

Zinc is absorbed in all parts of the small intestine (Hampton et al. 1964). Once absorbed, it is accumulated in various organs including the liver, pancreas, spleen and small intestine (Kincaid et al. 1976). During times of stress there is an increased sequestration of zinc (van Saun 2011).

Calves, especially if pre-ruminant, have a lower tolerance to high levels of zinc supplementation than adult cows, resulting in higher tissue zinc levels (Kincaid et al. 1976) (Jenkins KJ). Among adult cows, zinc levels are more readily elevated in multiparous older cows and those who have mastitis (Wegner et al. 1972).

The list of clinical signs of zinc toxicity includes anorexia, diarrhoea, chemosis, exophthalmos, polyuria, polydipsia, pneumonia, cardiac arrhythmias and seizures (Divers et al. 2008). In lactating cows it can also cause dropped milk yield and hypocalcemia (Smith et al. 1984) (Miller et al. 1989).

Post-mortem lesion can be found in the zinc-accumulating organs, with the pancreas the most consistently affected organ (Parkinson et al. 2010).

Zinc toxicity in cattle is not a new development. There have been at least a dozen cases documented in New Zealand, with every method of zinc administration implicated. When inserting intra-ruminal bullets, overestimation of animal weights has lead to toxicity. Toxicity has occurred with oral drenching of milking cows, when the amount of zinc given at a time is increased because the interval between drenches has been increased, possibly to save on labour costs. With regards to mixing zinc in the feed, incorrect mixing has also led to toxicities (Smits et al. 2000). Dispensing zinc through the water has lead to toxicity when there was an accumulation of zinc in the bottom of the water trough (McLachlan 2009).

**History**

From a mob of 25 spring-born calves, eight were ill-thrifty in January. They were treated with anthelmintics regularly every 4-6 weeks. The farm trough drinking water supply was treated with zinc sulphate heptahydrate...
since late December. This consisted of ‘chucking a handful of zinc’ into the small <200L troughs. The farmer suspected that the calves’ ill-thrift was due to facial eczema, and gave the calves their first intra-ruminal Zinc Capsule in January (The Time Capsule130/175, Agri-feeds Ltd, Tauranga, New Zealand). They continued to deteriorate and the worst of the mob were given another capsule five weeks later by the farmer. Four of these calves died, and a veterinary visit was arranged.

**Clinical exam**

Apart from eight calves, the mob appeared well-grown and healthy. The sick calves were emaciated, with Body Condition Scores ranging from 2.5-3.5. Their coats were dull and rough and there was alopecia on the points of the tuber ischium and ileum. Their faeces varied in consistency from watery (2/5) to loose (3/5), did not contain blood and were non-malodorous. Their temperatures were normal and there were no oral lesions.

**Differential diagnoses**

Yersiniosis, zinc toxicity, gastro-intestinal parasitism, facial eczema, copper deficiency, salmonellosis and Bovine Viral Diarrhoea.

**Laboratory results**

Blood and faecal samples were taken from the four worst affected calves.

**Serum biochemistry**

The following results were found on serum biochemistry (see table 1):

- Markedly elevated serum zinc. The laboratory reference range for supplementation with zinc salts was 18-34μmol/l (up to 150μmol/L if zinc bolus) with toxic levels at 27-92 μmol/l.
- Mildly elevated GGT. This could be mistaken for facial eczema but is more likely due to the high zinc levels, as the liver does accumulate zinc.
- Marginal copper. Zinc can reduce the release of copper from the enterocyte to portal circulation (Towers et al. 1981).
- Normal fibrinogen.

<table>
<thead>
<tr>
<th>Calf No.</th>
<th>Zn μmol/l</th>
<th>GGT IU/l</th>
<th>Cu μmol/l</th>
<th>Fib g/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>125H</td>
<td>53H</td>
<td>7.8L</td>
<td>4.7</td>
</tr>
<tr>
<td>20</td>
<td>160H</td>
<td>356H</td>
<td>12.0</td>
<td>3.6</td>
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<td>23</td>
<td>47H</td>
<td>28</td>
<td>13.0</td>
<td>7.5</td>
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<td>31</td>
<td>120H</td>
<td>50 H</td>
<td>8.7</td>
<td>3.3</td>
</tr>
<tr>
<td>Means</td>
<td>113H</td>
<td>122 H</td>
<td>10.4</td>
<td>4.8</td>
</tr>
<tr>
<td>Ref range</td>
<td>(11-20)</td>
<td>(0-40)</td>
<td>(8-20)</td>
<td>(2.0-8.0)</td>
</tr>
</tbody>
</table>

*Table 1. Serum biochemistry results for the worst affected calves*

**Faecal microbiology**

There was no Yersinia isolated.

**Parasitology egg count**

There were no Strongyle, Moniezia, Nematodirus or Coccidia eggs seen.

**Follow-up**

On the same day that the laboratory results returned, the farmer euthanased a fifth calf owing to its deteriorating condition. This calf (number 20) had been in the sick mob with three other calves that were still scouring and a few calves that seemed to be recovering. This calf had the highest serum zinc and GGT levels on serum biochemistry. A post-mortem was arranged.
Post-mortem
The carcass was emaciated, severely dehydrated and had icteric mucous membranes. The liver was a normal colour but swollen, with slightly rounded edges. The pancreas was a solid mass 2x2x7cm, gnarly and hardened. There were no gross lesions in the gastrointestinal tract and the faeces were firm.

Histopathology report
Pancreas
There was severe diffuse intralobular and interlobular fibrosis with corresponding atrophy of exocrine pancreatic acini. The pancreas is the classic organ for finding pathology in zinc toxicity.

Liver
There was widespread atrophy of hepatic cords with hydropic degeneration of hepatocytes.

Spleen
There was marked atrophy of white pulp with depletion of lymphoid follicles.

Kidney
There was scattered acute necrosis of the epithelium of convoluted tubules.

Mesenteric lymph node
There was generalized depletion of germinal centres.

Abomasum, small intestine, heart and lung
No lesions.

Biochemistry
The liver zinc level was 260mg/kg (Reference Range 25-100). This was further confirmation of zinc toxicity. The liver accumulates zinc and measurement of the zinc levels in this organ, kidneys or pancreas is useful in the diagnosis.

Diagnosis
Primary zinc toxicity.

Outcome
Of the 8/25 affected calves, 5/8 died and 3/8 survived. This resulted in a morbidity rate of 32%, a mortality rate of 16% and a case fatality rate of 62.5%. Of the three sick calves that survived, two of them later appeared no different to the rest of the mob but one remained smaller.

Discussion
When presented with sick cattle during the facial eczema season, zinc supplementation should always be discussed as part of complete clinical history. The clinical signs can be varied, and in this case were non-specific. The serum biochemistry was very valuable in reaching a diagnosis, although the farmer was not convinced that it was zinc toxicity until he saw the abnormal pancreas. This was the third case of zinc toxicity in calves seen by this clinic in 2011. Since then there have been further cases, mostly in milking herds. Two of these were after zinc bolus application and one after drenching with a high dose of zinc to reduce labour demands by increasing drench interval. This was despite the efforts made to remind farmers of the importance of correct administration by veterinarians, sales staff and articles in the client newsletter. These cases highlight that some farmers are still unaware of the risks of zinc toxicity, and client education will be paramount.

Acknowledgements
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Gribbles Veterinary Pathology New Zealand.
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