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OXALATE POISONING

1. The Effect of Oxalate-Containing Plants on Ruminants

By M. R. GARDINER, B.S., V.M.D., Chief Veterinary Pathologist

Poisoning by plants which contain salts of oxalic acid may be a more common cause of stock losses in Western Australia than was previously thought. This article describes the effects of these plants on ruminants and outlines an experiment in which the toxicity of sourso was examined.

An article in next month's Journal of Agriculture will describe the most important oxalate-containing plants found in Western Australia.

POISONING by oxalate-containing plants has been known to occur for many years but outbreaks have been thought to be infrequent and of no special consequence as a cause of sheep loss in Western Australia.

Routine studies of sheep tissues submitted to the Animal Health Laboratory during the past four years have suggested, however, that damage resulting from ingestion of these plants may be far more widespread than previously realised, even though mortalities are not often associated with their consumption. It is likely that oxalate poisoning may be one of the causes of the so-called non-specific losses with which every grazer is well-acquainted and which are seldom diagnosed accurately.

In most accounts of oxalate poisoning a lowering of blood calcium (hypocalcaemia) is considered to be the principal ill effect, causing the external symptoms. However, accumulated evidence indicates that hypocalcaemia may occur only as an uncommon but dramatic expression of oxalate plant poisoning. Insidious damage is far more widespread and important in loss of life and production in the sheep industry.

Kidney damage is undoubtedly the main harmful effect of these plants. As mentioned previously, routine studies have uncovered this fact and it may be conservatively estimated that as many as 25 per cent. of sheep in many flocks may suffer some degree of kidney damage during the autumn and early winter. A few of these sheep may die, while the great majority show no definite signs of poisoning, although they continue to carry the scars.

These sheep would be particularly vulnerable to further bouts of poisoning. Because of cumulative effects, they may suffer further and irreparable damage, or even death, in the following years.

There are other kinds of tissue damage associated with ingestion of these plants.
These may be briefly summarised as follows:

1. **Induced Calcium Deficiency**

Soluble oxalate salts have a strong affinity for calcium, forming insoluble calcium oxalate. This prevents its assimilation. There may, therefore, be interference with calcium metabolism in the intestine and in bone, leading to skeletal abnormalities and subnormal growth. These effects of chronic oxalate poisoning naturally vary with physiological conditions and with availability of calcium in pastures.

Pregnant and lactating sheep and cattle require considerable amounts of calcium, and oxalate intake during these periods of calcium stress may not only cause acute hypocalcaemia in some animals, but may also interfere with milk production and bone growth.

2. **Kidney Damage Causing Urinary Calculi**

Oxalates causing kidney damage may be involved in some forms of urinary calculi. This possibility has been studied in Queensland and is now being investigated in Western Australia.

3. **Brain Damage**

Oxalates may, in certain circumstances, crystallise out in other tissues, especially the brain. Paralytic symptoms and other disorders of the central nervous system may then be seen in some affected animals.

4. **Breakdown of Red Blood Cells**

Oxalates appear to have a toxic action on red blood cells, causing their breakdown.

**METABOLISM OF OXALATES**

Oxalates are normally metabolised to harmless products in the rumen of sheep and cattle. This undoubtedly protects many animals from its toxic effects.

However, rumen inactivation of oxalic acid depends obviously on normal function of this organ, a function which may be seriously upset in cobalt deficiency. We have definite evidence that oxalates may be more toxic where cobalt is deficient.

If oxalic acid is given to sheep directly into the blood stream or bypasses the rumen by injection into the fourth stomach (abomasum), very small quantities are sufficient to cause signs of poisoning, as Dodson showed in South Australia. He further demonstrated that most sheep grazing soursob (one of the plants containing high amounts of oxalates) eat the equivalent of 75 grams (2½ ounces) of oxalic acid each day without ill-effects during the winter, after they have become accustomed to the plant.

After a summer of dry feed, ingestion of small amounts of this plant will cause severe kidney damage and even death. The work of Dodson and others leaves little room for doubt that sheep can metabolise and destroy the oxalates of plants when they have become accustomed to it (that is, when specific bacteria essential for this process have developed in the rumen.)

The existing evidence strongly suggests that this rumen adjustment takes as long as 10 days and that during the initial period of oxalate plant ingestion, there is considerable susceptibility to its toxic effects.

The plane of nutrition of sheep before the intake of these plants, is important. This was shown by Dr. P. S. Watts, in South Australia. Thus, on a low level intake of wheat-chaff, amounts of oxalate-containing plant equivalent to 6 grams of oxalic acid per day, could be fatal, while on a high plane of nutrition (provided by wheat-chaff plus lucerne) much greater amounts of oxalic acid could be tolerated.

**LOCAL INVESTIGATIONS**

Some practical aspects of this problem were studied in the Department of Agriculture's Animal Health Laboratory in 1962. The basis of this investigation was the widely accepted belief that oxalates are broken down in the rumen to harmless by-products and that, in theory, ruminants should be able to metabolise the acid completely.

The sheep used were obtained from a property free from oxalate plants.

In the trial, some sheep were put on a low intake of oaten chaff for a week before the oxalate plant intake, while others were left on oxalate free intake.

One group of these sheep was allowed to change over gradually to soursob (containing an average of 5.9 per cent. oxalates...
dry basis), over seven days and then continued on a complete soursob diet. This might be one pattern in the field with one of the oxalate plants assuming rapid dominance following opening autumn rains.

A second group was changed abruptly from chaff to soursob, another possibility under some farm conditions, when a flock of sheep is moved, or otherwise gains access, to a heavy stand of the plants.

A third group was alternated abruptly from chaff to soursob at weekly intervals. This might happen in some pasture rotations.

These treatments were continued for four to five weeks, although in some cases death occurred earlier.

A summary of results is given in the table.

Results

There were marked differences in the ability of the sheep in the different groups to tolerate oxalates. All the sheep showed severe kidney damage but those which were transferred gradually onto soursob were able to eat from 1,300 to 1,600 grams of total oxalates over a period of 27 days with no more damage than sheep taking in 150 to 270 grams oxalate abruptly over a five or six day period. In each group one sheep died.

Another conclusion was that sheep put abruptly onto soursob on alternate weeks learned to tolerate the plants and to metabolise oxalates so that a second period of soursob feeding was better tolerated.

Kidney damage was more severe in sheep on restricted normal feed before starting soursob than in those on a prior optimum diet. However part of this greater severity was certainly due to a much greater consumption of soursob by the previously restricted and presumably hungrier sheep.

Kidney Damage Severe

It is remarkable how much kidney damage sheep can sustain without signs of ill-health. This damage occurs regardless of the method of administration of oxalate containing plants, although the length of time sheep can eat a pasture dominated by these plants, before sudden decline and death, does vary considerably with the way ingestion of these plants is related to normal feed intake.

Dr. L. B. Bull, working with oxalate plants in South Australia many years ago, considered that sheep could graze dominant soursob pastures for three to four weeks without injury. Our results showed that, at least under extreme conditions, death may occur in a few days.

No Hypocalcaemia

None of our experimental sheep developed hypocalcaemia, widely considered to be one of the main effects attributed to ingestion of oxalate plants. Although hypocalcaemia may occur after abrupt unrestricted access to the plants, it is probably rare compared with insidious chronic kidney damage.

In Western Australia, oxalate-containing plants are most important and dangerous following opening autumn rains which may occur as early as February or March. The appearance of a green pick of immature oxalate plants coincides with the end of a long period of poor quality feed intake, setting the stage for increased susceptibility to their toxic effects.

Furthermore, this appearance may also coincide with the end of pregnancy, or with lambing, both of which may be adversely affected by oxalate intake.

### EFFECTS OF SOURSOB ON EXPERIMENTAL SHEEP

<table>
<thead>
<tr>
<th>Group</th>
<th>Sheep</th>
<th>Pre-trial feeding</th>
<th>Number of days on soursob</th>
<th>Total Soursob</th>
<th>Approx Oxalate add intake</th>
<th>Degree of Kidney Damage</th>
<th>Consumption soursob 1st week</th>
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<tr>
<td>I.—Gradual change to soursob—7 days</td>
<td>1</td>
<td>Ad lib oaten chaff</td>
<td>Dead on day 27</td>
<td>150</td>
<td>1,600</td>
<td>Tremendous</td>
<td>12-5</td>
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<td></td>
<td>2</td>
<td>Ad lib oaten chaff</td>
<td>Killed on day 26</td>
<td>120</td>
<td>1,300</td>
<td>Severe</td>
<td>12-5</td>
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<td>II.—Abrupt change to soursob</td>
<td>3</td>
<td>Ad lib oaten chaff</td>
<td>Killed on day 6</td>
<td>13-5</td>
<td>150</td>
<td>Very severe</td>
<td>25-0</td>
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<tr>
<td></td>
<td>6</td>
<td>200 grams/day oaten chaff</td>
<td>Dead on day 6</td>
<td>25</td>
<td>270</td>
<td>Extremely severe</td>
<td>25-0</td>
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<tr>
<td>III.—Alternatively abruptly from soursob to chaff 7 day intervals</td>
<td>6</td>
<td>Ad lib oaten chaff</td>
<td>Killed on day 34</td>
<td>35</td>
<td>380</td>
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<td>3-0</td>
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<td></td>
<td>7</td>
<td>200 grams/day oaten chaff</td>
<td>Killed on day 34</td>
<td>75</td>
<td>810</td>
<td>Extremely severe</td>
<td>25-0</td>
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</table>
RECOMMENDATIONS

The following precautions should be taken in the autumn and winter, when oxalate plants may be prevalent in pastures:

- Avoid grazing pregnant or lambing ewes on such pastures. Only wethers should be allowed access to them for short periods.
- If sheep are placed on pastures containing many oxalate plants, supplementary feed, such as palatable hay, should be provided for a couple of weeks. If possible, rotation onto non-oxalate plant pastures should be practiced.
- Never run valuable rams or breeding ewes on pastures containing oxalate plants. It is probable that long-term adverse effects on fertility of both sexes may result both from chronic kidney damage and from interference with calcium metabolism.
- Do not graze sheep of any class on pastures carrying a dominant stand of these plants.
- Avoid the use of autumn paddocks containing oxalate plants for hoggets, especially ewe hoggets, as serious effects on growth and fertility may occur.

ACKNOWLEDGMENTS

It is a pleasure to record the able assistance of Mr. Pieter Visser, of the Animal Health Laboratory, in the conduct of feeding trials.

REFERENCES


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