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Control of cheesy gland in sheep

Cheesy gland abscesses in lymph glands between the lungs.

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Cheesy gland is a widespread problem in Western Australian sheep flocks. Less than 1 per cent of flocks are free of this disease, and all sheep in one line of 550 cull ewes slaughtered at Katanning Abattoir were infected.

Vaccination against cheesy gland is cost effective in 80 per cent of flocks. In flocks that are not vaccinated there is greater than a 4 out of 5 chance that more than 20 per cent of adult sheep have cheesy gland.

A study of what affects new cheesy gland infection found that shower dipping and keeping sheep under cover after shearing increased new infections. Farmers who shower dip sheep should consider vaccinating them against cheesy gland. Sheep should be let out into the open as soon as possible after shearing.

Infected sheep loose 4 to 7 per cent in clean fleece weight in the year of infection, and this has motivated some producers to control cheesy gland by vaccination.

The total cost of the disease in Australia is about $30 million annually, so it is important that efforts to increase cheesy gland control continue.

Vaccination against cheesy gland costs only 14 to 17 cents per sheep per year including labour costs, or 2 to 4 cents if other vaccines are already used.
The most significant potential cost of cheesy gland is the 4 to 7 per cent decrease in clean wool production in the year of infection. This means about 12 million sheep throughout Australia which become infected each year each lose about 250 g of clean wool. This is equivalent to a yearly loss of $1.20 million.

Inspection requirements for cheesy gland form the basis of mutton and lamb inspection procedures in Australian export abattoirs. Meat inspectors who inspect adult sheep spend about 75 per cent of this time either palpating for or trimming out cheesy gland abscesses. This inspection costs about $10 million a year.

American mutton and subsequently prohibited the importation of affected carcasses. This restriction was relaxed in the 1940s. However, large quantities of mutton are still condemned or rejected in Australian export abattoirs because of cheesy gland.

Cheesy gland is a common problem in Australian sheep. The variation in the prevalence of cull sheep with cheesy gland abscesses in 412 mostly unvaccinated flocks is shown in Figure 1. The impact of the $30 million annual cost of cheesy gland is largely hidden from individual sheep producers and, therefore, there are few market signals to encourage its control.

Prevalence or incidence

Prevalence, in epidemiological terms, is the proportion of diseased animals in a population at one point in time.

Incidence is the rate of new cases of disease in a given time.

Unlike prevalence, incidence reflects risk, that is the likelihood of an individual animal contracting the disease in a given period of time.

Economic significance

The most significant potential cost of cheesy gland is the 4 to 7 per cent decrease in clean wool production in the year of infection. This means about 12 million sheep throughout Australia which become infected each year each lose about 250 g of clean wool. This is equivalent to a yearly loss of $15-20 million.

Inspection requirements for cheesy gland form the basis of mutton and lamb inspection procedures in Australian export abattoirs. Meat inspectors who inspect adult sheep spend about 75 per cent of this time either palpating for or trimming out cheesy gland abscesses. This inspection costs about $10 million a year.
Cheesy gland abscesses, along with an unknown amount of normal tissue, are trimmed from affected carcases. If the abscesses are either large or pleurisy has developed as a result of lung infection, whole parts of the carcase, for example limbs or rib cage, can be lost. Downgrading and boning out of more severely affected carcases costs the industry from $1.3 million a year.

The most obvious cost of cheesy gland is the condemnation of severely affected sheep carcases. In 1987-88, more than 50,000 of the 9.5 million adult sheep slaughtered in Australian export abattoirs were condemned because of cheesy gland at a cost of $1.25 million. Fortunately, vaccination against cheesy gland has resulted in this cost decreasing significantly in the past four years.

The ELISA test

To measure the effects of new cheesy gland infection in sheep, the Department's research team had to develop a method of detecting new infection and to know at what stage in the sheep's life to look for it. An ELISA test was developed to detect the presence of antibodies to toxins and cell wall proteins of the bacteria in the sheep's blood.

An ELISA test uses an enzyme linked to an antibody-detecting protein to measure the level of antibodies to a disease in the blood. When antibodies are present in a blood sample, the linked enzyme causes the test solution to change colour. The ELISA test provides a simple visual means of detecting low levels of antibodies in the blood.

A study of the incidence, and prevalence by age, of cheesy gland in commercial sheep flocks showed that about 85 per cent of the spread of the disease was at the second and third shearing.

The cheesy gland toxin ELISA test has a sensitivity (ability to identify a positive animal) of about 90 per cent when an ELISA result is compared with a result taken four to six months earlier.

This sensitivity can be determined by comparing the presence of cheesy gland abscesses in individual sheep with ELISA results of that sheep.

However, the specificity (ability to identify an animal with a negative result) of this test varies if it is measured by its ability to identify sheep with abscesses.

Some sheep become infected with cheesy gland but fight off the infection and do not have abscesses. These sheep are important when studying the spread of disease. If scientists are looking for the presence of cheesy gland abscesses, then the specificity of the ELISA test varies from 100 to 40 per cent, depending on the amount of cheesy gland in the flock. If the prevalence of cheesy gland is high, then more sheep will have a positive ELISA test and not have abscesses, but if the prevalence is low few of these false positive sheep will be present.

If cheesy gland infection is important, then the 'true' specificity of the test is hard to define because there is no disease state—that is the presence of abscesses—with which to compare ELISA tests.

ELISA tests also have limited application in the individual diagnosis of cheesy gland in sheep with no previous test results.

Sheep with old, thick-walled abscesses and which have not come into contact with the cheesy gland bacterium for some time can have false negative tests. False positives show up when the sheep's immune system still produces antibodies after a cheesy gland infection has cleared, leaving no abscesses.

However, the tests are useful to assess the flock level of cheesy gland infection in old sheep or particularly to identify the incidence of cheesy gland in young sheep that previously tested negative for the disease. The cheesy gland toxin ELISA test is a useful research tool that can be used to monitor the occurrence of cheesy gland in commercial sheep flocks.
Although vaccination reduces the prevalence of cheesy gland, identification of risk factors that influence the incidence of cheesy gland could also help reduce its prevalence in Australian sheep flocks.

A previous study on five flocks with a high prevalence of cheesy gland showed 85 per cent of cheesy gland spread is at the second and third shearing. The annual incidence of cheesy gland in a commercial sheep flock, therefore, can be estimated by measuring the incidence in one- and two-year-old sheep between shearing and about five months after shearing.

In one of the experiments in which artificial infection was used, sheep exposed to cheesy gland did not produce less wool in subsequent years. There were also smaller differences in wool production in sheep with and without cheesy gland abscesses, compared with exposed and not exposed sheep. It is therefore likely that this loss of wool production occurs only once in a sheep's life, because sheep are rarely reinfected with cheesy gland, but often remain infected for life.

<table>
<thead>
<tr>
<th>Flock</th>
<th>Disease status</th>
<th>No.</th>
<th>Greasy fleece weight (kg)</th>
<th>Clean fleece weight (kg)</th>
<th>Micron</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Infected</td>
<td>49</td>
<td>5.61</td>
<td>3.99</td>
<td>23.7</td>
</tr>
<tr>
<td></td>
<td>Not infected</td>
<td>109</td>
<td>5.89</td>
<td>4.27</td>
<td>23.3</td>
</tr>
<tr>
<td></td>
<td>Difference (%)</td>
<td></td>
<td>0.28 (5.6%)</td>
<td>0.28 (7.0%)</td>
<td>-0.4 (1.7%)</td>
</tr>
<tr>
<td>2</td>
<td>Infected</td>
<td>120</td>
<td>6.67</td>
<td>4.86</td>
<td>23.7</td>
</tr>
<tr>
<td></td>
<td>Not infected</td>
<td>40</td>
<td>6.95</td>
<td>5.07</td>
<td>24.1</td>
</tr>
<tr>
<td></td>
<td>Difference (%)</td>
<td></td>
<td>0.28 (4.2%)</td>
<td>0.21 (4.3%)</td>
<td>+0.4 (1.7%)</td>
</tr>
<tr>
<td>3</td>
<td>Infected</td>
<td>99</td>
<td>4.04</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Not infected</td>
<td>4.20</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Difference (%)</td>
<td></td>
<td>0.16 (4.0%)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

There are also fears that Australia's current levels of cheesy gland may be a future barrier for the live sheep export trade; inspection standards in Middle Eastern abattoirs vary and some abattoirs condemn 10 to 15 per cent of Australian sheep because of cheesy gland.

**Loss in wool production**

Three flocks with a high prevalence of cheesy gland in cull sheep at slaughter were studied to measure the influence of new cheesy gland infection on wool production.

Before shearing, blood samples were taken from each of 50 one-, two- and three-year-old sheep to estimate the prevalence of cheesy gland in these age groups. Results indicated the two-year-old sheep were likely to have the highest level of new cheesy gland infection in the following year.

Blood samples were taken from all two-year-old sheep in each flock and their greasy fleece weight measured. Blood samples were taken five months later to determine which sheep had developed cheesy gland. At the end of the year greasy fleece weight was again measured. Wool samples were taken from flocks 1 and 2 to determine clean wool production and average fibre diameter. These production measures of sheep exposed or unexposed to cheesy gland were analysed (see Table 1). Fleece samples were not available from the third flock.

Sheep with new cheesy gland infection produced less greasy (4.0 to 4.8 per cent) and clean (4.1 to 6.6 per cent) wool than sheep with no evidence of exposure to cheesy gland. Exposure to cheesy gland, rather than the presence of cheesy gland abscesses, has most influence on wool production.

These flock results confirmed the losses in wool production seen in experiments with artificial infection with cheesy gland. In those experiments, artificial infection decreased greasy wool production by 0.2 to 0.3 kg and clean wool production by about 0.2 kg.

In one of the experiments in which artificial infection was used, sheep exposed to cheesy gland did not produce less wool in subsequent years. There were also smaller differences in wool production in sheep with and without cheesy gland abscesses, compared with exposed and not exposed sheep. It is therefore likely that this loss of wool production occurs only once in a sheep's life, because sheep are rarely reinfected with cheesy gland, but often remain infected for life.

**Spread of cheesy gland**

Although vaccination reduces the prevalence of cheesy gland, identification of risk factors that influence the incidence of cheesy gland could also help reduce its prevalence in Australian sheep flocks.

A previous study on five flocks with a high prevalence of cheesy gland showed 85 per cent of cheesy gland spread is at the second and third shearing. The annual incidence of cheesy gland in a commercial sheep flock, therefore, can be estimated by measuring the incidence in one- and two-year-old sheep between shearing and about five months after shearing.
The incidence of cheesy gland in age groups was estimated by studying changes in the immune status of 60 each of one- and two-year-old sheep. The relationships between the incidence of cheesy gland and management and environmental factors were studied in 126 age groups of sheep in 70 commercial sheep flocks with varying prevalence of cheesy gland in cull ewes.

Flocks were chosen from abattoir lists of 412 flocks (see Figure 1) which had been assessed for prevalence of cheesy gland abscesses in cull ewes. The prevalence of cheesy gland in the 70 flocks chosen approximated that seen in the 412 randomly selected flocks. Flocks were not selected if sheep were to be sold in the six months after shearing, or if sheep were more than 12 months old when brought into the flock. Flocks or age groups were also rejected if sheep had been vaccinated against cheesy gland.

Sheep in each age group were identified and blood samples taken before shearing and again five months later. The proportion of these sheep that, after first having a negative test, tested positive in the cheesy gland toxin ELISA test at the second blood sample, was an estimate of the incidence of cheesy gland in that age group. This incidence for each age group was compared with management factors and environmental measurements collected at shearing or five months later. The prevalence of cheesy gland in each age group before shearing was estimated by the proportion of sheep testing positive at the first blood test.

The incidence of cheesy gland in each age group was categorised into low and high around its median (5.5 per cent) to determine what management or environmental factors affected incidence. After analysis, a 'risk' was associated with the management or environmental factors to determine why sheep were in the high incidence group.

Results
The average flock size in this study was 5650 sheep and flocks ranged from 500 to 32,000 sheep. Flocks were spread throughout the agricultural area, from Northampton, south to
Farmers can use information on the prevalence of cheesy gland in their cull ewes, their dipping practice and where sheep are held after shearing, to assess the risk of high incidence of cheesy gland.

The most significant relationship identified by this study is the link between the incidence of cheesy gland and the use of shower dips. Shower dips are being used more widely to control sheep lice and the incidence of this disease in dipped flocks could increase.

The association between prevalence and incidence of cheesy gland in an age group seems to be of little practical use because producers are not likely to know the blood test results for cheesy gland in their one- and two-year-old sheep. However, sheep farmers can easily get a record of the prevalence of cheesy gland in their cull sheep from export abattoirs, and this figure can be used to estimate the risk of new cheesy gland infections and their effect on wool production.

The analysis showed that every 10 per cent increase in the prevalence of cheesy gland for an age group increases the risk of cheesy gland incidence in that age group being in the high category by 6.5 times. Every 10 per cent increase in the prevalence of cheesy gland in culls measured at abattoirs increases the risk that one- or two-year-old sheep will have a high cheesy gland incidence by 1.3 times.

Shower dipping of sheep can influence the incidence of cheesy gland because the bacterium can spread in dip wash. Previous research has demonstrated that cheesy gland could spread from dips even when sheep were dipped two weeks after shearing. This study showed that using a shower dip increased the risk of high cheesy gland incidence by 5.5 times.

Cheesy gland spreads mostly at shearing and it can spread without external abscesses being cut at shearing. Sheep coughing droplets containing bacteria from discharging lung abscesses can spread the bacteria onto shearing cuts on the skin of uninfected sheep, and this form of spread is likely to be more important at shearing than other forms of spread.

The risk of spread of cheesy gland from coughing is nearly doubled if sheep are under cover or in close contact in covered yards, away from wind and sunlight, for more than an hour after shearing. The average incidence of cheesy gland in sheep kept under cover for less than one hour after shearing was 13.2 per cent, significantly less than the 23.3 per cent average incidence of sheep kept under cover for one hour or more after shearing.

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Farmers can use information on the prevalence of cheesy gland in their cull ewes, their dipping practice and where sheep are held after shearing, to assess the risk of high incidence of cheesy gland.
This information can help sheep producers make decisions about controlling cheesy gland in their flocks.

**Control of cheesy gland**

This study of cheesy gland has led to the development of an economically effective vaccination program to control the disease. Vaccination gives lambs a good level of immunity against cheesy gland that can be boosted by yearly vaccinations before shearing, giving peak immunity at shearing when protection is really needed.

The following is an effective vaccination program:

- **Lambs.** Give two vaccinations, one at marking and one at weaning, ideally six weeks apart.
  - Adult sheep. Give annual booster vaccinations as close as possible to shearing, but not at shearing. For example, give adult sheep boosters at pre-lambing, marking or weaning for shearing in spring, or at the time of a summer drench for autumn shearing.

Vaccination is cost effective in 80 per cent of flocks. In flocks that are not vaccinated there is greater than a 4 out of 5 chance that more than 20 per cent of adult sheep have cheesy gland (see Figure 1).

Vaccination costs 14 to 17 cents per sheep per year including labour costs or 2 to 4 cents if other vaccines are already used. Lost wool production and lower prices for cull sheep cost about 25 to 35 cents per sheep per year when 45 per cent of adult sheep are affected. The free protection against pulpy kidney and tetanus (and other diseases if 6-in-1 vaccines are used) in the vaccine is a bonus.

**Recommendations**

- Vaccinate with Gianvac®, Cheesyvax®, Vaxall® or Guardian.
  - Assess whether a 6-in-1 vaccine is necessary. Use a 3-in-1 vaccine if black disease, black leg and big head are not economically significant problems.
  - Consign some cull sheep direct to an export abattoir and contact the AQIS veterinarian and request her/him to assess the prevalence of cheesy gland. You can then monitor future progress.
  - If using a shower dip, it is even more important to start an effective vaccination program.

**Conclusions**

Exposure to cheesy gland causes a 4 to 7 per cent reduction in clean fleece weight in the year of infection. This represents a significant loss of wool production efficiency to individual sheep producers and to the Australian sheep flock.

Shower dipping sheep after shearing increases the risk of high incidence of cheesy gland by about six times. Keeping sheep under cover for one hour or more after shearing doubles the risk of being in a higher incidence category.