Are deficiencies in calcium and magnesium implicated in lamb mortalities in sheep flocks in Australia?

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Three Components:

1. Field trials in 2016
2. Literature Review
3. Replicated experiments 2017
2016 data collection (courtesy David Masters)

- 16 farms – NSW, SA, WA, Vic
- Ewes – preferable carrying twins
- Blood and urine samples before and after lambing
- Forage and soil sampling
- Lamb survival
Calcium in forage – pre-lambing

Higher is better

Requirement

Magnesium in forage - pre-lambing
Sodium in forage - prelambing

Lower is better

Requirement

Potassium in forage - prelambing

Higher is better
Calcium in urine prelambing and lamb survival

\[ y = 0.12x + 0.68 \]
\[ R^2 = 0.26 \]
\[ P \approx 0.06 \]

Urine pH prelambing and lamb survival

\[ y = -0.13x + 1.8 \]
\[ R^2 = 0.24 \]
\[ P \approx 0.06 \]

Magnesium in urine prelambing and lamb survival

\[ y = 0.01x + 0.66 \]
\[ R^2 = 0.46 \]
\[ P < 0.05 \]
Conclusions - 2016

• Forage:
  – Ca, Mg, Na and K balance better than crops
  – Not convincing evidence that ewes are at risk

• Metabolites:
  – Alkaline urine
  – Ca status as indicated by plasma, urine and FE lower than expected from forage results
  – Mg status normal

• Lamb survival:
  – Higher survival related to higher Ca and Mg in urine, lower urine pH (P ~0.05 – 0.06)
  (urinary levels – indicator of Ca and Mg status)
Can we make a case for ewe Ca and Mg status impacting lamb survival?

• A relationship **BUT** lots of confounding factors in 2016
  – including breed, proportion of singles, time of lambing, pasture type, FOO ...

• Sub-clinical impacts (in addition to milk fever and grass tetany)

• But some evidence from the literature – sheep and other species ...
Low magnesium and lamb survival – possible mechanisms

- Decreased ability to meet metabolic demands of increased heat production
- Decreased weaning weight
- Ketosis (Pregnancy toxaemia)
- Lactation Failure
- Effect maternal behaviour? E.g. ewe-lamb bond
- Increased susceptibility to stress (ewe)
- Poor glycaemic control/insulin resistance
- Reduces PTH secretion and tissue responsiveness to PTH (Ca regulation)
- Mg also affects calcium homeostasis
- Clinical hypomag/Grass tetany
- Hypothermia/exposure
- Ewe death or inability to tend to lamb(s)
- Low Mg & Low Ca
- Reduce core body temp and thermogenesis (offspring)
What if we supplement with Mg?

- Neuroprotectant
  - Slow neuronal damage during hypoxia
- Magnesium supplement
  - Improved immunity in offspring
  - Increase IgA levels in colostrum and milk
  - Anti-stress effects
  - Improved maternal behaviour post-lambing
Low calcium and lamb survival – possible mechanisms

- Reduced rumen/abomasal activity
- Cervical dilation issues
- Retained placenta
- Uterine inertia
- Nerve stimuli and muscle weakness
- Clinical hypocalcaemia
- Risk of infection
- Maternal behaviour
- In utero death
- Prolonged labour

Compromised immune function in lambs
Ewe death; maternal behaviour
Overall conclusions

- Possible link between low ewe calcium and magnesium status and lamb survival in 2016 on-farm surveys
- Literature describes possible mechanisms by which this may occur
- Replicated experiments (+/- supplement) on 5 farms in 2017:
  - WA, SA, NSW
  - Mg$_2$SO$_4$, CaCl$_2$ and salt

Results by end of the year.
AWI-sponsored project

- Principal Investigator: Michael Friend

Co-investigators:
- **David Masters (UWA)**
- Susan Robertson, Marie Bhanugopan (CSU)
- Gordon Refshauge (NSW DPI)
- Serina Hancock, Andrew Thompson (Murdoch Uni)
- Janelle Hocking-Edwards, Emma Winslow (SARDI)

- Additional contributors to literature review:
  Kate Louden, Peter McGilchrist and David Miller (Murdoch Uni)
An alliance between Charles Sturt University and NSW Department of Primary Industries

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Sodium content in lucerne pastures in southern NSW, sampled from 76 farms (Hall, 1982)

67% of samples are below 0.6 g/kg DM (0.06% DM)
Low calcium and lamb survival – possible mechanisms

- Reduced smooth muscle activity
- Nerve stimuli and muscle weakness
- Retained placenta
- In utero death
- Prolonged labour
- Uterine inertia
- GIT = Loss of appetite
- Cervical dilation issues
- Ewe unable to rise
- Risk of infection
- Compromise future reproduction
- Compromised immune function in lambs
- Maternal behaviour
- Ewe death; maternal behaviour
- Preg tox; Lower birth weight; reduced milk production
- Clinical hypocalcaemia
- Reduced muscle activity
- Immune cell function