Can bioactive plants of Australia control rumen acidosis?

Peter Hutton
BSc (Animal science)

Animal Production Systems
The Future of Animal Industries

- **Clean**
  - No Hormones or Drugs
  - Peter Hutton

- **Green**
  - Ecosystem stewardship
  - Megan Chadwick

- **Ethical**
  - Animal welfare
  - Samantha Bickell
We have identified antimicrobial Australian plants with potential to prevent acidosis

• Acidosis is a major rumen disorder
• Controlled by in-feed antibiotics
• Ban on in-feed antibiotics
• Bioactive plants of Australia
• Lactic acidosis
• The use of in-feed antibiotics
• Australian plants and bioactivity
• My research
• Lactic acidosis
• The use of in-feed antibiotics
• Bioactive plants of Australia
• My research
Intensive animal production
Lactic acidosis

Starch → Saliva (pH 7) → Saliva buffering

- All bacteria
- Str. bovis

Absorbed

VFA

Lactic acid

pH ↓

Inhibition of many bacteria

pH < 5.2

Lactobacillus ↑

Str. Bovis inhibition

Absorbed

Metabolic acidosis
Bacteria

*S. bovis*

*Lactobacillus* spp.

Gabriel Milinovich, University of Queensland
6 hours
pH 5.2

Bacteria
S. bovis
Lactobacillus spp.

Gabriel Milinovich, University of Queensland
• Lactic acidosis
• The use of in-feed antibiotics
• Bioactive plants of Australia
• My research
Starch

Absorbed

VFA

Inhibition of many bacteria

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Lactic acid

Str. bovis

pH ↓

Lactobacillus

Str. Bovis inhibition

Metabolic acidosis

pH < 5.2

Virginiamycin
How much antibiotics do we use?

**USA**
- > 50% of antibiotic use is in livestock feed
- Animal growth promoters = $530 million per year

**Australia**
- Stock feed: 400 Tonnes = 57%
- Humans: 250 Tonnes = 35%
- Veterinary: 55 Tonnes = 8%

JETACAR report, 1999
Antibiotics as growth promoters

- Ban in Europe (2006)
- USA & Australia?
- Need to find safe alternatives
• Lactic acidosis
• The use of in-feed antibiotics
• Bioactive plants of Australia
• My research
Are Australian plants the answer?

Native plants for essential oils: Lemon tea tree (Paperbark company of WA)
Antimicrobial plants

- Tests on human pathogens
- Selective inhibition
- No testing in ruminants
Summary

1. Lactic acidosis is of microbial origin
2. Antibiotics - selective inhibition
3. In-feed antibiotics will be banned
4. Some Australian plants are antimicrobial
5. Australian plants - selective inhibition
• Lactic acidosis
• The use of in-feed antibiotics
• Bioactive plants of Australia
• My research
I expected to find Australian plants that could selectively inhibit bacteria that cause lactic acidosis.
Starch

All bacteria

Str. bovis

VFA

Lactic acid

Absorbed

Inhibition of many bacteria

pH < 5.2

Lactobacillus

Absorbed

Metabolic acidosis

Bioactive plants

Str. Bovis inhibition
Plant collection

Selection criteria
1. Native
2. Antibacterial activity
3. Available

Plant numbers
- Over 700 plants/extracts on the list
- Initial screening complete for 110
Initial screening of all plants

Fermentation activity

No additive

Virginiamycin
pH as an indicator of acidosis

No additive
pH as an indicator of acidosis

No additive

Virginiamycin
pH as an indicator of acidosis

- Plant A
- Virginiamycin
- Plant B
- No additive
## Extent of acidosis protection

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Selective inhibition of bacteria

Minimum inhibitory concentration

• Lactate producers
• Lactate utilisers
• Normal rumen bacteria
Selective inhibition

Control

Virginiamycin

Plant
Does success *in vitro* mean success *in vivo*?

- Induced acidosis - grain challenge
- Three groups of fistulated wethers;
- Virginiamycin - positive control
- No additive - negative control
- Plant A
Minimising pain and distress

• Vitamin B
• Minimum pH 5.0
• Rumen flush
• Sodium bicarbonate
• Re-inoculate with rumen fluid
Acidosis in fistulated wethers

Rumen pH
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0

Hours post infusion
-24
4
10
16

Acidosis
Wheat infusion
No additive

Hours post infusion
Virginiamycin prevents acidosis

Rumen pH

Wheat infusion

Virginiamycin

No additive

acidosis

Hours post infusion

-24 4 10 16 22 28 34 40 46
In vivo

Hours post infusion

Rumen pH

Virginiamycin

Wheat infusion

No additive

Plant A

acidosis

-24 4 10 16 22 28 34 40 46

Hours post infusion
Identification of the active compounds

- Chemistry Dept., UWA (Emil Ghisalberti & Ryan Duncan)
- Compound fractionation and purification
- Test compounds in bioassay
- Active compounds have been identified
We have identified antimicrobial Australian plants with potential to prevent acidosis

- Identified plants that:
  - inhibit bacteria that produce lactic acid
  - control indicators of acidosis
- Will the best plant work *in vivo*?
- Identified active compound(s)
Acknowledgements

- Zoey Durmic: School of Animal Biology, FNAS
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- John Day: The Paperbark Company of WA
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- Wayne O’Sullivan: CALM
- Megan Ryan and Richard Bennett: Salinity CRC, School of Plant Biology, FNAS
- Department of Agriculture Western Australia
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<td><strong>Accumulated gas</strong></td>
<td>119&lt;sup&gt;c&lt;/sup&gt;</td>
<td>171&lt;sup&gt;a&lt;/sup&gt;</td>
<td>134&lt;sup&gt;b&lt;/sup&gt;</td>
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<td><strong>Total VFA (mmol/L)</strong></td>
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