Dark cutting beef – latest research for pasture fed cattle

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OUTLINE

• Dark cutting re-cap
  – Nutrition

• King Island experiment
  – Mg

• Sth Aust experiment
  – Mg
Dark Cutting.....What’s wrong with high pH meat?

- Darker colour
- Variable tenderness
- Difficult to cook right
- Bacterial growth more rapid on aging

Ultimate pH >5.7
Meat Colour >3
$$$ Impact on Industry

- Producer penalties average = $0.59/kg HSCW
- The body is minced
- Downgrade likely should be $1/kg
- Everybody looses!

(McGilchrist et al 2012, Jose et al 2015)
LOW MUSCLE GLYCOGEN (ENERGY) AT SLAUGHTER

Glycogen

Lactic acid

ACID

pH

ALKALINE

LACTIC ACID

Glycogen

pH

pH5.5

pH6

Time in chiller
MUSCLE GLYCOGEN
Nutrition

MUSCLE
GLYCOGEN
Now a bit of glycogen biochemistry!
Glycogen turns over

Nutrition

Glycogen

Muscle enzymes

Glucose

Energy or fuel

Cold/hot
Exercise
Mixing
Stress

…….
A small shift over time on both sides can make a large difference
Change in LW vs muscle glycogen
(over 12 mo. in pasture fed beef Vic)

Glycogen (%) vs Live weight Gain (kg/day)

Danger Zone

Need Wt gains up here
So how much nutrition

- 0.8-1.0kg/day Live weight gain
- = high quality pasture

- 10.5MJ of ME/kg DM
- >100mm length
Incidence of Dark Cutting (grass fed beef)

(McGilchrist et al, 2014)
Incidence of Dark Cutting
(grass fed beef)

Energy / protein / minerals / mycotoxins?

National Average

(McGilchrist et al, 2014)
Role of Magnesium

• Plays a key role in many many systems
However of special interest:

- Nerve/muscle cell function – hence grass tetany when severe deficiency
- Reduces stress hormone response
- Improves stress related meat quality issues in slaughter pigs (D’Souza et al)
- Shown to make Merino lambs less stress sensitive (Gardner et al)
Then there is the bull dust stuff

- An additive in many horse calming tonics
- Used by humans for muscle relief
- ..........
- ????????
Hypothesis

• Animal Mg ‘status indicators’ will show NO relationship with dark cutters

• However forage Mg levels will
Methods
King Island

- Sampling period March to June 2015
- **66 lots of cattle, 3,185 hd of mixed sex, age and breed**
- Shipped Sunday and travel in semi trailers on the ship
- Slaughtered Monday, MSA graded Tuesday
- Pasture and silage analysed
- Bloods collected on-farm and at slaughter
Average percentage of dark cutting each kill date

- **Ave DFD%**
- **Min DFD%**
- **Max DFD%**

<table>
<thead>
<tr>
<th>Date (2015)</th>
<th>% Dark Cutting</th>
</tr>
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<tbody>
<tr>
<td>16-Mar</td>
<td>10%</td>
</tr>
<tr>
<td>23-Mar</td>
<td>15%</td>
</tr>
<tr>
<td>30-Mar</td>
<td>20%</td>
</tr>
<tr>
<td>6-Apr</td>
<td>25%</td>
</tr>
<tr>
<td>13-Apr</td>
<td>30%</td>
</tr>
<tr>
<td>20-Apr</td>
<td>35%</td>
</tr>
<tr>
<td>27-Apr</td>
<td>40%</td>
</tr>
<tr>
<td>4-May</td>
<td>45%</td>
</tr>
<tr>
<td>11-May</td>
<td>50%</td>
</tr>
<tr>
<td>18-May</td>
<td>55%</td>
</tr>
<tr>
<td>25-May</td>
<td>60%</td>
</tr>
<tr>
<td>1-Jun</td>
<td>65%</td>
</tr>
<tr>
<td>8-Jun</td>
<td>70%</td>
</tr>
<tr>
<td>15-Jun</td>
<td>75%</td>
</tr>
<tr>
<td>22-Jun</td>
<td>80%</td>
</tr>
</tbody>
</table>

Graph showing the percentage of dark cutting over the specified dates.
Pasture Magnesium

(P<0.05)
Sth Australia - Methods

• Sampling period June 2014 - November 2015
• 80 lots of cattle, 5,800 head
• Pasture, bloods and liver analysed
Pasture Magnesium (P<0.05)

![Graph showing the relationship between Mg (% Dry Matter) and %DC. The graph includes a line representing the model (%DC) and dashed lines for the confidence interval (Mean 95%).]
Far out this Mg story must be true!!
Other Minerals no relation to dark cutters BUT in Sth Aust

- Copper
  - 99% deficient

- Zinc
  - 94% deficient

- Both significantly correlated with both MSA marble score and rib fat depth
- Higher energy status = greater fat deposition
“lush pasture” effect on Mg

- High potassium ($K^+$)
- High protein
- Both antagonistic to Mg absorption
How to fix this?

• Maybe dolomite fertilizer will help
• Supplementation
  – MgO or MgSO$_4$
  – delivery and palatability always an issue
Magnesium supplementation

Short term Mg\textsuperscript{2+} supplementation for pasture fed beef cattle prior to slaughter

- 10 day Mg supplementation via pellets
- Canola meal based
- 46g MgSO\textsubscript{4} + 9.5gm MgO/0.5kg/day
Supplementation – preliminary results

• They eat the pellets!
• ~600 cattle to date on control & Mg Pellets
• Mg Treated groups have less dark cutters
Summary

- Nutrition important (energy or ME of pasture)
- Mg can be an issue
  - Fertiliser
  - Short term supplementation
Many thanks
Plasma Mg – consistent

Median Plasma Mg per lot (mmol/L) vs. Dark cutting (% per lot)

Plasma Mg mmol/L vs. Pasture K (% DM)

Plasma Mg mmol/L vs. DCAD (meq/Kg DM)
WA expt - Sampling

- Late September → mid December
- Albany, Manjimup, Boyup Brook, Dardanup
- 13 lots of cattle
- n=727
Hypotheses

Supplementation with a ration of 25MJ/head/day for cattle on pasture, fed for >9 days prior to slaughter will

1. Increase growth rate
2. Increase muscle glycogen
3. Decrease the incidence of dark cutting from 10% to 5%
We used a pelleted feed

- High energy 9mm pellet
- 13.3 MJ/kg
- 14.4% CP DM
- $432/tonne
- 2.5kg/head/day
- $1.80/head/day
You don’t need to use pellets

• Just need a high’sh energy supplement of some description

• Of course feed with skill – don’t want rumen acidosis
Measurements

• Liveweight (kg)
  – At allocation into treatment groups
  – Immediately after pre-slaughter mustering
• Pasture Samples
  – Feed on offer
  – Pasture quality
• pH decline
• MSA measurements
• Muscle glycogen
Will they eat it?
Treatment effects

We had a very low incidence of dark cutters = no effect of treatment on Meat Colour or pH
Dark cutters = 2.1% in controls & 1.8% supplemented

BUT

Had a positive effect on glycogen at slaughter
Glycogen at slaughter

About 0.11 g/100g extra glycogen
Glycogen at slaughter

13% -> 0%

About 0.11 g/100g extra glycogen
Economical?

• Of course in this experiment there were bugger all dark cutters – so waste of money eh ????

• BUT was there a carcase weight advantage under supplementation ??
Economical?

Indeed there was

CARCASS WEIGHT INCREASED BY 3KG

Feeding for the 14 days cost $15.12 per animal (2.5kg/hd)
Pellets were $432/t

@ $5.00/kg HCW = $15
@ $6.00/kg HCW = $18
@ $7.00/kg HCW = $21

You can work it out better than me