



EAAP 2018



**MURDOCH
UNIVERSITY**
PERTH, WESTERN AUSTRALIA

Contrasting metabolic indicators of energy and stress status in slaughter lambs and beef cattle

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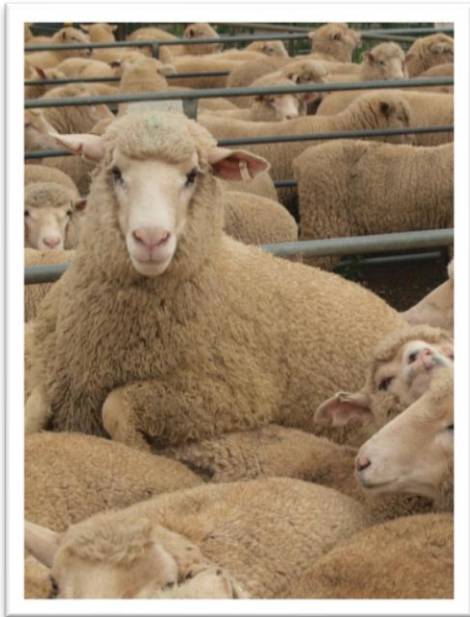
S.Stewart, K. Loudon, G. Gardner, P. McGilchrist, J. Thompson, F. Dunshea, R. Polkinghorne,
I. Lean and G. Tarr



8.45am Session 33 Elafiti 3: Improving carcass and meat quality

Overview

- Blood Energy/Stress indicators at slaughter
- Beef contrasted to lamb
- What are the consequences - if any ?



Energy/stress measures in blood at point of slaughter (exsanguination)

- Glucose
- Lactate
- Non esterified fatty acids (NEFA)

Energy/stress measures in blood

■ Glucose

- ↓ [glucose] pre slaughter fasting
- ↑ [glucose] acute pre slaughter stress (hepatic glycogenolysis)

■ Lactate

- ↑ [lactate] muscle excursion and acute pre slaughter stress (muscle glycogenolysis)

■ Non esterified fatty acids (NEFA)

- ↑ [NEFA] pre-slaughter fasting
- ↑ [NEFA] acute pre slaughter stress

General Aim

- The Meat Standards Australia eating quality cut x cook prediction model
- Could a panel of energy/stress markers at slaughter be possible to help improve the prediction of consumer sensory scores ?

Hypothesis (s)

- Blood response of energy/stress markers to commercial slaughter in lambs and beef cattle will be similar
- Stress response will relate to meat quality parameters (work in progress !)

Animals - Lamb

- n = 2,877, 7-10mo old , HCW 23kg, 2 years
- Extensively raised outdoors on 2 research farms
- 2 different abattoirs - electrical stunning then immediate exsanguination
- 24-36 hours of total feed deprivation
- Wide range of sire genetics

Animals – Beef cattle

Beef 1

- Bos Indicus cross steers, 4 farms, abattoir 'A' (**n= 343**) [Nth Aust]
- Slaughtered 24-48 hours after dispatch

Beef 2

- Bos Taurus steers/heifers from King Island farms, abattoir 'B' (**n=240**) [Sth Aust]
- Slaughtered 24 hours after dispatch

Beef 3

- Bos Taurus steers/heifers from Tasmanian farms abattoir 'B' (**n=244**) [Sth Aust]
- Slaughtered **48-72 hours** after dispatch

- HCW = 290±40kg, extensively raised outdoors on pasture
- Head percussion stunning then immediate exsanguination

Results – carbohydrate metabolism

(plasma mM)

	Glucose	Lactate	NEFA	D-3-OH Butyrate
Normal range	(2-4)	(0.5-1)	(0.5-0.15)	(0.3-0.5)
Lambs	4.7 ±0.9	3.5 ±2.3	1.2 ±0.5	0.4 ±0.1
Beef 1	6.9 ±0.9	9.4 ±3.2	0.4 ±0.2	0.2 ±0.1
Beef 2	7.4 ±1.2	14.5 ±3.3	0.3 ±0.2	0.2 ±0.1
Beef 3	6.2 ±0.9	12.0 ±2.5	0.6 ±0.3	0.3 ±0.1
Beef/Lamb	x 1.45	x 3.42	x 0.36	x 0.58

Conclusion

- ↑ [glucose] and [lactate] in plasma at sticking
- MORE so in beef cattle
- Heightened adrenergic response
 - Hepatic glycogenolysis (glucose)
 - Muscle glycogenolysis (lactate)
- Muscle exertion
 - Muscle glycogenolysis (lactate)

Results – fat metabolism

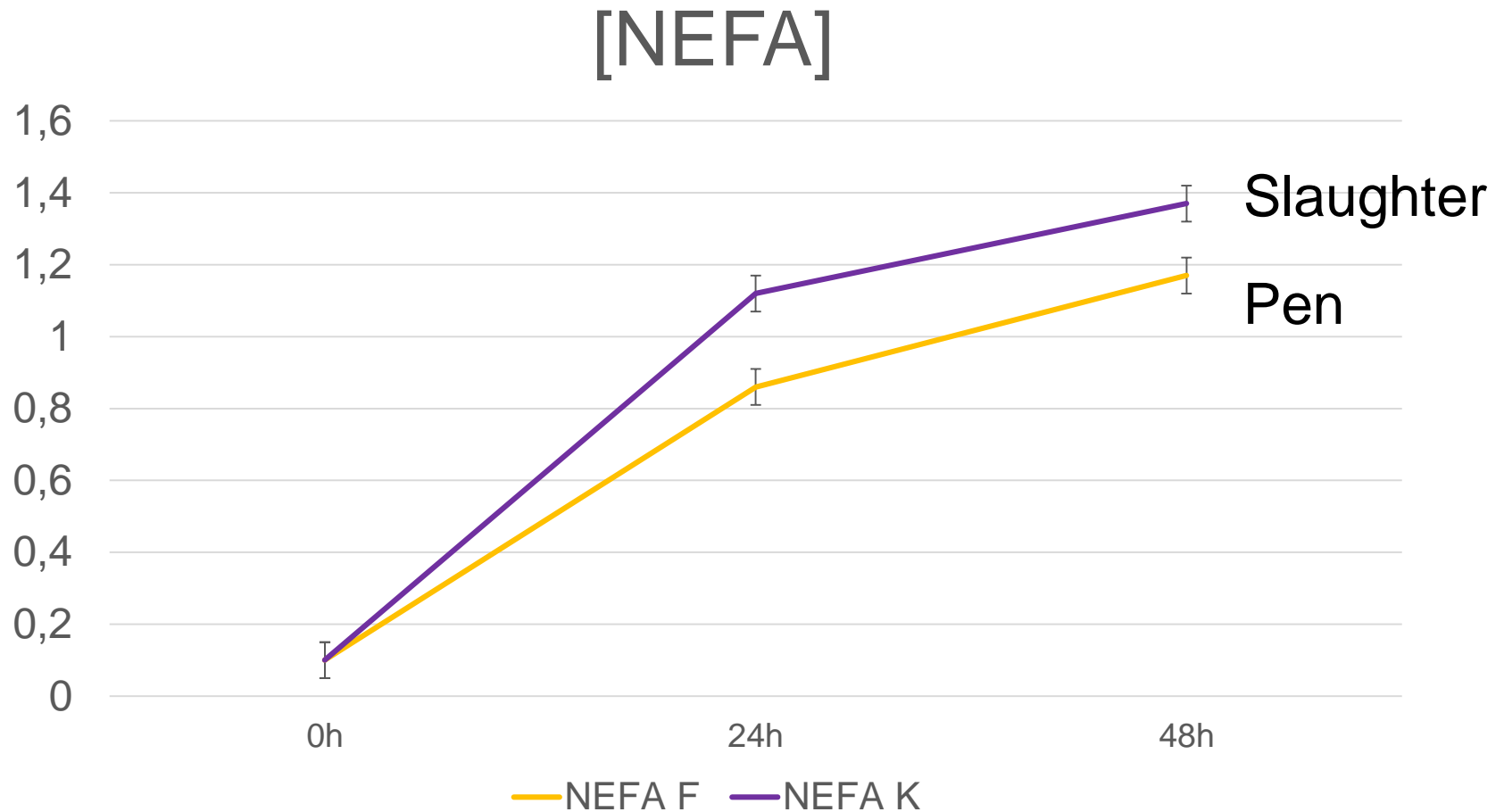
(plasma mM)

Normal range	Glucose (2-4)	Lactate (0.5-1)	NEFA (0.05-0.15)	D-3-OH Butyrate (0.3-0.5)
Lambs	4.7 ±0.9	3.5 ±2.3	1.2 ±0.5	0.4 ±0.1
Beef 1	6.9 ±0.9	9.4 ±3.2	0.4 ±0.2	0.2 ±0.1
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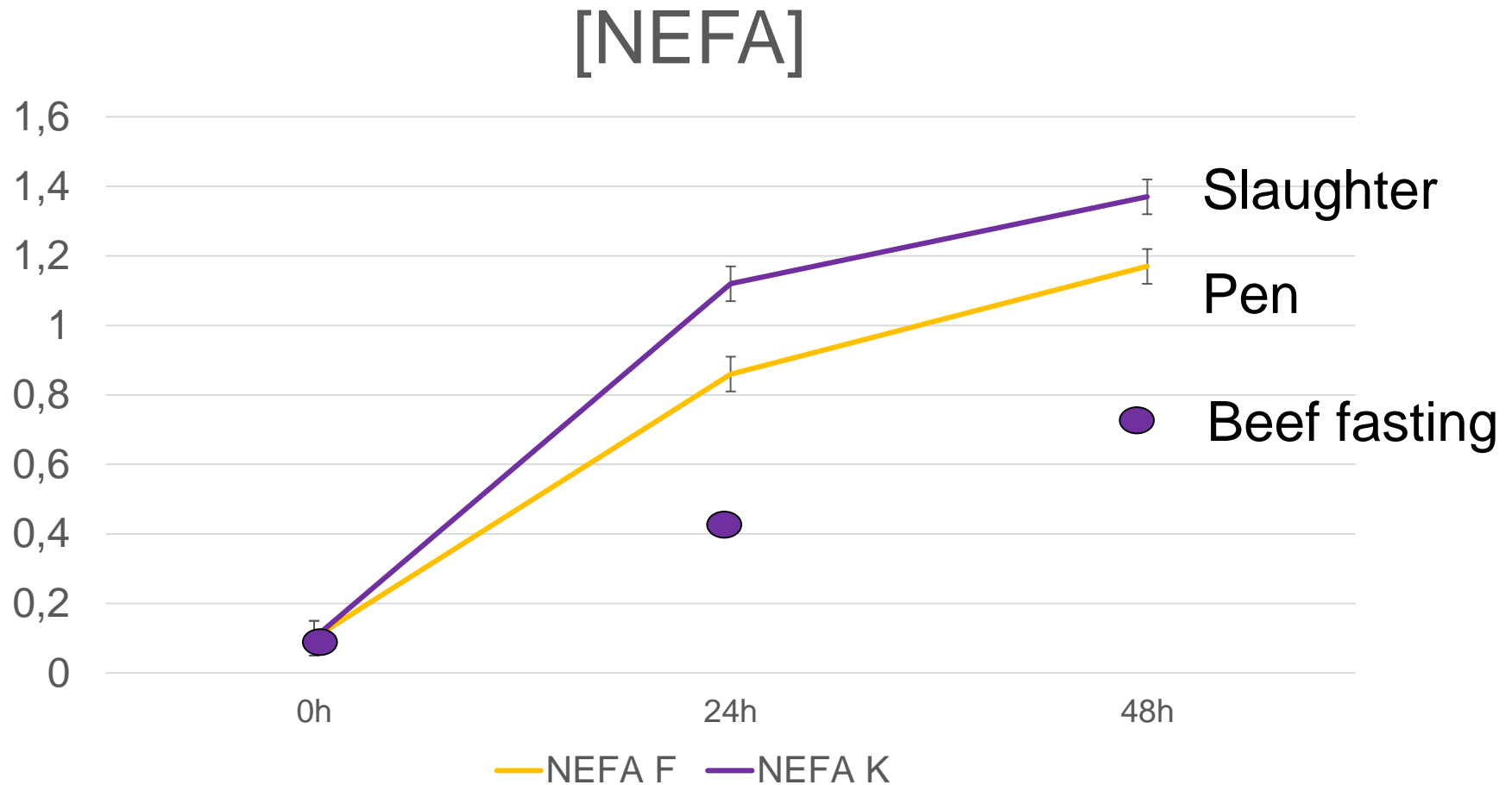
Conclusion

- ↑ [NEFA] in plasma at exsanguination
- MORE so in lamb than beef cattle
- So for lamb
 - Greater response to time off feed ??
 - Or heightened lipid adrenergic/stress response ??

Lamb – fasted in pen versus fasted then slaughtered (Stewart et al 2018)



Beef fasting expt (van der Walt et al. 1993)



Conclusion

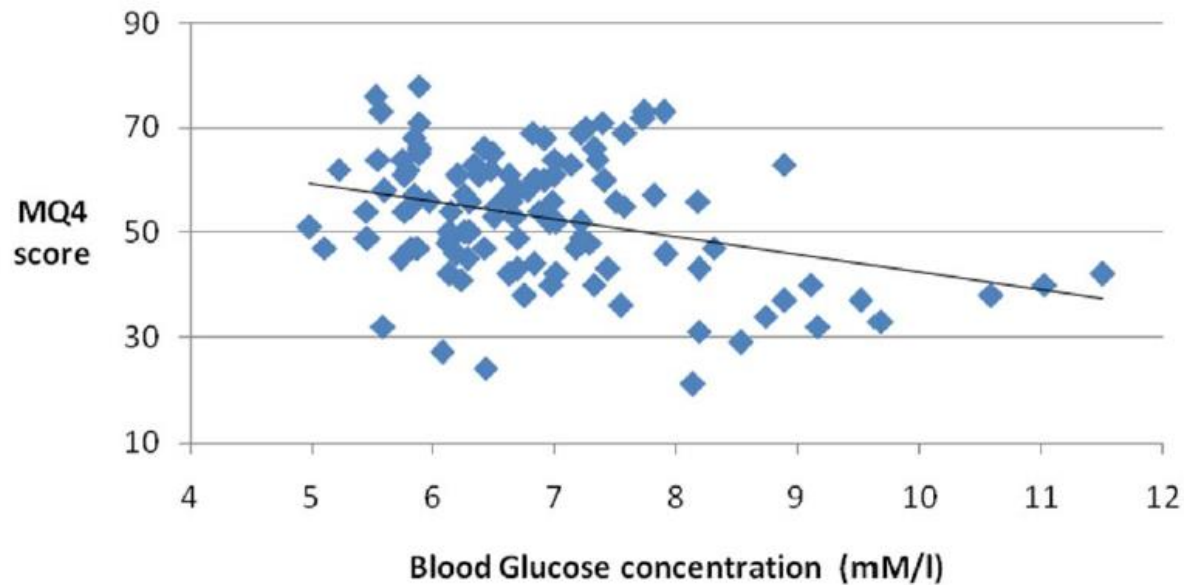
- ↑ [NEFA] due mainly to pre-slaughter fasting response
- This response is greater in lamb compared to beef
- Why ?
 - Rumen fill / retention ?
 - Metabolic scaling ?
 - Increase metabolic rate beyond scaling ?

Possible Consequences - some examples

Markers for meat quality issues ????

(i) Eating quality - beef

Beef 1 - weak negative effect with \uparrow [glucose]



(Polkinghorne et al. (2018), 25mm grilled striploin, 7-10 days aging)

(i) Eating quality - beef

Beef 2 and 3 studies – effects on MSA score in 5 muscles (/100)

- Glucose –ve effect 4 muscles = -2.5 points (*not sign*)
- Lactate –ve effect 5 muscles = -3 points (*2 sign*)
- NEFA +ve effect 5 muscles = +3 points (*2 sign*)

Loudon et al. Unpublished, 25mm grill, 10 and 20 days aging
5 muscles = eye round, outside, oyster, striploin, tenderloin

(i) Eating quality - beef

Another Previous beef study using \pm electric goads negative effect associated with \uparrow [lactate] = -4 points

Warner et al (2007)

(i) Eating quality - beef

Beef cattle

- So a possible association of ↑ [glucose] and ↑ [lactate] with small reduction in eating quality
- Clearly fat mobilization is modest and not associated with any reduction in eating quality

(ii) Carcasse shrink - lamb

Carcasse shrink due to fasting in lamb is very significant (Thompson *et al* 1897)

- 0.1%/hr weight loss after about 12 hours
- Beef more like 0.03%/hour
- Strong NEFA response matches this difference

Thank you