Factors affecting metabolites in lambs at slaughter

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Tuesday 26th August 2014 - Session 25

Outline

- Metabolic indicators of acute pre-slaughter stress
- Previous findings in cattle
- Hypothesis
- Factors influencing metabolites in lamb
- Future research – link metabolites to meat quality and yield

Metabolic indicators of stress

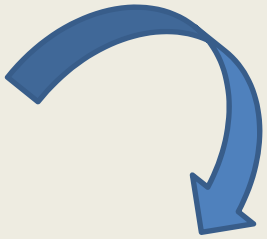
Immediately Pre-slaughter

- Human contact
- Social mixing
- Physical activity
- Novel environments

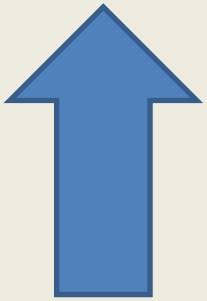
Acute stress

Metabolic indicators of stress

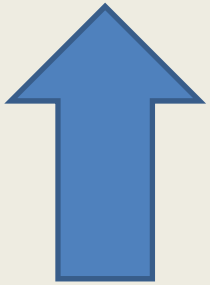
Acute stress



Muscle/liver glycogenolysis
Adipose tissue lipolysis



Plasma lactate and glucose



Plasma NEFA* (also chronic)

*Non-esterified fatty acids

Metabolic indicators @ slaughter

	Mean ± SD mmol/L
Lactate	9 ± 3.2 (3 → 37)
Glucose	7 ± 1.1 (4.7 → 11.6)
NEFA	0.4 ± 0.2 (0.09 → 1.2)

(Polkinghorne et al *in press* 2014; Pethick and McGilchrist 2011, Small and Ferguson 2011)

Metaboli indicators @ slaughter

	L
Lactate	
Glucose	6)
NEFA	.2)

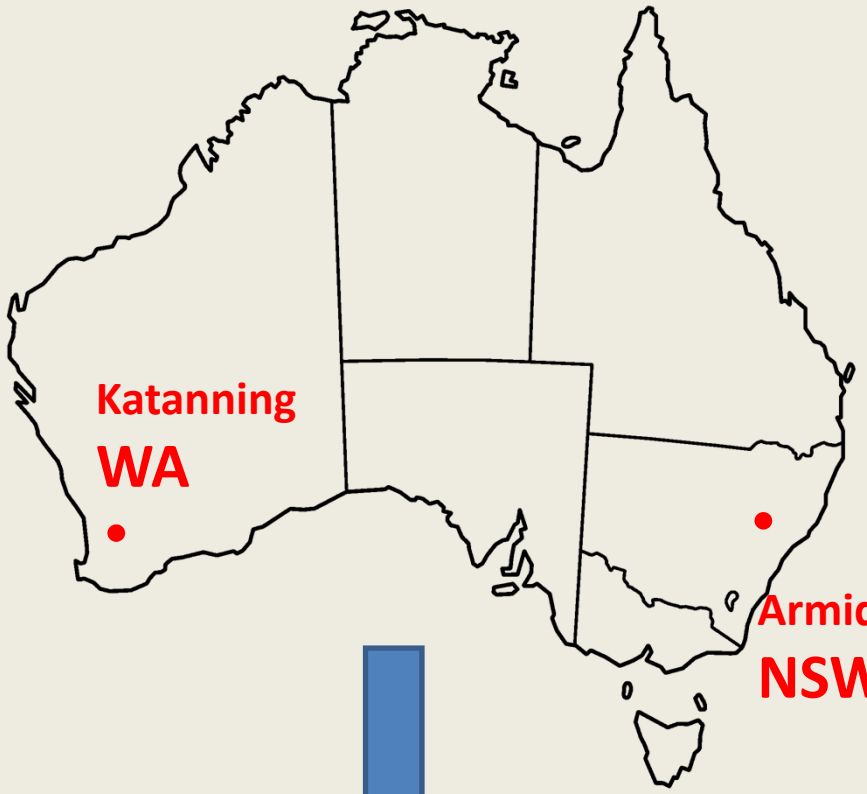
(Polkinghorne et al *in press* 2014; Pethick and McGilchrist 2011, Small and Ferguson 2011)

Hypothesis

- Metabolites (lactate, glucose, NEFA) at slaughter will be influenced by
  - Flock
  - Killgroup
  - Breed type (merinos)
  - Time/order of slaughter
- Expect similar results to beef cattle @ slaughter (uncontrolled hypothesis!)

Methods

- Prime Lambs n = 1436
- Blood collected at slaughter
- Sheep CRC/MLA genetic FLOCKS x 2
- ~ 200 sires (AI dams)
- Extensively managed
- Killgroups x 14
- 21 hrs off feed
  - 2 hours curfew on farm
  - 0.5- 2hours transport
  - ~ 17 hours in lairage



- Lactate
- Glucose
- NEFA

Methods - Analysis

Mixed Linear effect models

Dependent variables

Lactate

Glucose

NEFA

Random terms

Sire ID

Dam ID

Fixed Effects

Flock

Killgroup

Siretype

Birthtype Reartype

Age of dam

Covariates

Killorder

HCWT

Methods - Analysis

Mixed Linear effect models

Dependent variables

Lactate

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Random terms

Sire ID

Dam ID

Fixed Effects

FLOCK

KILLGROUP

SIRETYPE

Birthtype Reartype

Age of dam

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Methods - Analysis

= Time/order of slaughter

- **~6 lambs/min**
- **Exposure to acute stress**
- **Flock hierarchy**

Dam ID

Fixed Effects

Flock

Killgroup (flock)

Siretype

Birthtype Reartype

Age of dam

Covariates

KILLORDER

HCWT

Results

		BASAL LEVELS (mmol/L)
Glucose		2.5-5.0
Lactate		<0.5
NEFA		0.02-0.05

Results

	SLAUGHTER LEVELS (mmol/L)	BASAL LEVELS (mmol/L)
Glucose	4.9 ± 0.9 (2.5 – 8.7)	2.5-5.0
Lactate	4.2 ± 2.5 (0.6 – 16)	<0.5
NEFA	1.1 ± 0.5 (0.2 – 2.8)	0.02-0.05

Results

Glucose	4.9 ± 0.9 (2.5 – 8.7)	6.9 ± 1.1 (4.7 → 11.6)
Lactate	4.2 ± 2.5 (0.6 – 16)	9.5 ± 3.2 (3.0 → 37)
NEFA	1.1 ± 0.5 (0.2 – 2.8)	0.4 ± 0.2 (0.09 → 1.2)

Hypothesis

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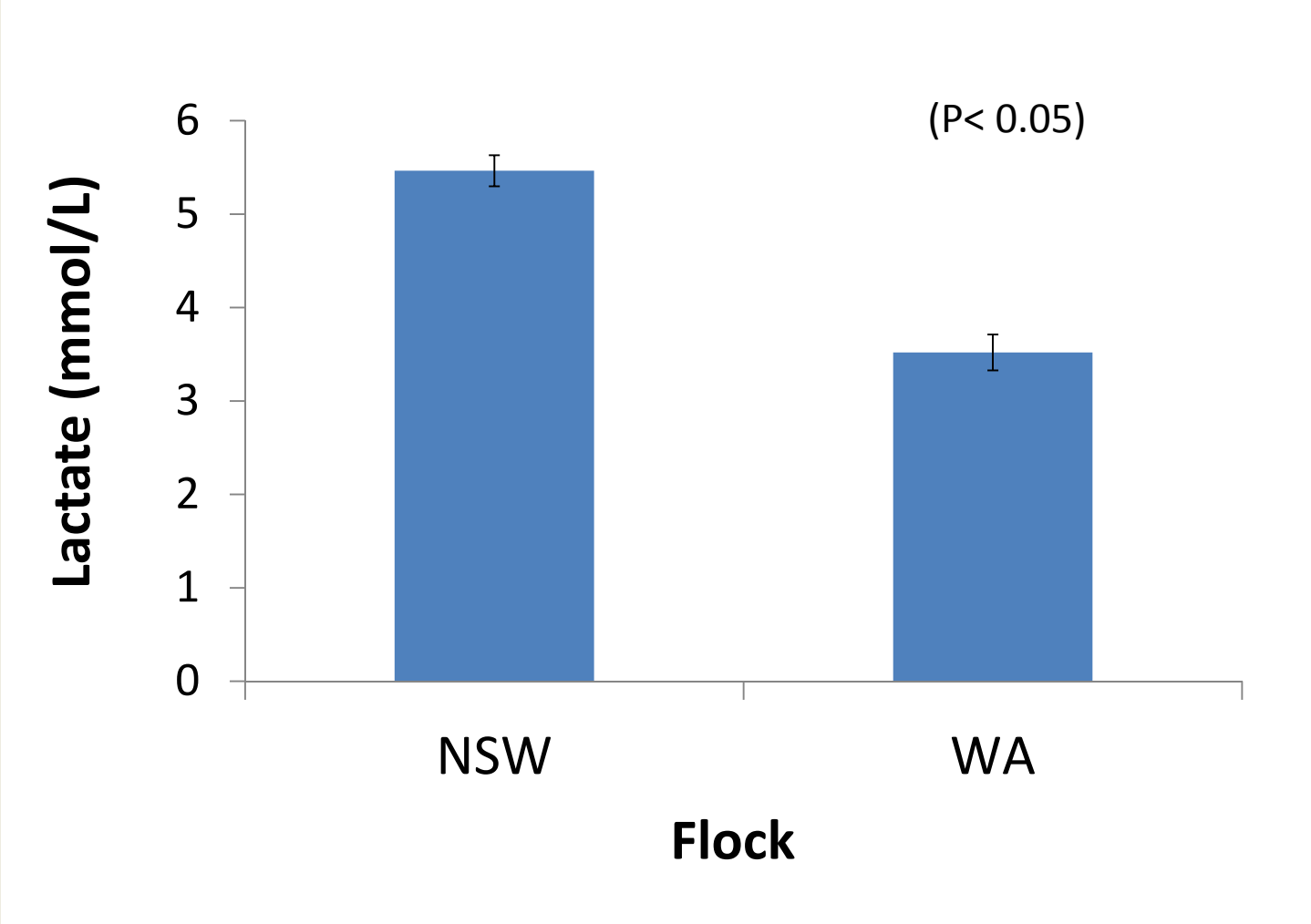
- **Expect similar results to beef cattle @ slaughter (uncontrolled hypothesis!)**

What factors affected metabolites?

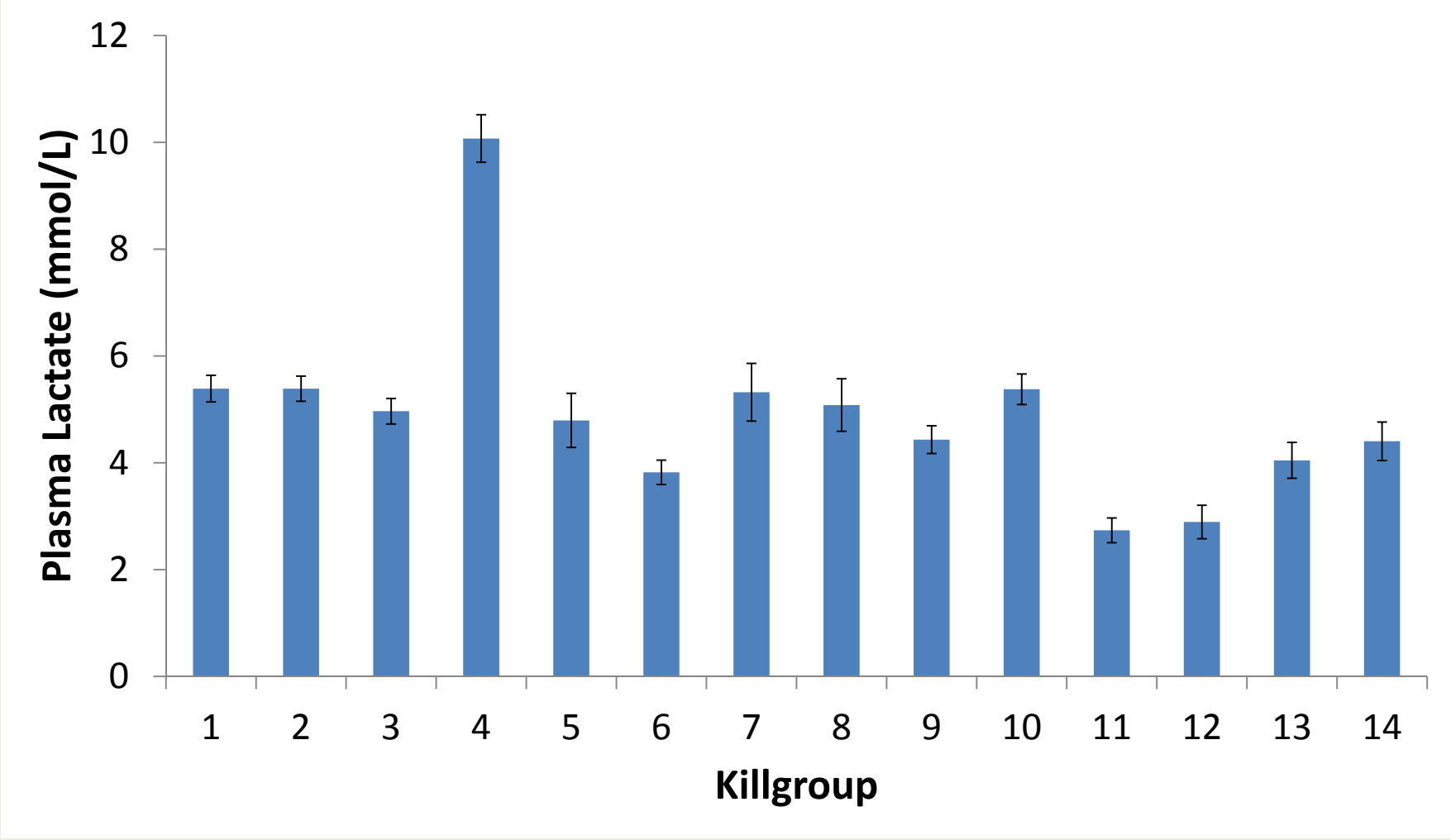
	LACTATE	GLUCOSE	NEFA
Flock	✓	✓	✓
Killgroup	✓	✓	✓
Killorder	✓	✓	✓
Siretype	✓	✗	✓
Sire	✓	✓	✓

P<0.05

Flock effect



Killgroup effect



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Flock	✓	✓	✓
Killgroup	✓	✓	✓
Killorder	✓	✓	✓
Siretype	✓	✗	✓
Sire	✓	✓	✓

Hypothesis

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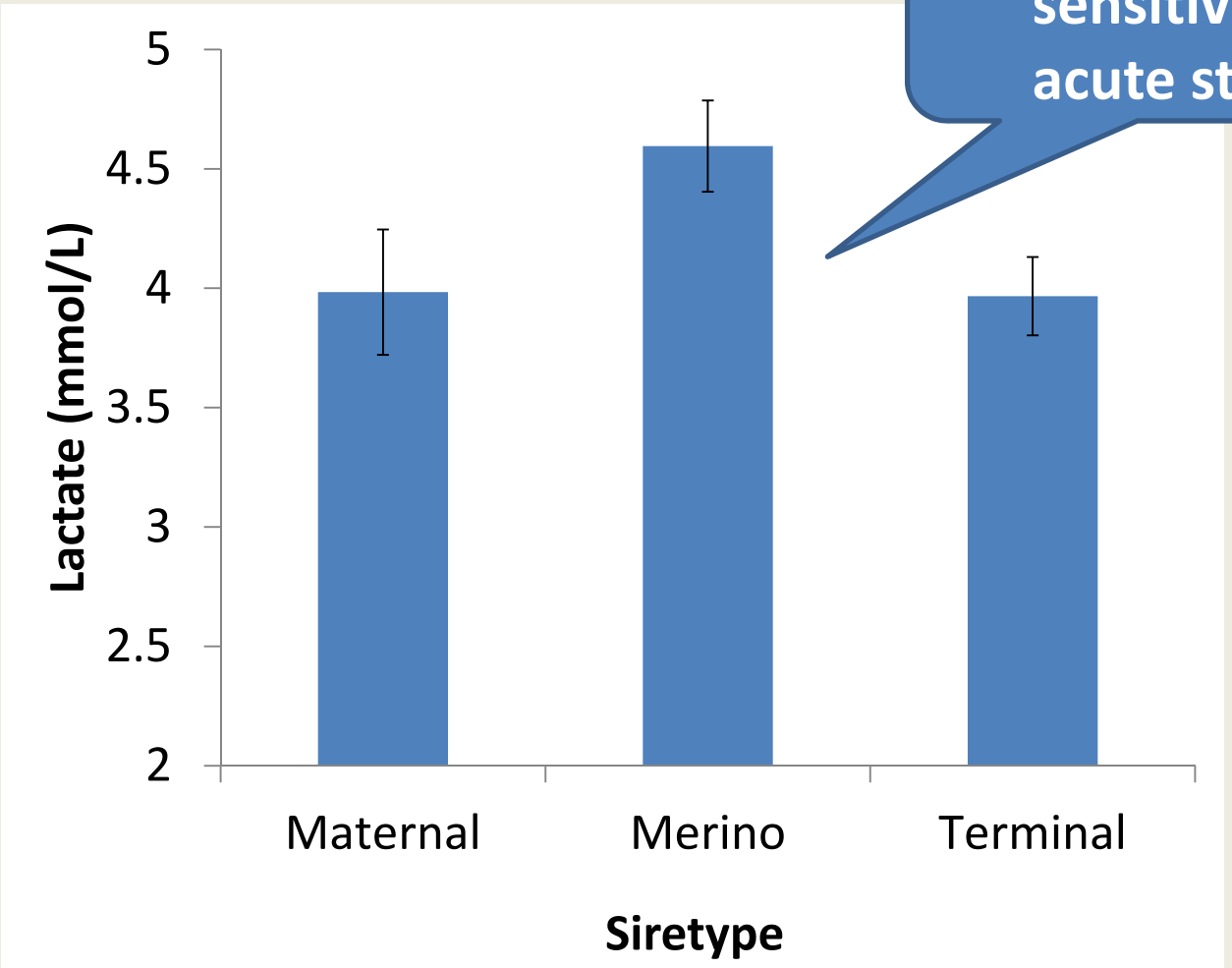
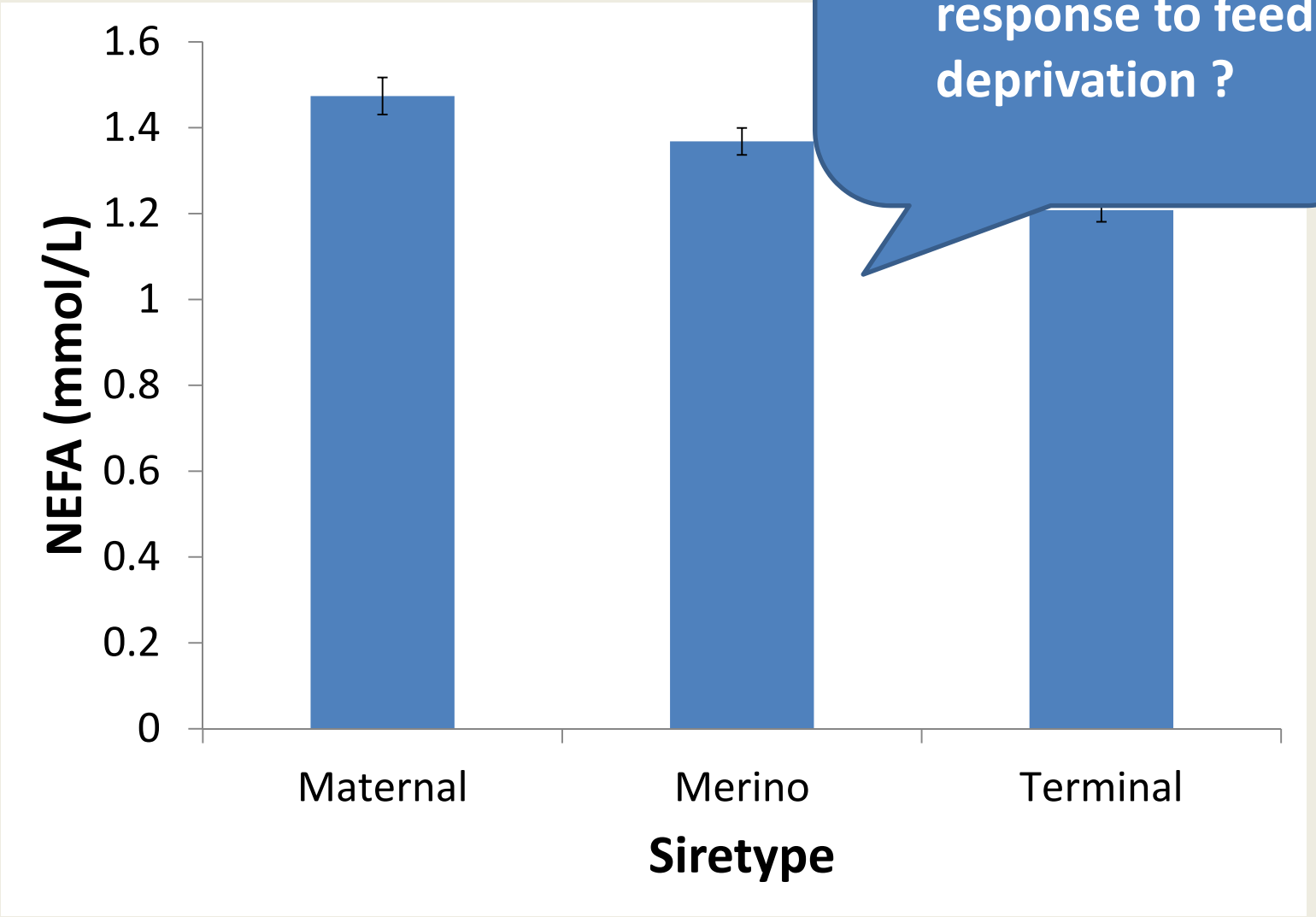
  - Flock
  - Killgroup
  - **Breed type (merinos)** ?
  - Time/order of slaughter

Merinos have higher lactate



Gardner et al 1999

NEFA



Turnover rates for adipose tissue in response to feed deprivation ?

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  - **Breed type (merinos)**
  - Time/order of slaughter

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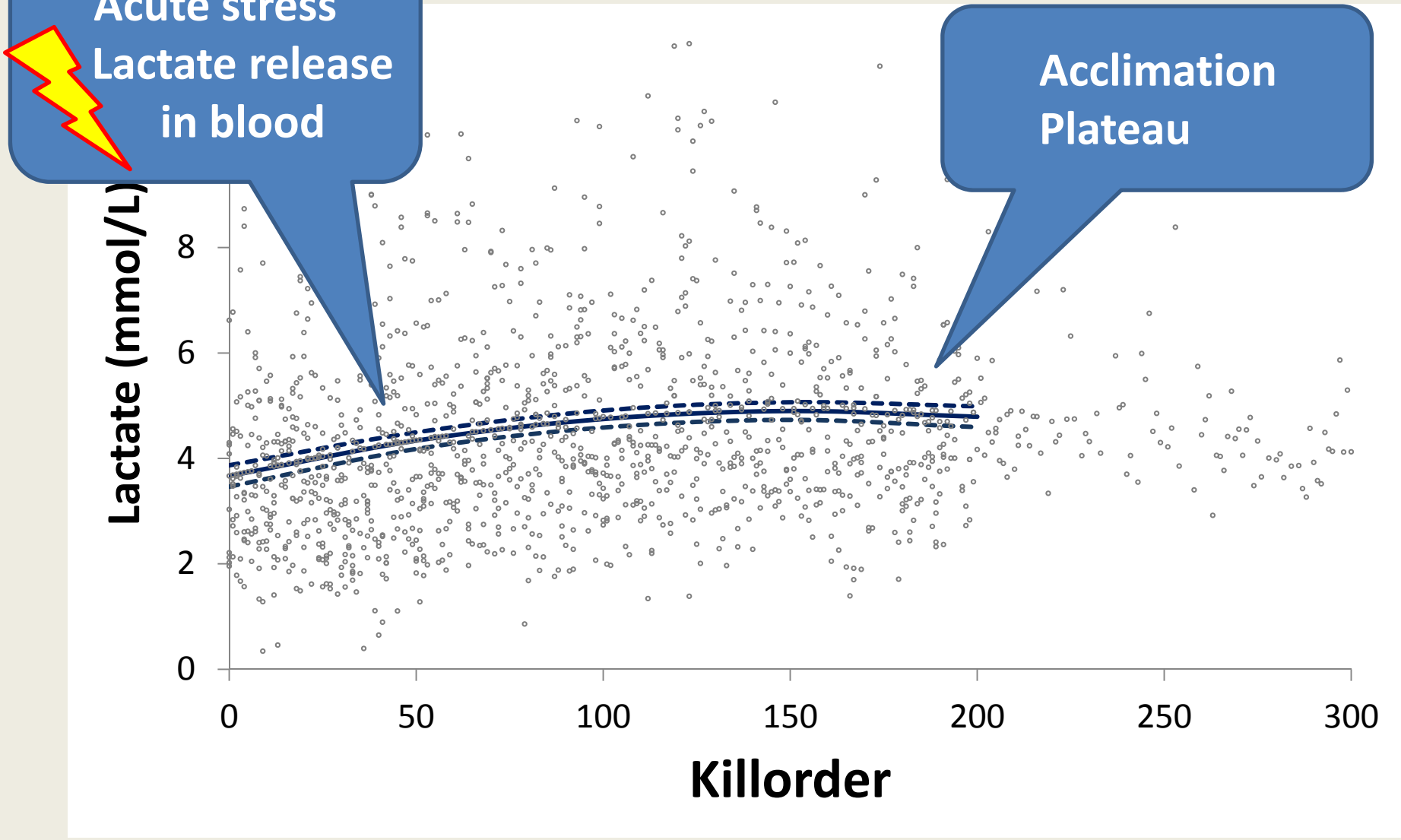
  - Breed type (merinos)
  - **Time/order of slaughter ?**

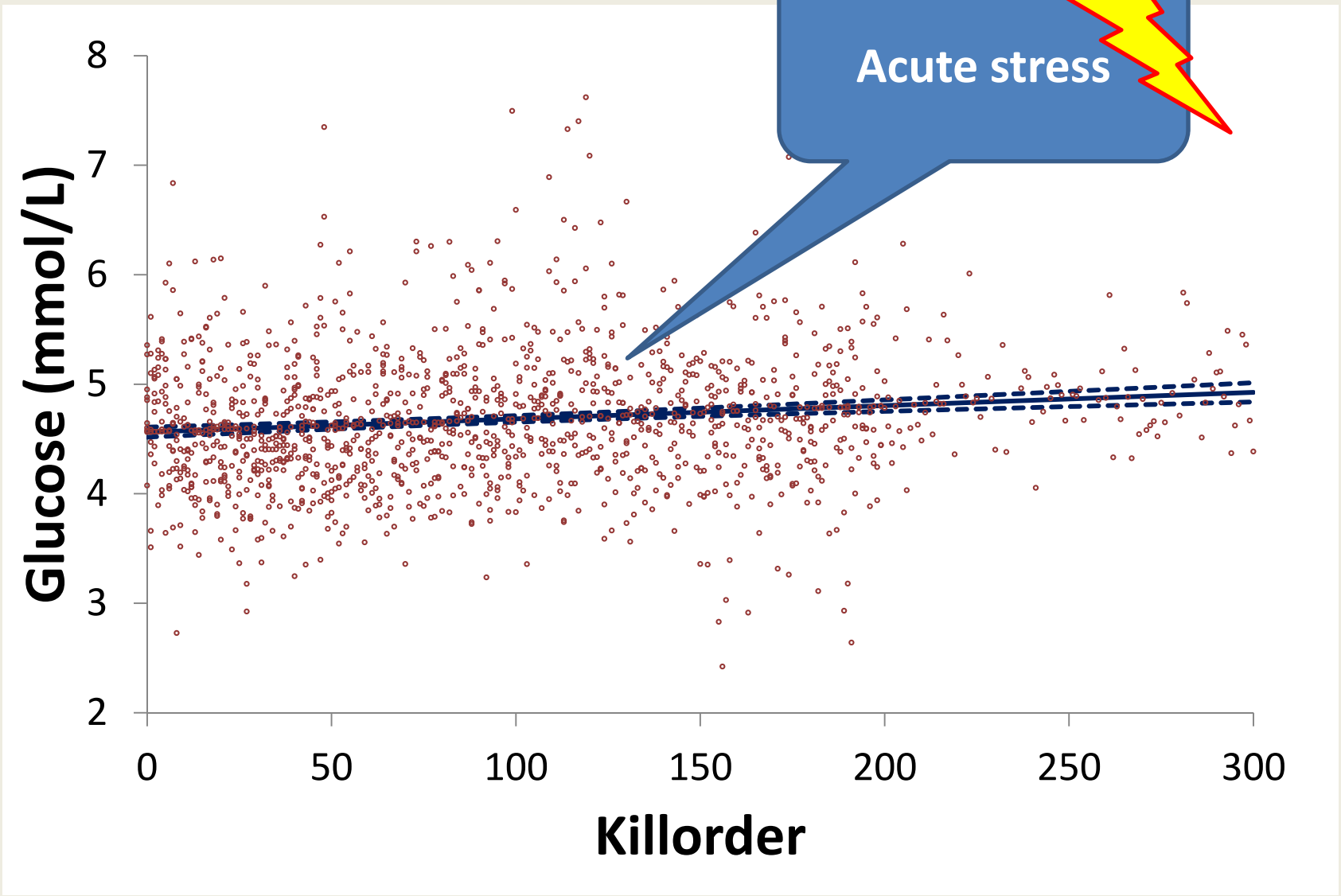
Killorder – Lactate

P<0.05



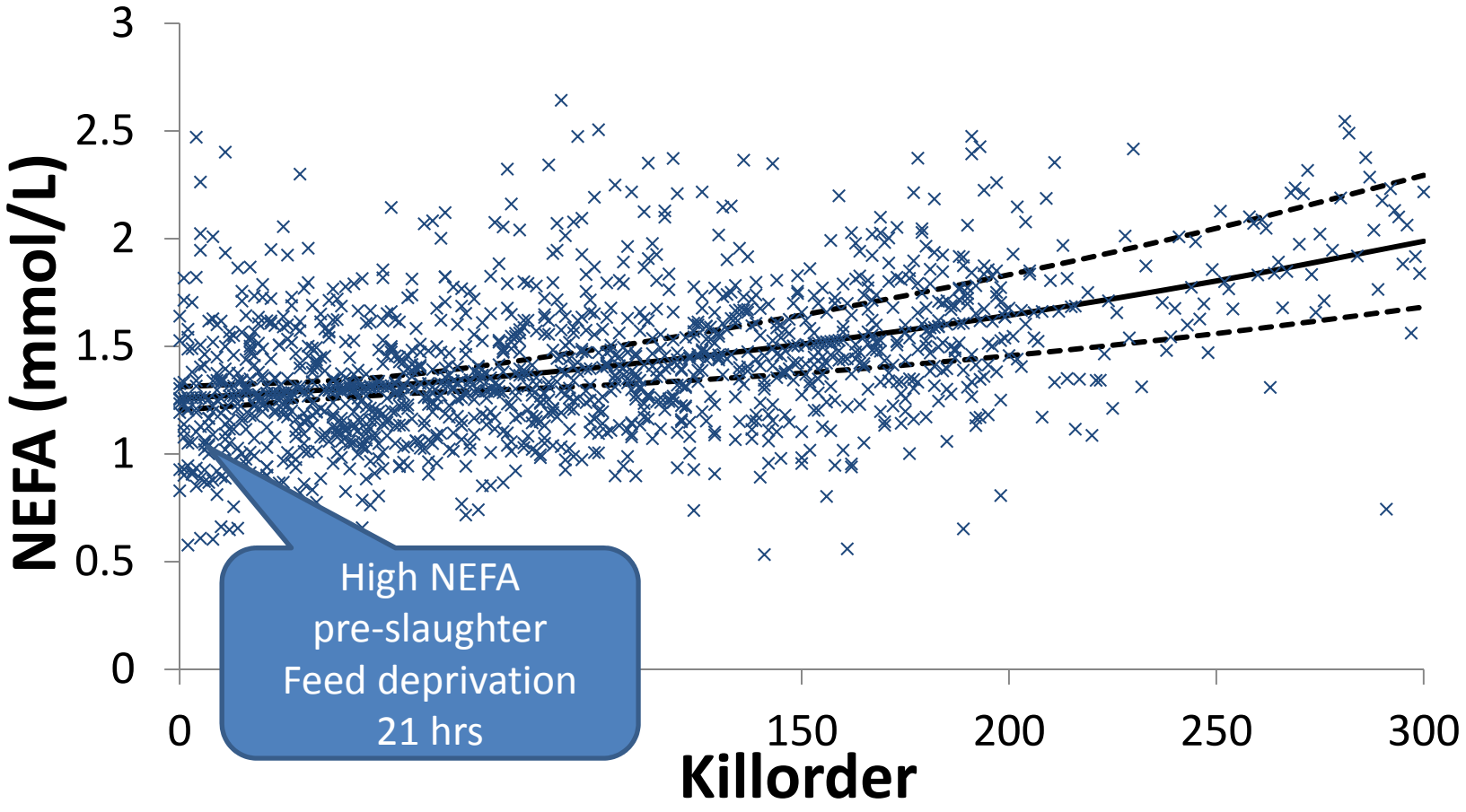
Killorder – glucose

P<0.05



Killorder - NEFA

P<0.05



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Summary

- Variation in metabolites exists between flocks and killgroups
  - Abattoir
  - Pre-slaughter management
- Breed type and genetic (sire) effects
- Killorder influenced metabolites
  - Exposure to acute stress
  - Hierarchy effect

Further work

- Suite of physiological parameters @ slaughter
- Relate to carcass and meat quality
  - Yield and composition
  - Shear force, IMF, colour, pHu
  - Sire genetics
  - Consumer sensory panels
- Biomarkers of lamb meat quality and yield
- Best practice pre-slaughter management

Thank you!