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Glucocorticoids as Biomarkers for Feed Efficiency in Cattle

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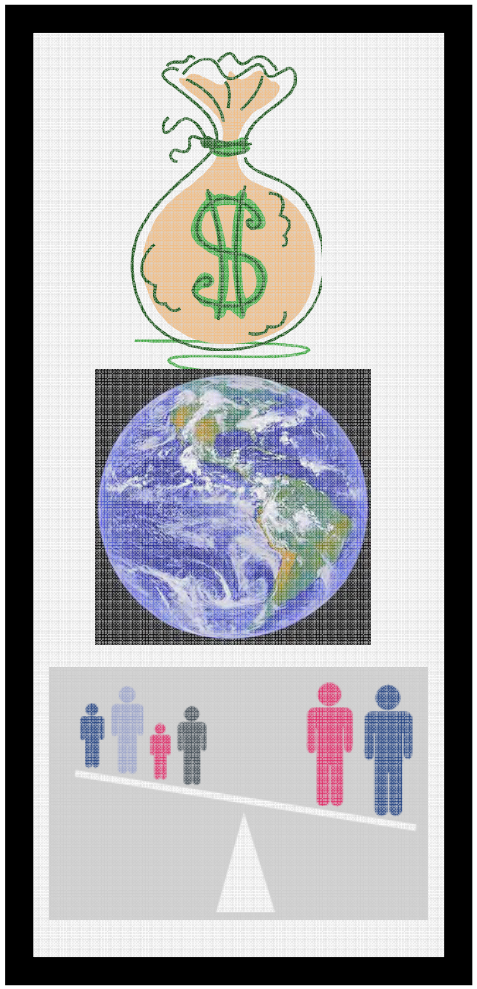
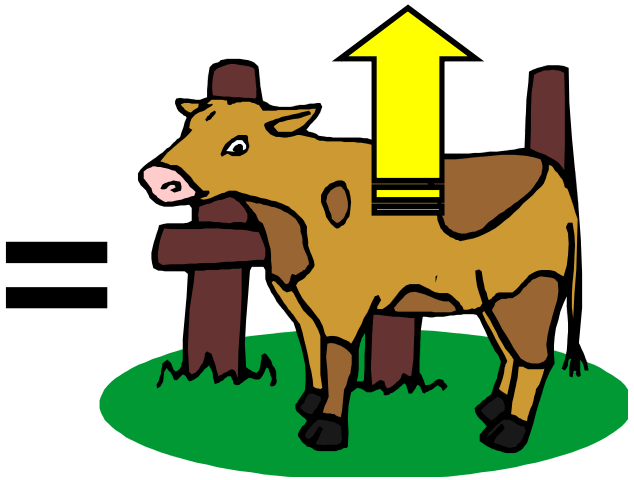
Outline

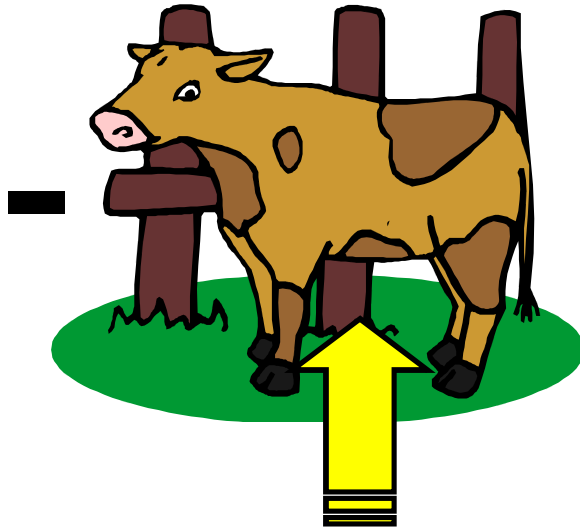
- Why biomarkers for feed efficiency?
- Why glucocorticoids?
- Methodology and resources
- Results and comments
- Conclusions and final remarks

Background



- Products

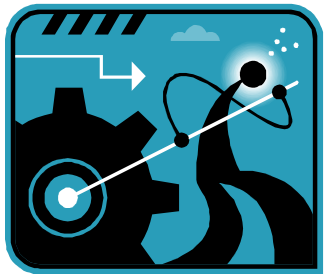




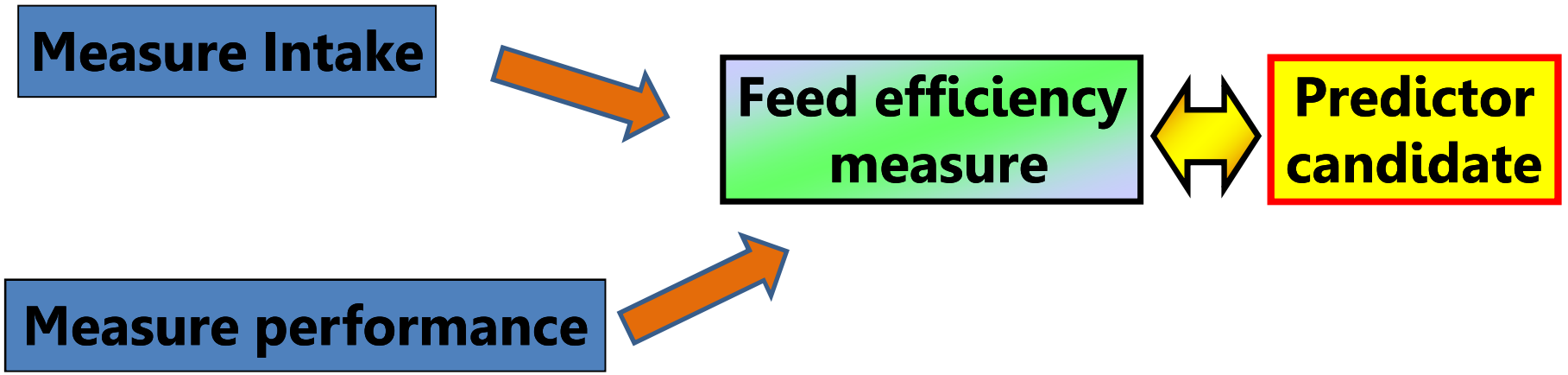
- Intake

Background

- Measuring feed intake :

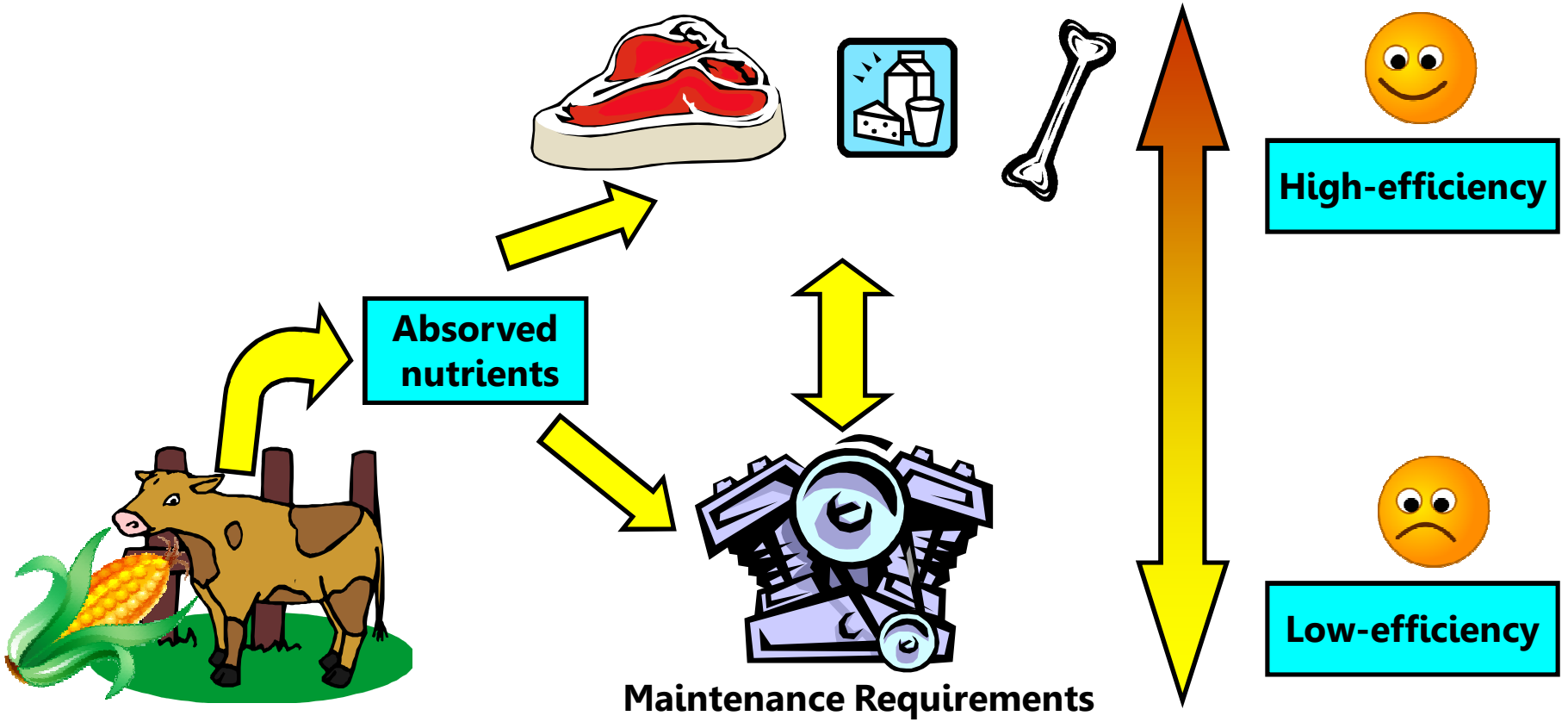

- Predicting feed intake:



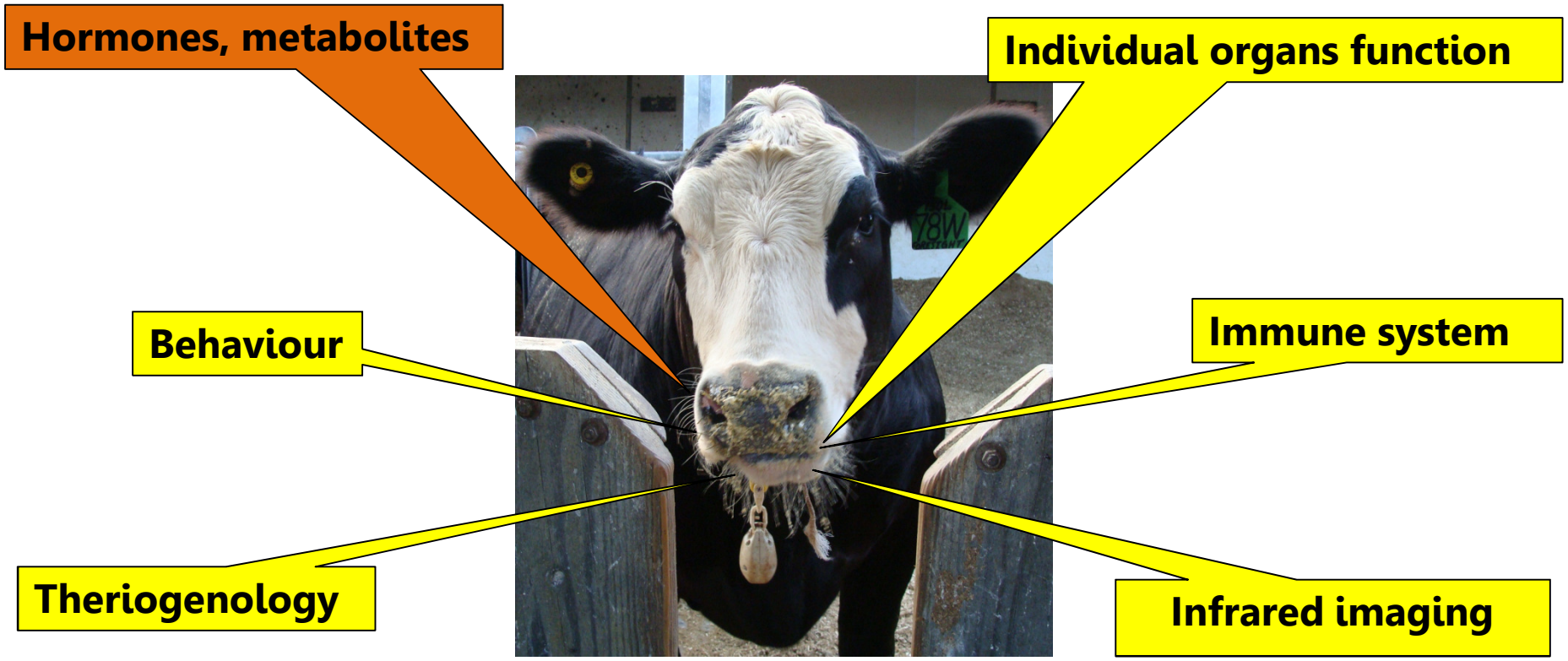
Background

Residual feed intake (RFI)

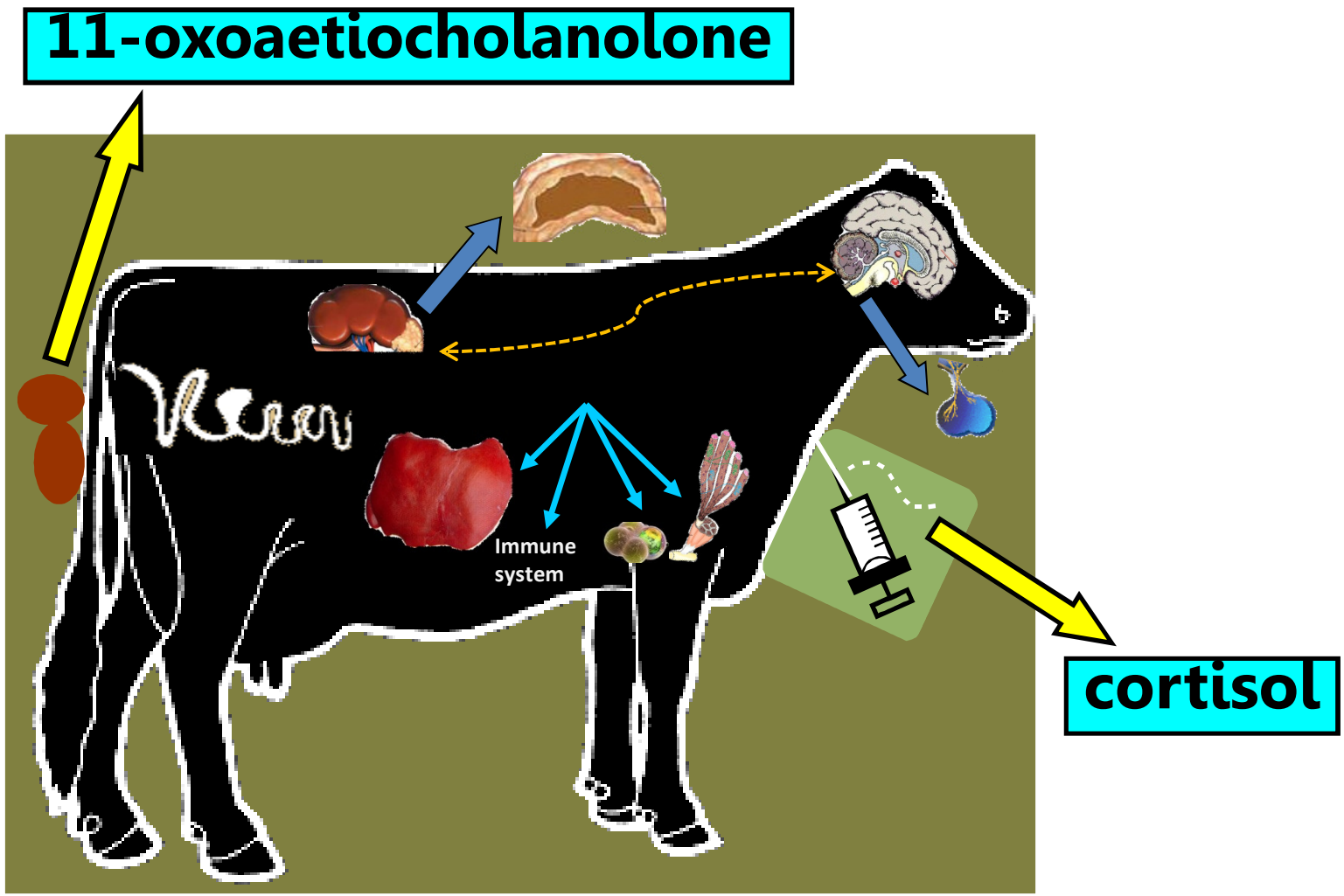
$$RFI = DMI_{observed} - DMI_{estimated}$$



Background

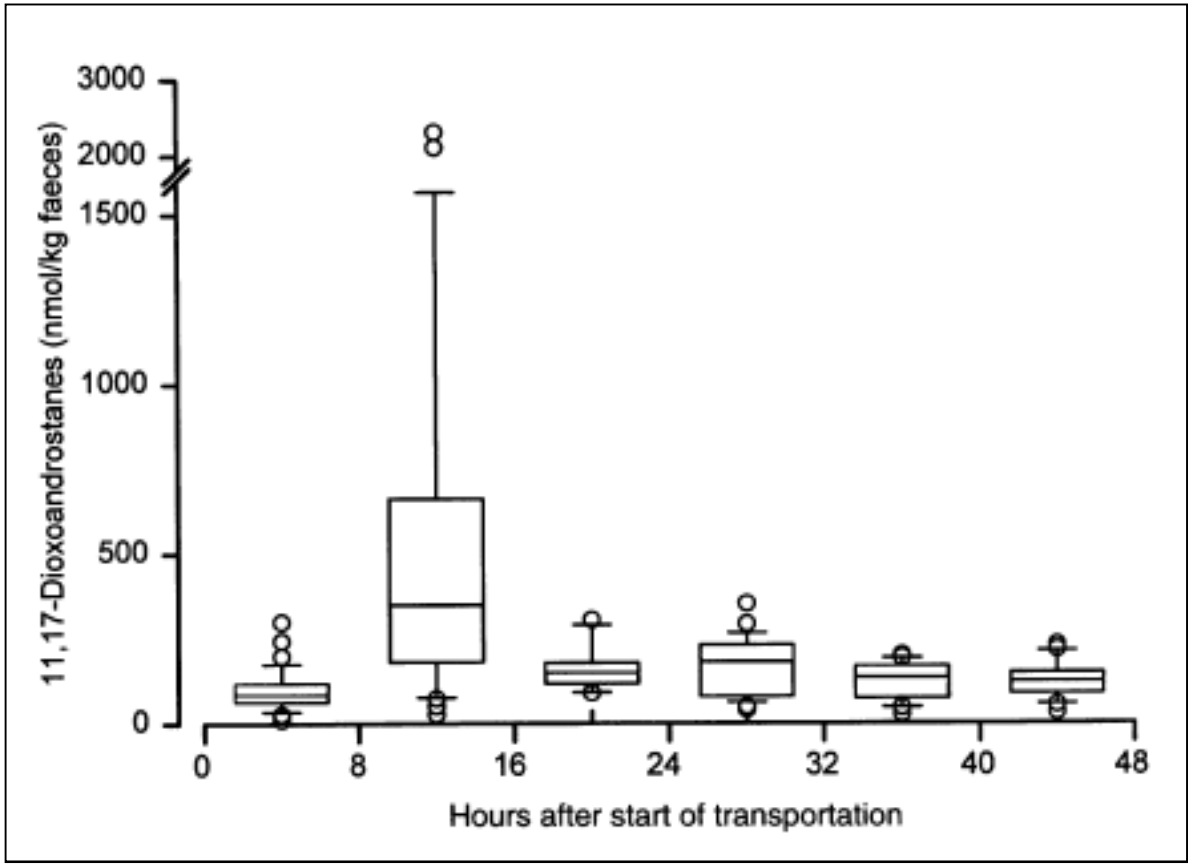

Hormones, metabolites
Individual organs function
Behaviour
Immune system
Theriogenology
Infrared imaging
CALORIMETRY

Background



Background

- **FCM: plasma cortisol response with 12h lag time**

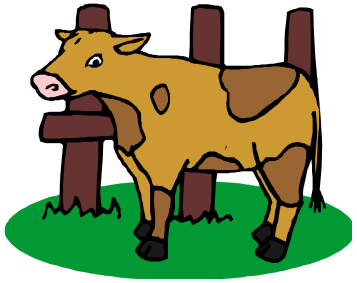


Palme et al. 2000

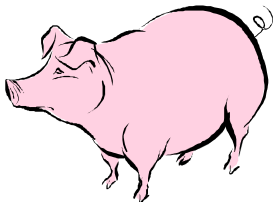
Background

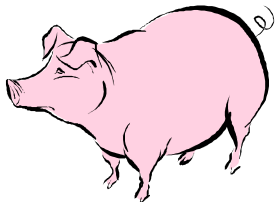
	High-efficiency	Low-efficiency	P-value
FCM (ng/g)	51.1[a]	31.2[b]	0.040
PLC (ng/mL)	40.9	41.3	0.944

Montanholi et al., 2010



- Geverick et al. 2002 & 2004:
  - Calmer ↑ Cortisol basal
  - Calmer ↑ Energy efficiency





- Voisnet et al. 1997:
  - Calmer ↑ feed efficiency

Hypothesis

- **Cattle with superior feed efficiency may have greater baseline levels of cortisol as indicated by the FCM concentration.**

Objectives

- To verify if the relationship between feed efficiency and FCM holds in a larger population of cattle with more samples collected over time.

- To compare PC levels measured over the circadian cycle in cattle with distinct feed efficiency.

Materials and Methods

- 50% Simmental or Angus crossbred cattle
- 112 steers -> 8 pens
- **Feedlot ration:**
  - 78% high moisture corn
  - 13.5% haylage
  - 5% soybean meal
  - 3.5% premix (monensin, salt, trace minerals, vitamins – soybean meal)

Materials and Methods

$$RFI = FI_{observed} - FI_{predicted}$$

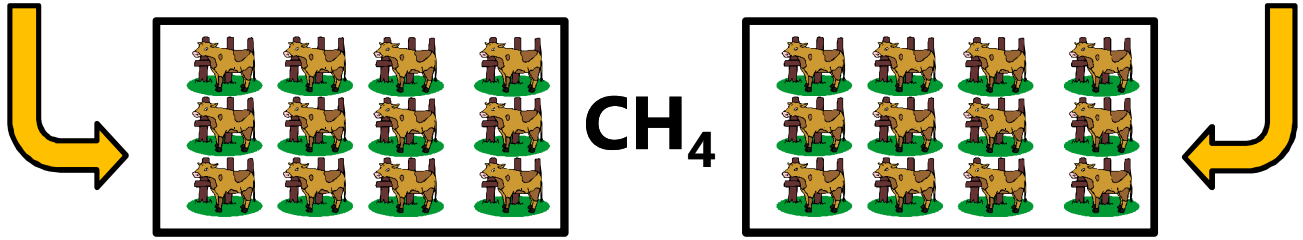
$$FI_{observed} = FI_{predicted} + RFI$$

$$FI_{observed} = \alpha_0 + \beta_1(ADG) + \beta_2(WT) + \beta_3(BKFT)\ \beta_4(RBEA) + RFI$$

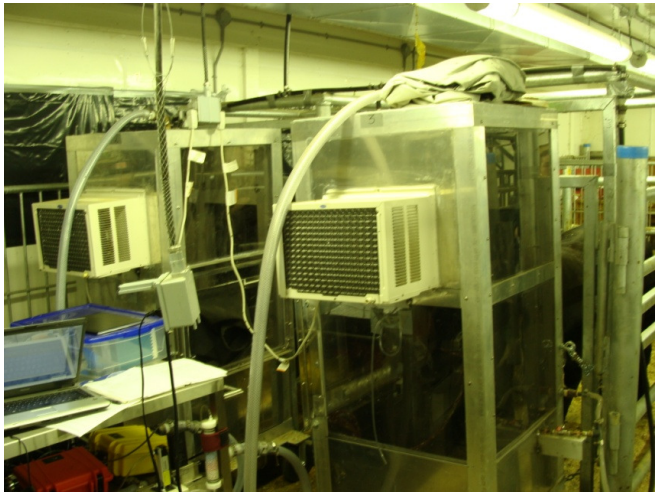
Materials and Methods

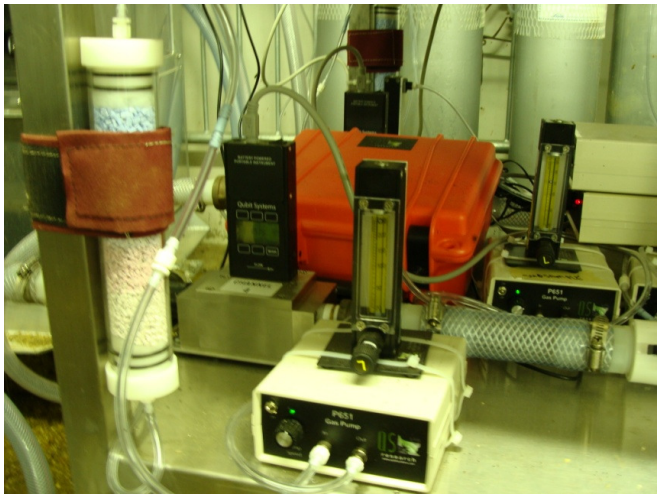
Tested for Feed efficiency - RFI

Tested for FCM



Materials and Methods





Materials and Methods

FCM and plasma cortisol determinations

- Blood plasma: RIA - Coat-A-Count®cortisol (ng/ml)
- Fecal extract: EIA – (Möstl & Palme, 2002) (ng/g)

CH_4 determination

➢ **STP conditions:**

Vstp = (V_measured (L/s) * 2.697) / (Room_Temp (K) / Barometric _Pressure (kPa))

➢ **CH4 volume (ml/min):**

VCH_4 = V_outlet air flow (L/s) *Difference inlet and outlet concentration (mL/L)

Materials and Methods

Statistical analysis

➢ **GLM procedure:**

To compare feed efficiency groups (32 vs. 32 and 12 vs. 12).

➢ **MIXED procedure:**

To compare repeated measures overtime:

- Plasma cortisol and fecal cortisol metabolites (biweekly sampling, 32 vs. 32).
- Plasma cortisol over the circadian cycle (12 vs. 12).

Results

Productive performance traits and age

Traits	High-Efficiency	Low-Efficiency	P value
Dry matter intake (Kg/d)	9.12 (±0.14)	10.66 (±0.20)	< 0.001
Average daily gain (Kg/d)	1.91 (±0.04)	1.92 (±0.06)	0.7265
Feed to gain ratio	4.83 (±0.13)	5.63 (±0.17)	< 0.001
Residual feed intake (Kg/d)	-0.74 (±0.07)	0.76 (±0.09)	<0.001
CH_4 production* (ml/min)	493.4 (±21.78)	680.2 (±20.57)	0.0834
Age start of trial (d)	257.19 (±3.37)	266.31 (±4.78)	0.6909

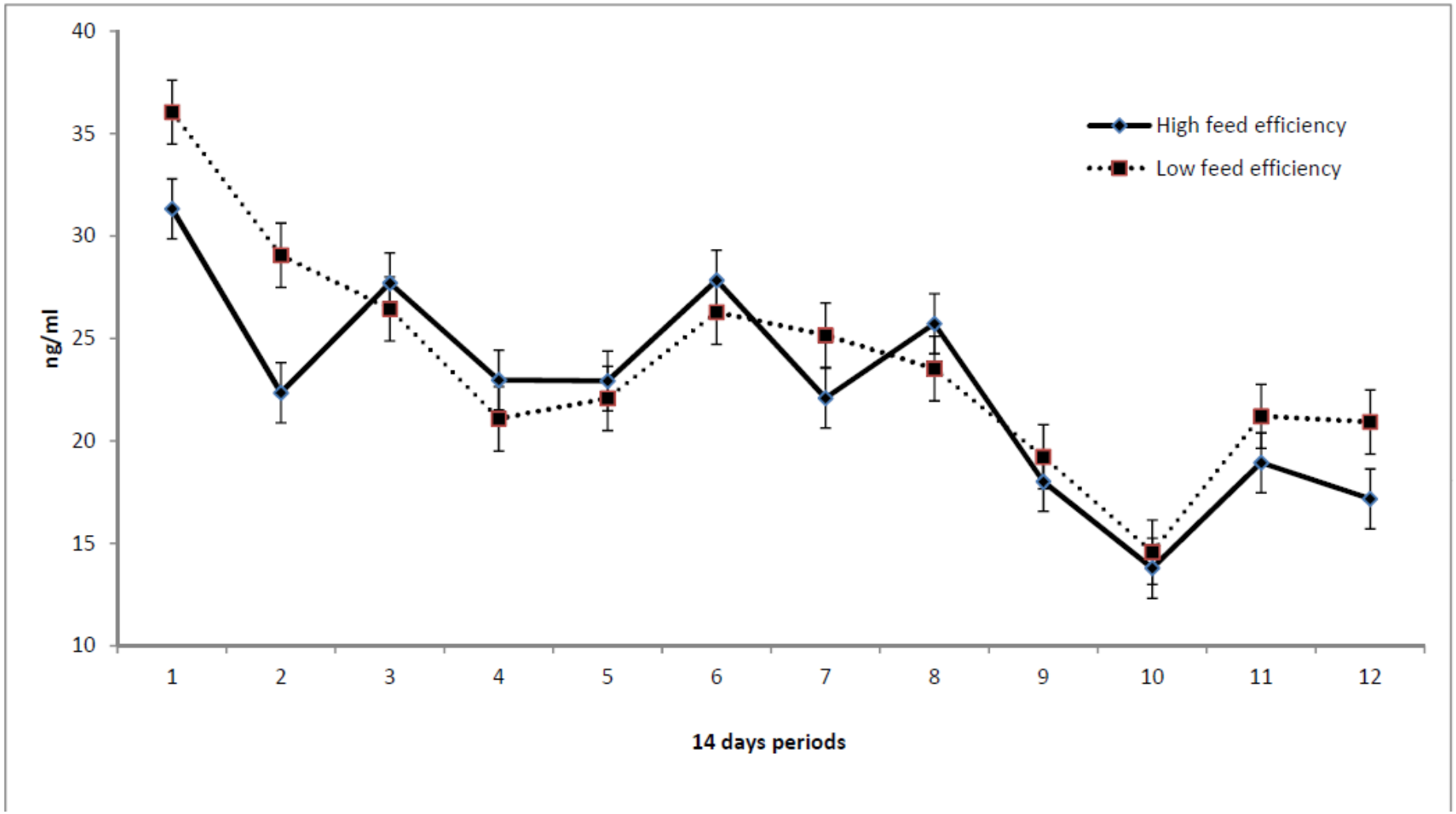
Results

Ultrasound and body weight traits

Traits	High-Efficiency	Low-Efficiency	P value
Backfat thickness start (mm)	2.89 (±0.28)	3.01 (±0.40)	0.7757
Backfat thickness end (mm)	12.49 (±0.81)	13.07 (±0.57)	0.4806
Ribeya area start (cm^2)	59.11 (±1.00)	58.83 (±1.40)	0.8417
Ribeya area end (cm^2)	108.00 (±1.39)	108.41(±1.97)	0.8389
Body weight start (Kg)	330.7 (±7.76)	335.1 (±10.98)	0.6906
Body weight end (Kg)	513.7 (±8.38)	520.2 (±11.86)	0.5827

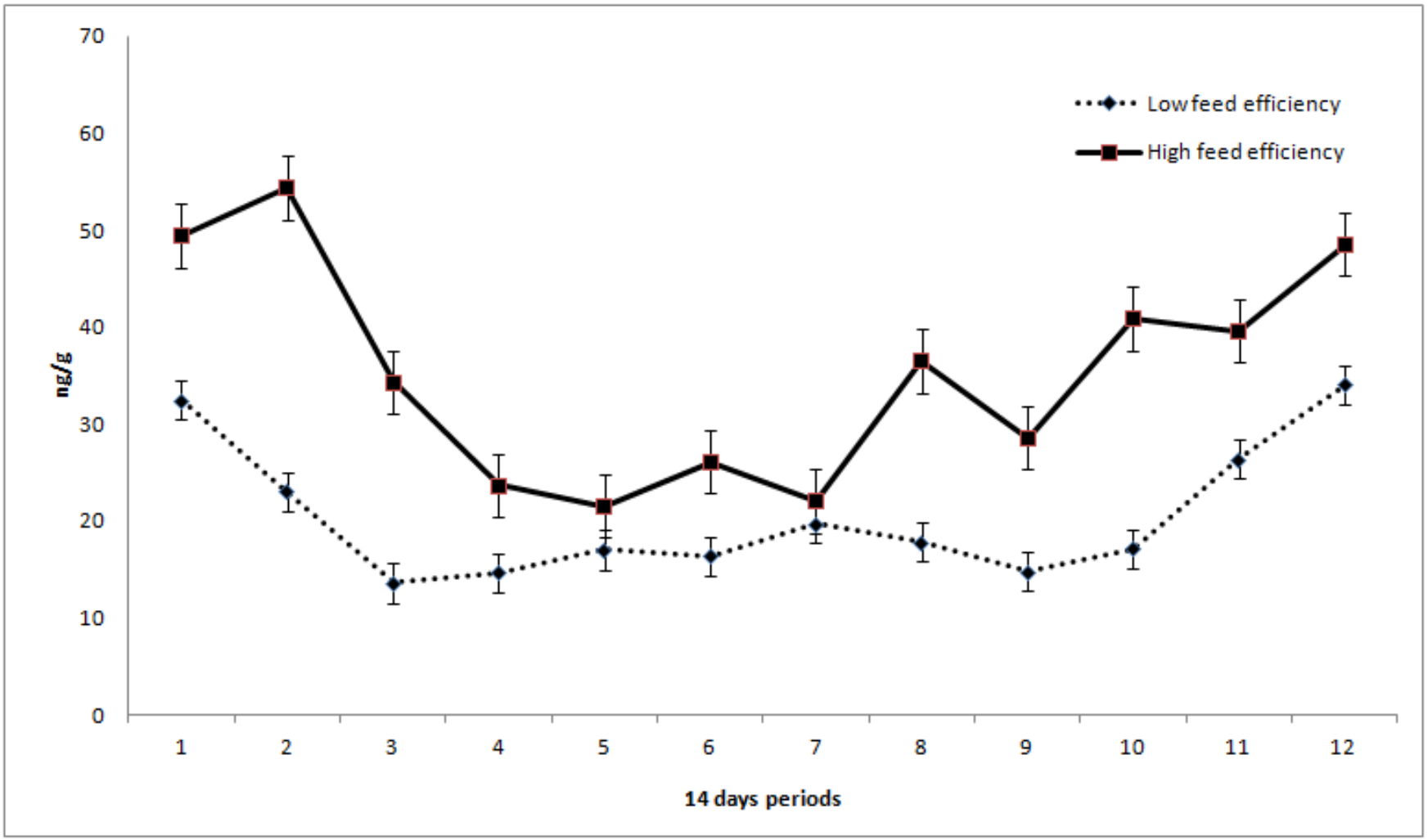
Results

Plasma cortisol – biweekly sampled



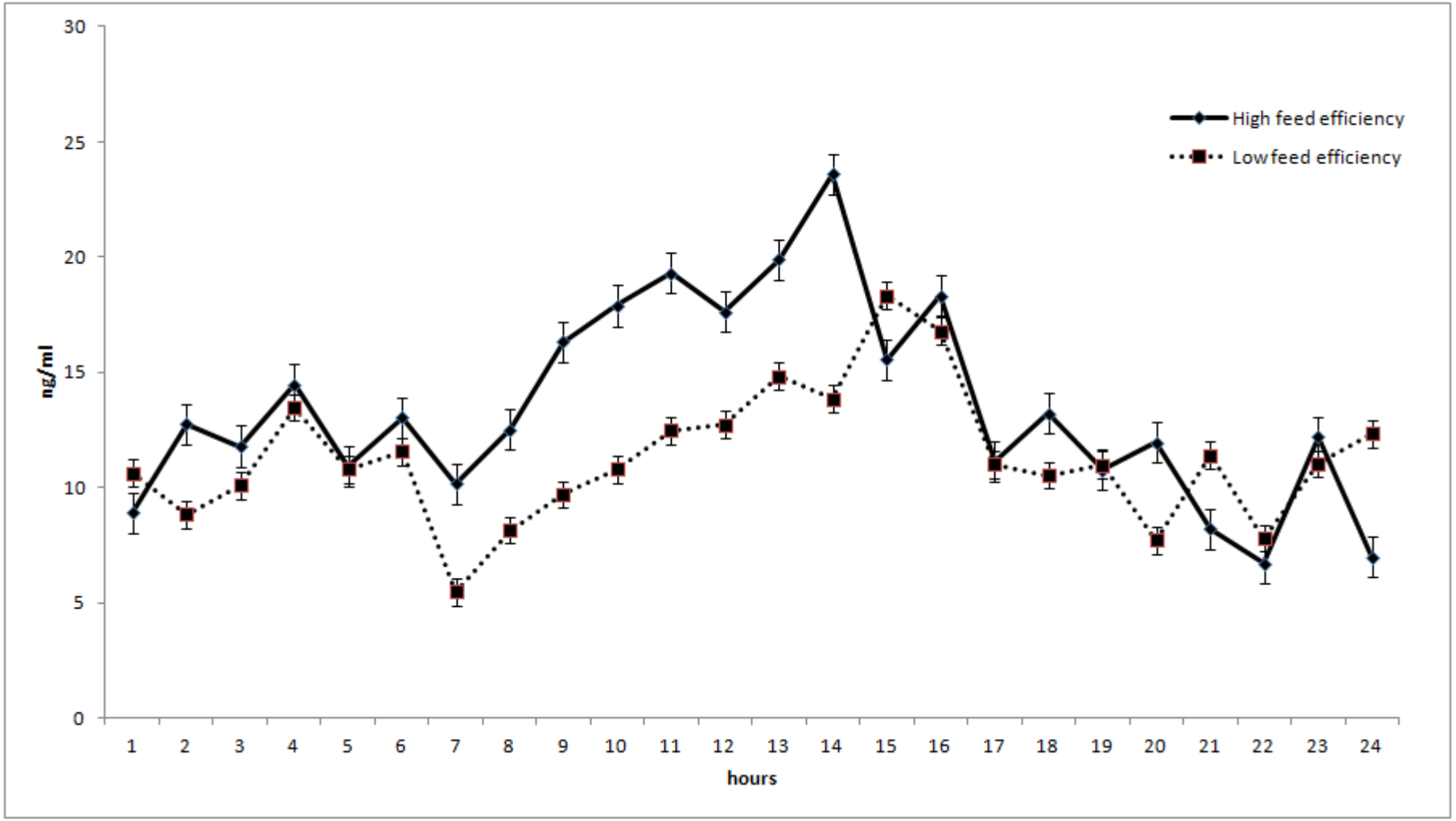
Results

Fecal cortisol metabolites – biweekly sampled



Results

Plasma cortisol – hourly

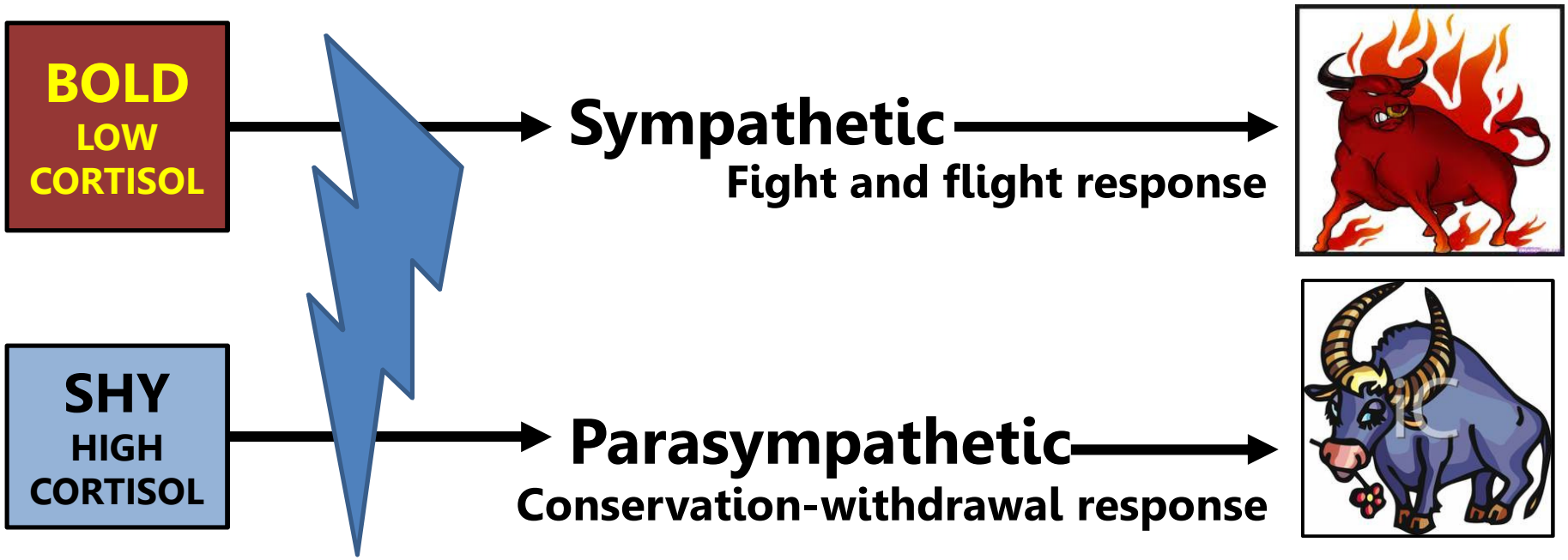


Discussion

Endogenous steroids as growth promoters

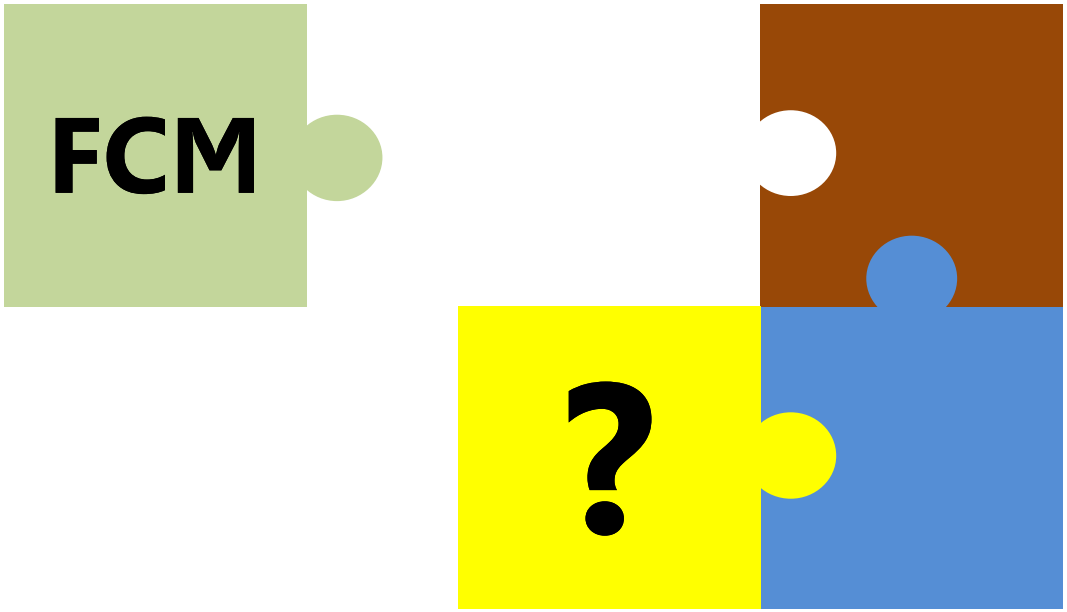
(Fritsche et al., 1999; Courtheyn et al., 2002; Cannizo et al., 2011)

Coping styles (Koolhaas et al., 1999)



Conclusions

- **This study provides further evidences of the association between feed efficiency and fecal cortisol metabolites in beef cattle.**



Further investigations

- Long term profiles for FCM
- Different animal categories
- Different physiological conditions
- Different husbandry systems

+

SOP for FCM assessment

Acknowledgments

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Ontario Innovation Trust

Canada Foundation for Innovation
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Agriculture and Agri-Food Canada

Cattlemen Committed to Cattlemen

Ontario

BCRC
Beef Cattle Research Council
A division of the Canadian Cattlemen's Association