Modelling energy partitioning and milk production performance in grass based suckler beef systems

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Background

Suckler beef production system in Ireland

- Beef sector accounts for 35% of agricultural output (DAFM, 2014)
- More than 50% of beef output value is from the suckler herd (DAFM, 2016)
- The most competitive advantage - Grass based production system (cost of production is lower)
Typical production cycle

Cows calve close to start of grazing season

Cows and calves graze together for first season at grass

Weaning of calves - autumn followed by housing

Weaning weight of calves - key output in suckler beef systems
Modelling

Strategies for improvement in key output

- It is necessary to know how the energy intake is transformed to
  - Homeostasis functions e.g. maintenance
  - Homeorhesis function e.g. pregnancy, lactation

Impacts on productive outputs in suckler beef systems

Modelling: - Low cost, no harm, timely and effective
- Models on animal and farm level
- Model on energy partitioning and production performance in grass based systems are lacking.
Objective

To develop a dynamic model of energy partitioning and milk production performance in grass based suckler beef systems.
Materials and methods

- Data and parameters: Published literature, INRAtion software
- Irish Net Energy System – UFL (I) (1 UFL = 7.1 MJ)

Software: A dynamic modeling - Stella (V9.0): day 1 to 890 days
Model description

- Two suckler beef cow genotypes representing alternative suckler cow replacement strategies in Irish suckler herds are used
  - Beef – Late maturing beef cows (B) - sourced from suckler herds
  - Beef x Holstein Friesian (BF) - sourced from dairy herds

Model consists of 4 modules

- Energy intake module
- Energy partitioning module
  - Maintenance, pregnancy, lactation, growth
- Milk production module
  - Breed, parity, lac curve
- Live weight change module
Energy calculation equations

**Energy intake**
- Grange Suckler Beef System Model (Crosson et al., 2006).

**Maintenance requirement** (Jarrige, 1989; Jouven et al., 2008)

- 1.4+0.6 × LW/100+0.099(2.5-BCS) × (1+Grazing Activity) -------Eq 1

**Pregnancy requirement** (O’Mara, 1996; Jouven et al., 2008)

- Parity 1= 0.0001 × d² - 0.0170 × d+0.312 ------------------------Eq 2
- Parity 2= 0.0001 × d² - 0.0158 × d+0.312 ------------------------Eq 3

**Milk production requirement** (INRAtion, Crowley et al., 2001)

- 1 kg of milk produced = 0.45 UFL ------------------------ Eq 4
- Depends on lactation curve of the cows
Energy calculation equations

Lactation curve

Woods equation (Wood, 1967) fitted to Irish data for Beef and Beef dairy crossbred (McGee et al., 2005). Wood equation is: \[ y = at^b(e)\times -ct \]

where:
- \( a \) = initial milk yield,
- \( b \) = increasing rate until peak
- \( c \) = declining rate after peak
- \( t \) = days in lactation

- **Beef parity 1 and 2**
  \[ 6.9 \times t^{0.072} \times (e)^{-0.0022} \times t \] Eq 5
  \[ 7.8 \times t^{0.072} \times (e)^{-0.0018} \times t \] Eq 6

- **Beef*Dairy parity 1 and 2**
  \[ 8.4 \times t^{0.068} \times (e)^{-0.0022} \times t \] Eq 7
  \[ 10.1 \times t^{0.068} \times (e)^{-0.0016} \times t \] Eq 8

Cow performance (INRAtion, Jouven et al., 2008)

- LW gain of 1 kg = 4.5 UFL
- LW loss of 1 kg = 3.5 UFL.

- LW initial = 440 kg (B) - 65% of Mature weight (680 kg)
  \[ = 410 \text{ kg (BF)} - 65\% \text{ of Mature weight (630 kg)} \]
  \[ = \text{BCS initial} = 2.0 \]
Results

Energy intake by cows

The Irish Agriculture and Food Development Authority
Maintenance requirement

Predicted maintenance energy requirement

The Irish Agriculture and Food Development Authority
Pregnancy energy calculation

Pregnancy energy requirement and supply for B and BF cows

Days (d)

UFL

Requirement
B supply
BF Supply

Reserves
Lactation Energy

Lactation energy requirement for B cows

Lactation curve × 0.45 UFL
Lactation Energy

Lactation energy requirement and supply for B cows

Ave. MY
I parity – 7.3 kg/d
II parity – 8.7 kg/d

Days (d)
Lactation Energy

Lactation energy requirement and supply for BF cows per day

Days (d)

UFL

Requirement
BF supply

The Irish Agriculture and Food Development Authority
Live weight change of cow

Live weight evolution in cows

Days (d)

Kg

1  61  121  181  241  301  361  421  481  541  601  661  721  781  841

Calving

Calving

B

BF

The Irish Agriculture and Food Development Authority
Conclusion

❖ A dynamic model of energy partitioning and milk production performance has been developed

❖ Energy intake in suckler beef cows
  ❖ Currently, it is limiting particularly late gestation and post calving (3 months)

❖ Milk production of cows
  ❖ Ability of cows to mobilize live weight

❖ Future work will look on validation, expansion to calf model and economic analysis.
Thank You

Questions, Comments and Suggestions