Variable nutritional trajectory contributes to the robustness of beef cows whatever their body condition at calving
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_01 Context

Beef suckling cows & french beef cattle production systems

Charolais cows: late maturing beef breed

carcass weight ≈ 450 kg
The concept of ROBUSTNESS:

Numerous definitions

The robustness is a property that accounts of the ability of a system to maintain its function despite external or internal perturbations

Kitano, 2004

⇒ At the animal level, the robustness is defined as its ability to maintain its functioning and being resilient when facing environmental disturbances

Strandberg, 2009

⇒ Such a capacity relies on adaptive abilities of animals that may involve trade-off between life functions when environment becomes limiting
From a systemic point of view

In changing environment

Dynamic biological system

Production

Main biological functions
- growth, maintain itself
- produce
- reproduce

Over a productive cycle

⇒ Trade-off between functions

⇒ Cows have to reach an optimal resources allocation to achieve functions whatever the environmental constraints

That question has been considered in high-producing dairy cows
(Kirkland and Gordon, 2001
Friggens and Newbold 2007, Martin and Sauvant, 2010...)

Robustness of suckling beef cows?

What indicators?
The cow as an active system

E_{\text{residual}} = E_{\text{intake}} - E_{\text{(production and tissue growth)}}

- **E_{\text{intake}}**: Digestive and metabolic processes
- **E_{\text{production and tissue growth}}**: Production / Reproduction
- **Body reserves**
- **Metabolism**
- **Maintenance**
- **Growth**
- **Overall metabolism**
Objectives:

To propose an indirect approach to apprehend robustness in beef cows

- Differences in Eresid between cows experiencing from calving a variable nutritional trajectory and cows subjected to a non limiting (=stable) nutritional trajectory

- Test the impact of initial body condition at calving on Eresid
Material and methods
The nutritional challenge involving adaptive response to changing environment

Constraining period (120 days)
- 40 multiparous charolais cows
  - Calving (d 0)
    - Fat cows (BCS = 2.8 ± 0.08)
    - Thin cows (BCS = 2.0 ± 0.04)

Feeding
- Energy level
  - Stable
    - FS (n=9)
  - Variable
    - FC (n=9)
  - Stable
    - TS (n=9)
  - Variable
    - TV (n=10)

Requirements
- d 120
  - 39 MJ/d

Recovery grazing period (76 days)
- 40 ares per cow/calf pair
- Non-limited permanent pasture with high nutritive quality

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Calculation method

Working hypothesis

\[ E_{\text{resid}} = E_{\text{intake}} - E_{\text{lactation}} - E_{\text{foetus}} +/- E_{\text{mobilized \/retained tissues}} \]

expressed in **Net Energy for lactation in MJ**

**Constraining period**

- Weight-suckle-Weight method (Le Neindre, 1973)
- Adipose cell size measurements
- Allometric equations (Robelin & Daenicke, 1980)
- Compocow model (Garcia & Agabriel, 2008)

\[ E_{\text{lact.}} = 3.2 \text{ MJ x kg of milk drunk} \]

**Recovery Period**

- Estimation of individual intake of grazed grass using fill unit system (Faverdin et al, 2011)
- NE tissues for 1 kg body mass change = 66.7MJ x %lipids + 39MJ x %proteins
Results
Milk production & ADG of calves

Milk yield (kg/day)

Constraining period (120d)

Recovery period (76 d)

Calf growth rate
0.8 kg/d 1.1 kg/d

Post-partum weeks

Milk production is maintained suggesting the priority of lactation function in beef cows
Body composition changes
Over the nutritional challenge (196 days)

End of the nutritional challenge: recovery of LW and body condition
→ adaptive trajectories: mobilization and reconstitution of body reserves
Eresid variations over the nutritional challenge (196 days)

\[
\Delta \text{Eresid} = 35\% \text{ according to energy level and body reserves at calving}
\]
Energy allocation in Fat and Thin cows

- Energy put in milk is similar between groups (≈ 30% Eintake)
- Body reserves buffer differences between energy supply and requirements

Eresid (MJ/d/kg\(^{0.75}\))

- Thin cows exhibited the same Eresid changes than fat cows

=> no differences in energy allocation
Conclusions / Perspectives
Eresid changes over productive cycle

- Ability of beef cows to maintain milk production in changing environment

- Our experimental design allows to observe Eresid changes
  - $\Delta$Eresid : 35%

- Eresid changes could be an indirect criteria of robustness since reflect safeguarding energy allocation to life functions

Further investigations to validate:
- Relevance of Eresid as a trait of robustness in changing nutritional environment
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Theoretical requirements

- **Constraining period**
  - Days post-partum: 10, 120
  - Nutritional requirements: 70%

- **Recovery period**
  - Days post-partum: 120, 196
  - Nutritional requirements: 120%

**NUTRITIONAL CHALLENGE**