Differences in digestibility between beef cows receiving the same diet contribute to explain differences in feed efficiency

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Introduction

- Feed efficiency (FE) is a major issue for Ruminant production
  - Improvement of ruminant feed efficiency in particular with the use of local food especially grass and forages

- Residual Feed Intake (RFI) : one indicator of the FE
  - Difference between actual feed intake and expected feed intake according to metabolic requirements and production
  - Independant of the production traits (BW, level of production)
Physiological basis for RFI

- Considerable individual animal variation in feed intake as well as in RFI
  [Russell et al., 2016]
- Variability of FE between animals ≈ variability of FE between diets
  [From data of Mialon et al, 2014]
- Contributions of biological mechanisms to Δ RFI, [Richardson & Herd, 2004]
Aim of the study and experimental design

**Determination of individual variability of digestive efficiency**

- Measurement of the apparent digestibility of contrasted diets in two divergent RFI non-pregant non-lactating beef cows.

⇒ RFI ranking: 12 weeks on grass silage diet distributed *ad libitum* when cows were 21 months old

<table>
<thead>
<tr>
<th>RFI (kg DM/d)</th>
<th>ADG/DMI</th>
<th>RFI +</th>
<th>1.02 ± 0.34 kg DM/d</th>
<th>BW = 753 ± 75 kg</th>
<th>BCS = 2.97 ± 0.63</th>
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<tbody>
<tr>
<td>-2.00</td>
<td>0.00</td>
<td>RFI -</td>
<td>-0.73 ± 0.59 kg DM/d</td>
<td>BW = 761 ± 79 kg</td>
<td>BCS = 2.69 ± 0.69</td>
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<td>-1.50</td>
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Δ = 3.09 kg DM/d
**Experimental design**

- RFI +: 1.02 ± 0.34
- RFI -: -0.73 ± 0.59

2 contrasted diets *ad libitum*

- 100% hay
- 67% maize silage
- 33% concentrate (MS+CO)

- 100% hay
- 67% maize silage
- 33% concentrate

4 periods: 2-3 weeks of adaptation + 1 week of total faeces collection
Measurements

- **Individual feed intake**: offers and refusals every day
- Weight of **total faeces collection** for each cow
- **Dry matter** (offers, refusals and faeces): oven at 60°C for 72 h
- **Organic matter** (offers, refusals and faeces): incineration of dried samples at 550°C for 6 h

DMI  OM digestibility (OMd)
Relation of DMI within diets

Maize silage and concentrate diet

\[ y = 0.566 + 6.07 \]
\[ R^2 = 0.51 \]

Hay diet

\[ y = 0.811x + 1.49 \]
\[ R^2 = 0.76 \]

Similar results with OM digestibility

- DMI and OM digestibility within diet are repeatable
Results: Dry matter intake (DMI)

- Variability is important among individuals.
- Cows which eat the most hay are globally the ones which eat the most maize silage and concentrate.
- No effect of RFI ranking on DMI ($P=0.27$), even when expressed per kg BW, $BW^{0.75}$.

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Y = 0.558x + 7.48
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- $\Delta = 4$ kg/d
- $\Delta = 4.7$ kg/d
- $P = 0.03$
- RSE : 0.92
- $r^2 = 0.30$

$\Delta$ = diff. between the largest and the smallest value
OMd ranged from 5.8 (MS+CO diet) to 7 points (hay diet)

The cows’ ranking is similar between diets

OM digestibility is 1.02 > in low-RFI than in high-RFI cows ($P<0.01$)
Conclusions of this experiment

- DMI and OMd vary among animals

- For a given diet, the ranking of cows according to DMI and OMd is repeatable

- Under our conditions, animals with higher feed efficiency exhibit higher digestive efficiency regardless the type of diet
Low-RFI cows tended to have a greater digestive potential than high-RFI cows.

But RFI test and digestibility measurements were not performed in the same time.

*preservation of FE according to physiological stage and diet?*
Thank you for your attention

Acknowledgments:
I. Constant, L. Genestoux, F. Picard, D. Roux for technical expertise, ApisGene (C. Capel) for funding
OM digestibility is 1.02 fold higher in low-RFI than in high-RFI cows.

**Apparent digestibility of OM**

- **OMD (%)**
  - **Maize silage**
    - RFI +: 72.2%
    - RFI -: 73.5%
  - **Hay**
    - RFI +: 64.0%
    - RFI -: 65.1%

**Statistical Analysis**
- Diet: $P<0.0001$
- RFI: $P=0.018$
- RFI*Diet: $P=NS$