Do biomarkers of residual feed intake in beef cattle remain consistent regardless of feeding levels?

G. Cantalapiedra-Hijar¹, K. Nedelkov², P. Crosson³ and M. McGee³

¹INRAE (FR); ²Trakia University (BG); ³Teagasc (IR)







CONTEXT

- Improving feed efficiency (FE)
 - = Enhancing the sustainability of animal production (FAO, 2022)
- Strategies : Nutrition, Genetic selection and Nutrition x Genetics
- FE criteria:
 - Growth-related = Feed Conversion Efficiency(FCE)
 - Intake-related = Residual Feed Intake (RFI)
- Measuring feed efficiency is expensive and time consuming
- RFI biomarkers : cost-effective technology to identify efficient cattle

MECHANISM: TRUE DETERMINANT vs CORRELATED RESPONSE?



INRAC

All identified mechanisms potentially co-vary with intake!

 Concentration of blood metabolites (biomarkers) may be influenced by the feeding level and consequently indirectly connected to RFI.

DISSOCIATING CAUSATION FROM SIMPLE CORRELATION



INR









For their successful use as biomarkers, it is essential to understand to what extent blood metabolites are related to animals' feeding behaviour or to physiological differences

Metzler-Zebeli et al., 2019





OBJECTIVE

To determine if plasma biomarkers of RFI, originally identified under ad libitum feeding conditions, remain consistent when animals are fed at the same level with the same diet

EXPERIMENTAL DESIGN

- 60 Charolais crossbred fattening bulls tested <u>twice</u> for FE in a crossover design.
- Adlib ≈ 1.90%BW

INRA

- Restriction = 1.45%BW
- 24 most extreme RFI animals (12/12) in the first test were identified and sampled for their blood. Same animals were sampled in second test.



EXPERIMENTAL DESIGN

- 48 plasma samples subjected to LC-MS and colorimetric analysis to quantify 74 targeted metabolites
- Repeated measurements analysis were conducted: fixed effects of RFI, feeding level and their interaction and random effect of animal
- False discovery rate corrections were applied

INR



RESULTS

• Variability in RFI severely decreased with feed restriction (ISEP 2022; Cantalapiedra-Hijar)



REPEATABLE METABOLITES ACROSS FEEDING LEVELS

| | Intrac | lass correlation | coefficient |
|--|--------|-------------------|------------------------------------|
| High repeatability | | | |
| 3-Methyl-histidine | | 0.91 | |
| Betaine | | 0.78 | Individuals maintain their ranking |
| Carnosine | | 0.78 | in terms of metabolite plasma |
| 1-Methyl-histidine | | 0.76 | appointer arross the two |
| Indoleacetic acid | | 0.76 | concentration across the two |
| Moderate repeatability | | | feeding periods |
| Homoarginine | | 0.69 | |
| Creatinine | | 0.66 | |
| 2-aminoadipate (or Alpha-aminoadipic acid) | | <mark>0.65</mark> | |
| Lactic acid | | 0.63 | |
| Glutamate | | 0.61 | |
| δ-aminovalerate (or 5-Aminovaleric acid) | | <mark>0.59</mark> | |
| Tryptophane | | 0.58 | |
| β-Aminobutyric acid | | 0.57 | |
| Symmetric dimethylarginine | | 0.55 | |

CANTALAPIEDRA-HIJAR ET AL. EAAP 2023, Lyon (France)

INRAe

RFI BIOMARKERS IRRESPECTIVE OF THE FEEDING LEVEL (GROUP A)



CANTALAPIEDRA-HIJAR ET AL. EAAP 2023, Lyon (France) Do biomarkers of RFI in beef cattle remain consistent regardless of feeding level?

INRAC

RFI BIOMARKERS UNRELATED TO FEED INTAKE (GROUP B)



CANTALAPIEDRA-HIJAR ET AL. EAAP 2023, Lyon (France)

INRA

Do biomarkers of RFI in beef cattle remain consistent regardless of feeding level?

Lysine degradation pathway



Interestingly, in both group A and B the only plasma metabolite significantly impacted by RFI with both feeding levels belongs to the lysine degradation pathway

Other authors found this pathway down-regulated in efficient RFI cattle (Liu et al., 2023; Taiwo et al., 2022; Goldansaz et al., 2020)

CANTALAPIEDRA-HIJAR ET AL. EAAP 2023, Lyon (France) Do biomarkers of RFI in beef cattle remain consistent regardless of feeding level?



CONCLUSIONS

Two lysine degradation metabolites were identified as biomarkers of RFI even when all animals were fed at the same restricted feeding level

Metabolic regulations associated with RFI are not solely driven by differences in feeding level

THANK YOU FOR YOUR ATTENTION

SmartCow

an integrated infrastructure for increased research capability and innovation in the European cattle sector

www.smartcow.eu

MOVING TO A NEW ERA OF PUBLISHING



Free and transparent preprint and postprint recommendations in Animal Science

https://animsci.peercommunityin.org/



The SmartCow project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°730924



qonzalo.cantalapiedra@inrae.fr