School of Agriculture, Policy and Development
Animal, Dairy and Food Sciences Division

University of Reading

EFFECTS OF DIET ENERGY AND NUTRIENT CONTENTS ON NITROGEN USE EFFICIENCY IN BEEF

A. Angelidis[1], L. Crompton[1], T. Misselbrook[2], T. Yan[3], C. Reynolds[1], S. Stergiadis[1]

[1]Animal, Dairy and Food Chain Sciences, University of Reading, School of Agriculture, Policy and Development, PO Box 237, Earley Gate, Reading RG6 6AR, United Kingdom

[2] Rothamsted Research, North Wyke, Okehampton, Devon EX20 2SB, UK

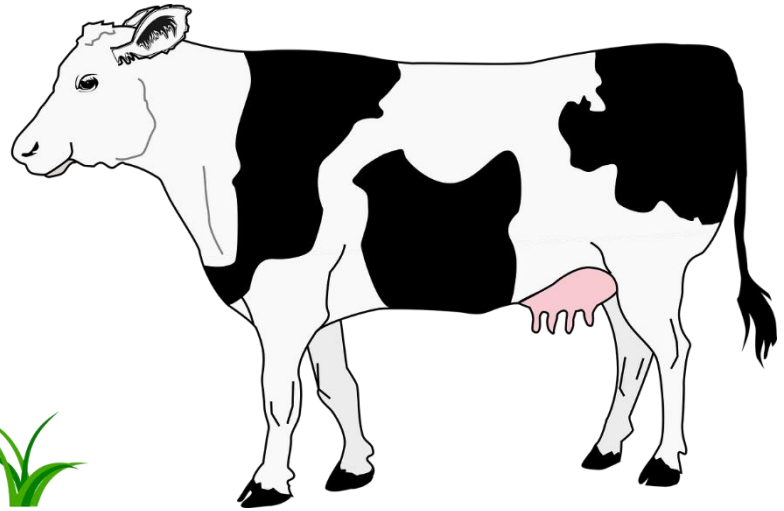
[3] Sustainable Agri-Food Sciences Division, Agriculture Branch, Agri-Food and Biosciences Institute, Large Park, Hillsborough, County Down, BT26 6DR, United Kingdom

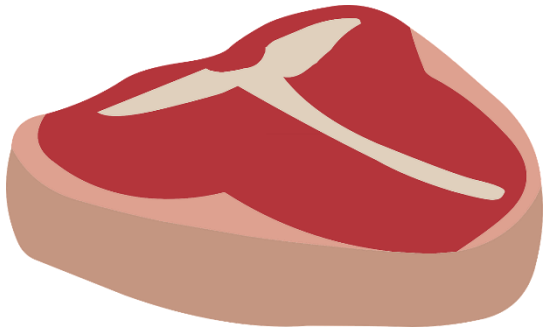
INTRODUCTION

Ruminants and Nitrogen

- Ruminants play a critical role in global food security due to their unique capacity to transform
  - fibrous feeds,
  - low-quality protein and
  - non-protein N sources

  into foods of high nutritional value.





…BUT…

- They excrete about 60-85% of their N intake
- Increase NH_3, $\mathbf{N_2O}$, N_2 and NO_3^- release to the environment

  ⇩
  - losses of ozone in the atmosphere
  - 298 times higher warming potential than CO_2

NH_3 = *ammonia,* N_2O = *nitrous oxide,* N_2 = *nitrogen,* NO_3^- = *nitrate,* CO_2 = *carbon dioxide*

INTRODUCTION

Improving Nitrogen Use Efficiency (NUE)

- Reduce environmental footprint of ruminant production systems
- Reduce cost of feeding and production
- Meeting with EU regulations without compromising profit

Key issues

- Deeper understanding of N utilisation and its partitioning
- Prediction tools available in research and farm environment
- Develop mitigation strategies for cattle raised for meat production

INTRODUCTION

Objective

The main objective of this work was to investigate the diet's influence, and particularly of:

- N
- neutral detergent fibre (NDF)
- acid detergent fibre (ADF)
- ether extract (EE)
- starch
- metabolisable energy (ME)

on

- faecal N (FN)
- urinary N (UN)
- manure N (MN)
- retained N (RN),
- NUE (expressed by the ratios FN/MN, UN/MN, FN/nitrogen intake (NI), UN/NI, MN/NI)

MATERIALS AND METHODS

Data Collection

Individual animal data from beef digestibility trials with beef fed at growing or finishing levels were used.

- Experiments conducted at the Centre for Dairy Research (CEDAR)
- 300 treatment means

Data were split in groups according to diet N content

- Low < 21 g/kg DM
- Medium 21-27 g/kg DM
- High > 27 g/kg DM

MATERIALS AND METHODS

Statistical analysis

- A multivariate redundancy analysis (RDA) was performed
- RDA is a method to extract and summarise the variation in a set of response variables that can be explained by a set of explanatory variables.
- RDA for this study, was carried out using the CANOCO 5 statistical package with automatic forward selection of variables and significances calculated using Monte Carlo permutation tests.

MATERIALS AND METHODS

Statistical analysis

- Diet energy and nutrient contents were used as the drivers and UN, FN, MN, and the NUE ratios as the response variables

to associate

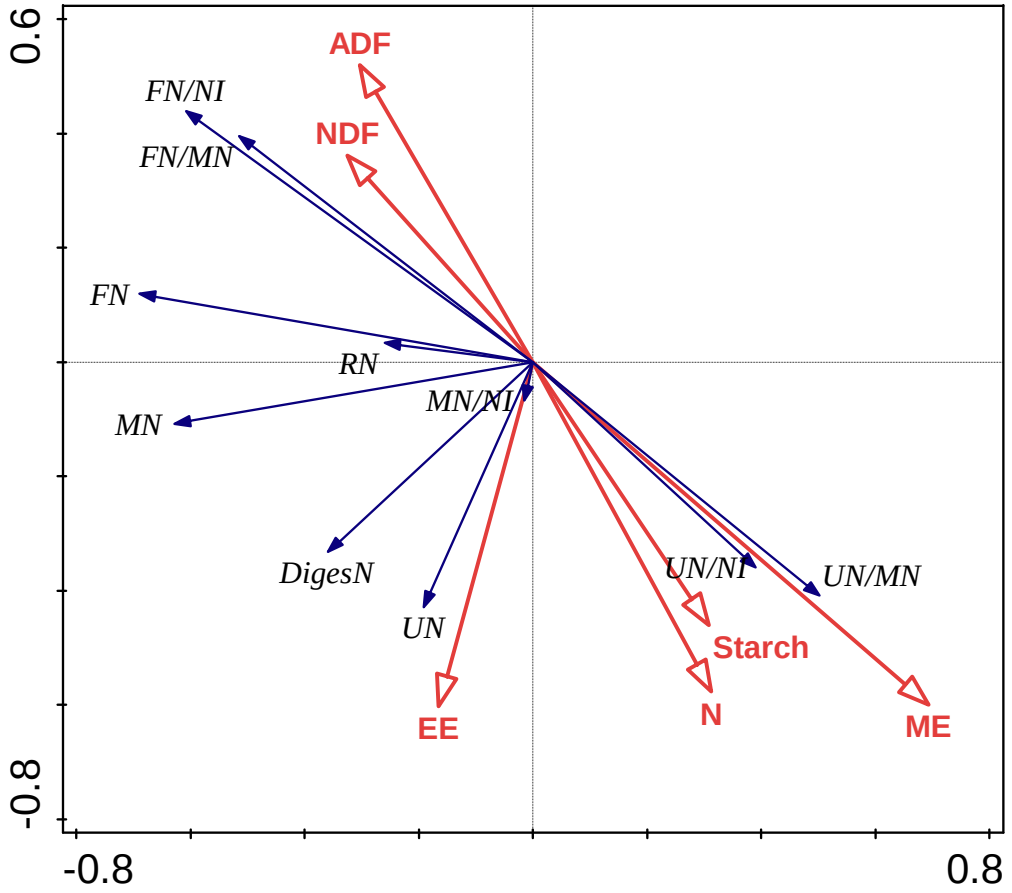
The diet chemical composition

with

N output in manure, faeces and urine and the various NUE ratios

RESULTS
Low protein diets (<21 g/kg DM)

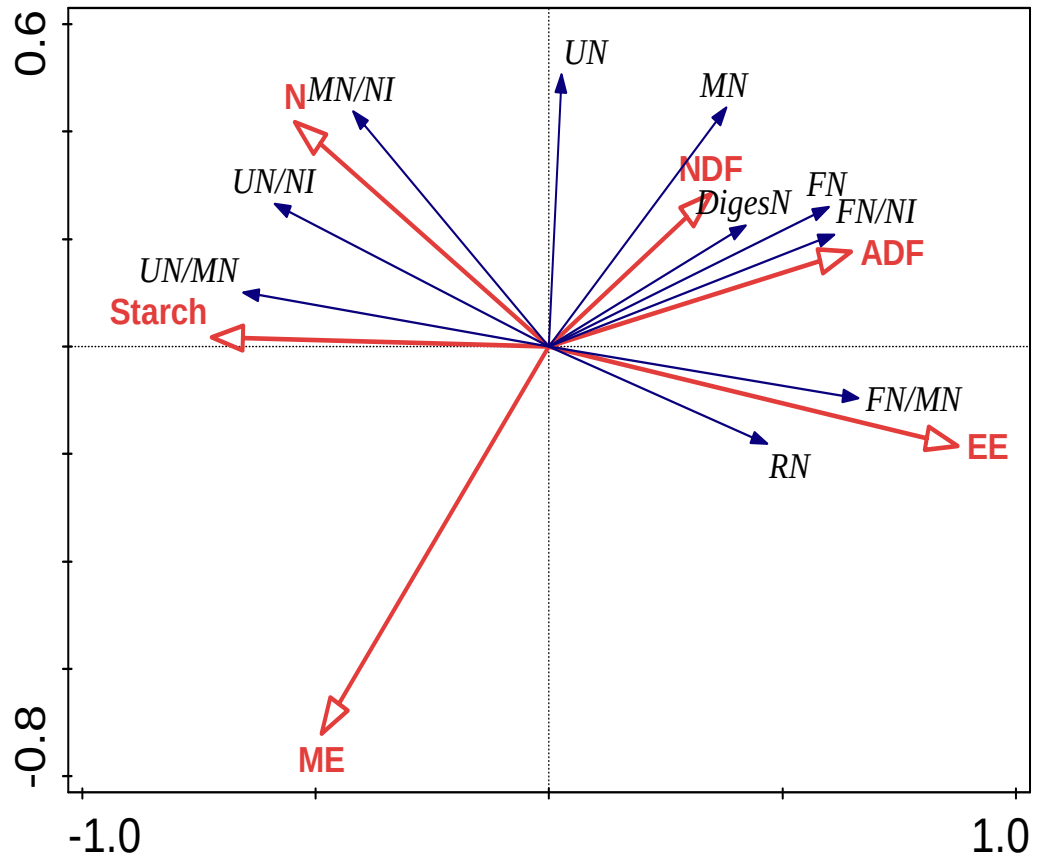
Figure 1 Summary of the variation in functional trait composition explained by the environmental variables



- Both ME and N composition parameters were strong (P< 0.05) drivers of N balance
- In contrast, ADF, NDF, Starch and EE were relatively weak drivers of N balance (P> 0.05)
- Diet N was positively associated with UN and negatively correlated with NUE, as was ME and Starch.
- Diet NDF and ADF was not strongly associated with N outputs, while being positively associated with NUE

RESULTS
Medium protein diets (21-27 g/kg DM)

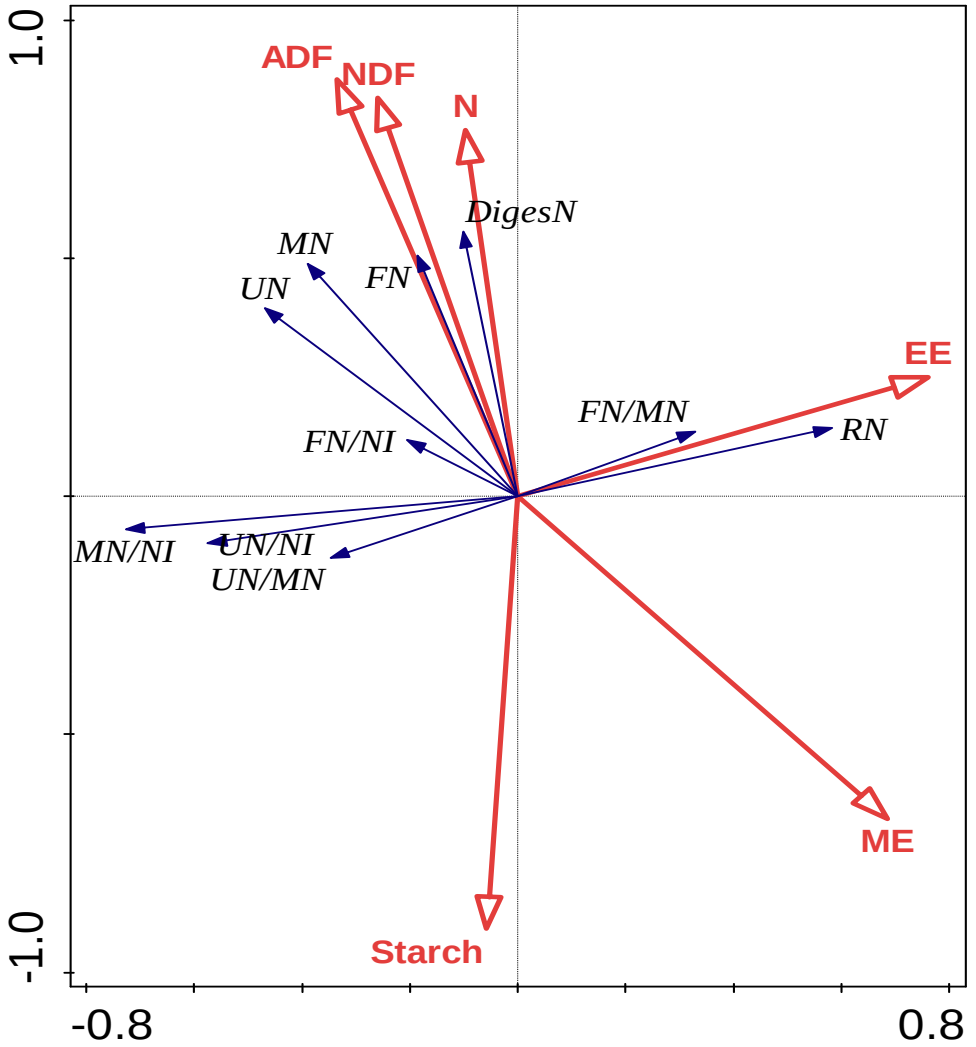
Figure 2 Summary of the variation in functional trait composition explained by the environmental variables



- All used dietary parameters were strong (P< 0.05) drivers of N balance, apart from starch
- Diet N was positively associated with N outputs, yet slightly, and negatively associated with NUE
- Diet NDF and ADF were positively associated with N outputs and NUE
- EE was positively associated to NUE, with ME displaying a strong negative association with N outputs

RESULTS
High protein diets (>27 g/kg DM)

Figure 3 Summary of the variation in functional trait composition explained by the environmental variables



- All used dietary parameters were strong (P< 0.05) drivers of N balance
- Diet N, NDF and ADF were positively associated with N outputs and negatively correlated with NUE
- Diet ME and starch were negatively associated with N outputs, while ME appeared to be positively associated with NUE
- EE was positively correlated to N and NUE

CONCLUSIONS

- In order to mitigate N outputs and improve NUE in beef:
  - ✓ Use improved feed quality (e.g. rich in ME and starch), and
  - ✓ reduce diet N content (but to a level that still supports high growth rates) may be recommended
- However, in diets with low N content (e.g. 13.6-21 g/kg DM),
  - ✓ higher NDF and ADF, and
  - ✓ less ME and N

  may shift N outputs from urine to faeces, which is also preferable from an environmental point of view.

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