In vivo digestibility of seaweed as a protein source for ruminant nutrition

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Why seaweed?

• Increase of import soya in Norway by 35% in 2050 (Özkan Gülzari et al. 2017; Ag Sys)
• Alternative protein feed requirement
• Macroalgae (aka. Seaweed) application area
• Abundant in the nature!
• PROMAC identified seaweed species with high protein content
• In vitro gas assay: High concentration of metabolisable protein
WHY NOT?*

*With the lessons learnt
Macroalgae species

- Brown (Saccharina latissima): low-medium protein, high iodine, large size, easy to cultivate.


- Red (Porphyra spp.): rich in protein, small size, nori

  Source: fao.org/fishery/culturespecies/Porphyra_spp/en

- Both grow along the whole coast of North Atlantic

  Extracted

  Purchased
Production of protein-enriched fractions for animal feeding

- Frozen, wet biomass
  - Milling
  - Drying
  - Milling
  - Drying
  - Protease treatment
  - Drying
  - F1

- Heating
  - Enzyme treatment
  - Centrifugation
    - Insoluble fraction
    - Drying
    - F2

- + Water
  - Liquid (soluble) phase
  - Membrane filtration
  - Retentate
  - Drying
  - F3

- F5
  - Protease treatment
  - Drying
  - F6

- Retentate
  - Drying
  - F3
Hypothesis

- (Nitrogen) Digestibility of *S. latissima* is comparable to / higher than that of Soybean meal (and *Porphyra spp*)

Reflection: *S. latissima* is edible and will be taken up by all animals (*)
Experimental design and feeding

- In vivo trial 4 x 4 Latin square design
- Four diets: Control, *S. latissima*, *Porphyra*, Soybean meal
- 8 days adaptation 7 days collection
- Diets meet maintenance energy and protein requirements
- Diets isocaloric and isonitrogenous
- Restricted feeding twice a day
FEED COMPOSITION IN EXPERIMENTAL RATIONS (G/KG DM)

- **CONTROL**
  - Hay: 961
  - Protein feed: 8
  - Molasses: 2

- **S. LATISSIMA**
  - Hay: 821
  - Protein feed: 16
  - Molasses: 26

- **PORPHYRA SPP**
  - Hay: 848
  - Protein feed: 36
  - Molasses: 26

- **SOYBEAN MEAL**
  - Hay: 838
  - Protein feed: 36
  - Molasses: 40
CHEMICAL COMPOSITION OF FOUR EXPERIMENTAL RATIONS

Organic Matter
- Control: 915 g/kg DM
- S. latissima: 910 g/kg DM
- Porphyra spp: 912 g/kg DM
- Soybean meal: 913 g/kg DM

Kjeldahl-N
- Control: 2 g/kg DM
- S. latissima: 1.8 g/kg DM
- Porphyra spp: 1.9 g/kg DM
- Soybean meal: 1.7 g/kg DM

Gross Energy
- Control: 18 MJ/kg DM
- S. latissima: 17.5 MJ/kg DM
- Porphyra spp: 17.8 MJ/kg DM
- Soybean meal: 17.9 MJ/kg DM
Nitrogen digestibility

**Control**
- S. latissima: 54.5%
- Porphyra spp.: 64.2%
- Soybean meal: 65.6%

**Protein complexes phlorotannins/fiber (?)**
Nitrogen balance

N intake (g/d)

Urine N (g/d)

Faecal N (g/d)

Faecal N extretion / total N intake (g/d)

Control
S. latissima
Porphyra spp.
Soybean meal

S. latissima N went the wrong way
Rumen fermentation products

Ammonia mmol/L
P=0.052

Total VFA mmol/L
p=0.048

Higher ash (?) & iodine content!!!
Plasma AA composition (μM/L)

Protein absorbed is similar in quality / microbial protein
Conclusions

- Processing of plant material
- Adaptation period to the diet

Not every seaweed species is the same. Story with S. latissima is not over but...