Nutritional value of seaweeds for ruminants

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Nordic Seaweed Conference 12th – 13th October 2016, Grenaa, Denmark
Background

• Seaweed is a large biomass source
• Use of seaweeds in animal feeding is not new
• But knowledge on feed value is very limited
Outline

• Ruminant nutrition

• Results, specie and season effect on seaweed composition and digestibility

• Potential and concerns, seaweed as ruminant feed
Ruminant/cow nutrition

• Forestomachs, fermentation chamber

• Fermentation/degradation of carbohydrates and protein

• Fermentation products:
  – Volatile fatty acids (energy for the cow)
  – Microbial cells (protein for the cow)

• Some protein and carbohydrates will escape rumen degradation and might be digested in small intestine
Therefore:

Energy supply and microbial protein supply require:
• High digestibility, high fermentability in the rumen

Feed protein supply require:
• Low protein degradability in the rumen
• High digestibility in the small intestinal of rumen escape protein
• Appropriate amino acid composition of rumen escape protein
Aim

• Study feed value for ruminants of seaweed, and variation between seaweed species and seasons in:
  – Chemical composition
  – In vitro digestibility
  – Protein quality, degradability and digestibility
AltPro - Legumes and seaweeds as alternative protein for sheep

Samples:
• 9 seaweed species
• 2 seasons, spring and autumn
• 2 years, 2014 and 2015

Bodø: 67°19'00" N, 14°28'60" E
Sample collection

• Hand picked
• 2 baths with sea water
  – eliminate sand, animals and fouling organisms
• 1 quick bath with 30% sea water
  – eliminate salt
• 1 quick bath in pure fresh water
  – eliminate more salt
Red seaweeds
Rhodophyta

Mastocarpus stellatus

Porphyra sp.

Palmaria palmata

Photo: M. Novoa-Garrido

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Brown seaweeds
Ochrophyta

Pelvetia canaliculata

Photos: M. Novoa-Garrido, M.Y. Roleda, M.R. Weisbjerg

Laminaria digitata

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Alaria esculenta

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Saccharina latissima
Green seaweeds
Clorophyta

Acrosiphonia sp.

Ulva sp.

Photo: M. Novoa-Garrido,
Composition of seaweeds

Acid insoluble ash only analysed in spring 2014 samples, however concentrations were low or below detection level

→ No sand pollution
Composition of seaweeds

Brown: DM (g/kg) 364, 207, 98
Red: DM (g/kg) 286, 184, 85
Green: DM (g/kg) 226, 180, 143
Composition of seaweeds

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Digestibility of seaweeds

IVOM (g/kg OM)

Brown

- 629
- 874
- 310

Red

- 545
- 811
- 906
- 745

Green

- 444
- 545
- 754

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In situ measures of protein availability in dairy cows

Species

Indigestible
Digestible escape
Rumen degradable

Tayyab et al. 2016

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Amino acids - rumen degradation and intestinal digestion

Bhatti, 2016
Carbohydrates
Very different from terrestrial plants

• **Brown**
  – Fucoidans, sulphated saccharides (Cell wall)
  – Laminarin (storage carbohydrate)

• **Red**
  – Carregenans, agars, cellulose, mannan and xylan polysaccharides (cell wall)
  – Floridean starch (storage carbohydrate)

• **Green**
  – Glucans and soluble fibre (cell wall)

Makkar et al. 2016
Conclusions

- Dry matter concentrations as high as for land grown forages
- Very high and variable ash (not sand)
- Low to very high protein concentration, higher in spring than in autumn
- Amino acid N out of total N as high as for terrestrial green forages
- Non NDF non protein organic matter high in brown seaweeds
- Very low to very high organic matter digestibility
Conclusions, cont.

- Proteins in some seaweeds seems to be naturally protected against rumen degradation, however acid labile, making the rumen escape protein digestible in the small intestine.

- Carbohydrates unusual as ruminant feed, fermentation pattern and effect on rumen and intestinal environment fairly unknown.

- Some seaweed species could be highly interesting as energy (some red and brown) and protein (some red and green) feed for ruminants.
Potentials in animal nutrition

Beside mineral, energy and protein source:

• Health improvements

• Methane mitigation
Concerns in animal nutrition

- High ash concentration
- High concentration of arsenic, cadmium and iodine, especially in brown seaweeds
- Transport, water content
- Conservation
- Palatability
Any future for seaweed as ruminant feed??

Cultivated seaweed at present too expensive

However residues from production for human consumption or industrial production might result in significant amounts of residues at competitive price

Harvest of natural seaweed for environmental reasons could result in significant amounts of seaweed where use as feed could be the best paying alternative
Some recent publications

Seaweeds for livestock diets: A review

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Abstract

The aim of this review was to provide an overview of the current knowledge on the use of seaweed feed ingredients for livestock diets. The review focuses on the nutritional value of seaweed and the potential benefits of using seaweed as a feed additive. The review also discusses the challenges associated with the use of seaweed in livestock diets and suggests potential solutions to overcome these challenges.

Keywords: Feeding | Livestock | Seaweed | Feed additive

Rumininal and intestinal protein degradability of various seaweed species measured in situ in dairy cows

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Abstract

The aim of this study was to measure the ruminal and intestinal degradability of various seaweed species for use in dairy cows. The study was conducted in situ in dairy cows to assess the potential of seaweed as a dietary supplement for dairy cows. The results showed that the degradability of seaweed species varies significantly, and the researchers suggest that further research is needed to optimize the use of seaweed in dairy cow diets.

Keywords: Seaweed | Dairy cows | Protein degradability
Thank you for your attention