Locally produced legumes and seaweed. Sustainable protein sources for a self-sufficient European animal production?

MARGARITA NOVOA-GARRIDO[1]*, INGRID BAY-LARSEN[2], FELIX HECKENDORN[3], MARTIN R. WEISBJERG[4], EDUARDA MOLINA-ALCAIDE[5], VIBEKE LIND[1]

[1] Norwegian Institute for Agricultural and Environmental Researcn (Bioforsk), 1430 Ås, Norway; [2]Nordlandsforskning, 8049 Bodø, Norway; [3]FiBL, 5070 Fricks, Switzerland; [4]Aarhus University, 8000 Aarhus, Denmark; [5] Estacion Experimental del Zaidin (CSIC), 18008 Granada, Spain.

Key words: animal production, legumes, protein, seaweed, self-sufficiency,

Author's Background

M. Novoa-Garrido is a veterinarian specialized in microbiology. Her areas of expertise are animal husbandry, feeding strategies such as use of seaweed and seaweed products in feed, gastrointestinal ecology, and animal health.

I. Bay-Larsen holds a phd in public management of outfield resources and experience from a number of Research projects on adaptation to climate change and sustainable development in arctic communities.

F. Heckendorn is a veterinary parasitologist. He works on various strategies of non-chemical control of helminthics, mainly of ruminants.

M. R. Weisbjerg is an animal scientist specialized in ruminant nutrition, especially dairy cattle, and ruminant feed evaluation and digestive physiology.

E. Molina-Alcaide is a biologist specialized in animal nutrition. Her areas of expertise are ruminant nutrition, feeding strategies based on the use of by-products, ruminal ecology and quality of animal products

V. Lind is specialised in sheep production systems and feeding regimes. She works with feeding strategies related to lamb growth, methane emission and pasture management and utilization.

Summary

The animal feeding industry is looking for new local sources of high quality protein in order to reduce import and ensure sustainable and environmental friendly animal production systems. Local legumes and seaweeds may be alternative sources of protein.
We present in this paper the background for the ongoing Norwegian Research Council project **Legumes and seaweeds as alternative protein sources for sheep (AltPro)**, which aims to investigate the suitability and potential of legumes and seaweeds as new and underutilized protein sources in sheep diets. The project addresses several critical aspects for the future development of the agriculture industry in Norway applicable to other European countries from an integrated social and natural scientific approach:

1. use of protein sources alternative to soya,
2. environmental, climatic, societal and economical sustainability,
3. animal health and welfare.

Background

In the first half of this century, global demand for food, feed and fiber is expected to grow by 70 percent. Further, the European livestock production relies heavily on the import of protein feed, particularly soybean and its by-products. However, the capacity to expand the arable lands is limited, and the necessary production for an increased self-sufficiency must come from increased yields and cropping intensity. It is also mandatory to broaden available resources and technological options (FAO 2012).
The climate change will allow for successful future cultivation of new crops in cold European regions. Sustainable use of marine resources as ingredients for animal diets should also be considered. In general, the use of locally produced protein-rich sources for livestock is more sustainable and environmental friendly than import of soy.

Legumes and seaweeds as alternative protein resources

Protein is the most critical nutrient component contributing to the nutritional value of the diet. The feeding value of the protein rich legumes is often greater than that of grasses in ruminant, owing to their more rapid particle breakdown, faster rumen fermentation, lower rumen mean retention time and, consequently, greater voluntary feed intake (Ulyatt 1973). Studies show that increasing the proportion of either white or red clover in the pastures increases milk production of dairy cows (Harris et al. 1997) and growth rate of lambs (Penning et al. 1995). However, other legumes such as *Lotus* sp. are also of interest to improve the sustainable productivity of ruminants. Due to the climate change longer and warmer growing seasons are expected in the arctic part of Norway, increasing the possibilities for growing new legume species. Seaweeds, on the other hand, have traditionally been used in the coastal communities in Norway as a supplement in animal feeding especially when there was shortage of forage. Due to geography, environment and the aquaculture production, conditions along the Norwegian coast are well suited for production of seaweeds. In addition, seaweed culture may contribute to reduce CO_2 emissions.
Crude protein content in certain seaweed species can reach 47 % of the dry matter (Arasaki and Arasaki 1983, Burtin 2003), and the amino acid composition of certain red and green seaweeds is similar to proteins from soybean and eggs (Fleurence 1999). Digestibility of seaweeds has been scarcely studied. Protein digestibility and rumen degradability of different seaweed species are going to be determined in AltPro as crucial factors determining protein value in ruminants.

Effect of including unconventional components in the diet on methane emissions:
The effect of including unconventional components in the diet of ruminants on methane emissions and changes in methanogenic microorganisms in the rumen has been scarcely studied. However, promising results obtained with plant by-products may indicate the adequacy of studying the antimethanogenic effects of both legumes and seaweeds under colder climatic conditions. Feeding *Lotus* sp. to sheep has been associated with a reduced CH4 production mainly due to its content of condensed tannins.

Animal health and welfare impacts:
Legumes and seaweeds contain plant secondary compounds (e.g. polyphenols, tannins) with broad bioactivity and consequently potential animal health and welfare impacts. Gastrointestinal nematodes are responsible for considerable morbidity and mortality in sheep herds. The rapid increase of anthelmintic resistance has become a great concern for the European small ruminant production. In AltPro we will study the anthelmintic effects of a number of legumes and seaweeds on gastrointestinal nematodes.

Societal aspects:
The increased level of legumes and the inclusion of seaweeds in sheep diets may strengthen sustainability of the industry while at the same time face barriers at the managerial level and among individual farmers. AltPro challenges farmers and public authorities with respect to the discussion about the use of imported versus locally produced feed ingredients in livestock production.

Core messages and conclusions

- It is necessary in Europe to find alternatives to imported protein sources in order to increase Europe's self-sufficiency in the animal production sector.
- Consideration of new alternative protein sources must be based on the combination of several determining factors such as local production, sustainability, environmentally benefice of life cycles with low CO_2 footprints, beneficial health and/or product quality side effects, etc.
- Marine resources such as seaweeds do not compete with land areas for food production and therefore are interesting as alternative protein sources for certain European regions characterized by cold climate and good access to coastal areas.

References

Arasaki, S., and T. Arasaki. 1983. Low calorie, high nutrition vegetables from the sea. Japan Publication, Inc., Tokyo.

Burtin, P. 2003. Nutritional value of seaweeds. Electronic Journal of Environmental, Agricultural and Food Chemistry 2:498-503.

Ellis, J. L., E. Kebreab, N. E. Odongo, B. W. McBride, and E. K. F. Okine, J. . 2007. Prediction of Methane production from Dairy and Beef Cattle. J.Dairy.Sci. 90:3456-3467.

FAO. World agriculture towards 2030/2050: the 2012 revision. www.fao.org/economic/esa.

Fleurence, J. 1999. Seaweed proteins: biochemical, nutritional aspects and potential uses. Trends in Food Science and Technology 10:25-28.

Harris, S. L., D. A. Clark, M. J. Auldist, C. D. Waugh, and P. G. Laboyrie. 1997. Optimum white clover content for dairy pastures. Proc.N.Z.Grassl.Assoc. 57:189-197.

Penning, P. D., A. J. Parsons, R. J. Orr, A. Harvey, and R. A. Champion. 1995. Intake and behaviour responses by sheep, in different physiological states, when grazing monocultures of grass or white clover. Appl.Anim.Beh.Sci. 45:63-78.

Ulyatt, M. J. 1973. The feeding value of herbage, p. 131-178. *In* G. W. Butler and R. W. Bailey (ed.), Chemistry and Biochemistry of Herbage, vol. 3. Academic Press, London.