TECHNICAL NOTE

LowInputBreeds

Regional high protein feeds for poultry diets

Marinus van Krimpen

About

New organic regulations with respect to regional cultivation of feed and removal of the permitted inclusion of low levels of conventional feed ingredients calls for regional organic protein production.

This technical note presents options and conditions for a sustainable increase in European organic protein production for livestock feeds.

Why regional protein cultivation?

EU resolution

There are increasing concerns about the quantity of feed proteins imported from outside the European Union and reasons for concern differ between governments, NGOs, and consumers. In 2011, the European Parliament adopted a resolution on 'the EU protein deficit', putting forward a series of measures to reduce dependency on protein imports for animal feed, primarily from the US, Argentina, and Brazil.

Organic regulations

Because of new regulations with respect to regional cultivation of feed, and the removal on permitted inclusion of any conventional feed ingredients, including synthetic amino acids, organic livestock have urgent need for regionally produced high quality protein feeds. Therefore, organic producers seem an appropriate sector to investigate new protein sources and may serve as a pilot for increased use of novel protein sources in conventional intensive animal production systems.

Study on cultivation, processing and application of protein sources

On request of the Dutch Ministry of Economic Affairs, Agriculture, and Innovation, scientists from Wageningen UR Livestock Research (WLR), Plant Research International (PRI) and Food and Biobased Research (FBR) have collaboratively studied options to increase European protein production. This study was to describe conditions for successful cultivation, processing and feeding of protein sources to (organic) pig and poultry under European climatic conditions, taking sustainability characteristics, and legislative aspects into account. From this study, the relevant aspects for organic livestock production are summarized below (Van Krimpen et al., 2013).

Van Krimpen (2014): Regional protein sources for application in poultry diets.
LowInputBreeds technical note. Download at www.lowinputbreeds.org

Protein sources

There is a range of potentially interesting protein sources that might enhance regional feed protein production (Table 1), some of which are already used in organic diets (e.g. rapeseed expeller, sunflower seed expeller, peas and lupines). New categories are leaf proteins, aquatic proteins, and insect proteins.

Presently, European soybean production is negligible, but increasing, especially in the Danube region in the South-Eastern part of Europe. (Photo: FiBL)

Besides, new upcoming techniques enable the production of protein enriched concentrates, with a crude protein content of at least 65 percent. Some techniques, however, require the use of hexane, which is not allowed in organic livestock production.

Table 1. Short list of potentially interesting sources to increase EU feed protein production

Category	Protein source
Oil seeds	Proteins of defatted soybeans, rapeseed and sunflower seed
Grain legumes	Peas, Vicia faba, lupines and their concentrates, chick peas
Forage legumes	Lucerne (alfalfa)
Leaf proteins	Grass, sugar beet leaves
Aquatic proteins	Micro algae, seaweed and duckweed
Cereals and pseudo cereals	Proteins from oat and quinoa
Insects	E.g. mealworm, housefly, house cricket1

[1)] The nutritional aspects of insects were studied in a separate project and presented in the report 'Insects as a sustainable feed ingredient in pig and poultry diets – a feasibility study' (Veldkamp et al., 2012).

Cultivation of protein sources

Due to lower potential yields (Table 2), the profitability of growing protein crops in Western Europe are lower than wheat cultivation, and may not be as attractive for farmers.

Growing grain legumes, especially peas and beans, is appealing due to their relatively high protein content (17-35 %) and because cultivation practises are not dissimilar to those of cereals. However, these crops are very sensitive to pests and pathogens.

Table 2. Protein content, yield/ha and protein yield/ha of the various protein sources

	Protein content (%)	Yield in EU possible (tons ds/ha/y)	Protein yield possible (tons/ha/y)
Oil seeds – soybean	40	1.5–3	0.6–1.2
Oil seeds – rapeseed	25	3	0.75
Oil seeds – sunflower	23	3	0.7
Legumes (pulses) – peas/beans/ lupine	17–35	4-6	1-2
Legumes (forage) – lucerne	19	13	2.5
Cereals – oat	12–15	3-5	0.4–0.75
Pseudo cereals – quinoa	12–18	3	0.4–0.5
Leaves – grass	12	10-15	1.2–2
Leaves – (e.g. sugar beet leaves)	12	4.5	0.5
Macro algae - seaweed	10–30	25	2.5–7.5
Micro algae	25–50	15–30	4–15
Duckweed	35–45	30–40	10–18
Wheat (as reference)	11	10	1.1

Soybeans might be interesting because of the high protein content, although currently yields are too low to make cultivation attractive for European farmers. Further development on breeding high-yielding cultivars with a short growing-season is needed.

Rapeseed (meal) is already cultivated in considerable quantity in the EU with reasonable protein yields of acceptable quality.

The protein quality of **oats** and **quinoa** are interesting, although they yield lower than wheat. Intensive breeding input is needed, but with adequate attention, the production level could reach that of wheat.

Aquatic protein sources are very interesting because of their high protein content (duckweed, several micro-algae and some seaweed species) and very high yields, although processing and feasibility for feeding still needs much research. Not only is the high yield, as for duck-weed, and the high protein level attractive, but the fact these potential protein sources do not need good agricultural soil for cultivation. However for all protein sources with high water content, such as [left-over] leaf material, duckweed, algae and seaweed, a drying step for storage and transport is required.

Algae production at the Algae Park of Wageningen University. (Photo: Wageningen University)

Processing of protein sources and its economy

Processing of ingredients to reduce anti-nutritional factors (ANFs) and concentrate the protein content above 65%, would fulfil the need for high quality proteins for all kinds of organic diets, but especially for young animals (broilers, rearing hens).

Processing selected feed resources to enhance their protein content is generally still in development and not yet well established.

In the short term, attractive enriched protein resources might be:

- Oil seeds: rapeseed protein concentrates. Protein enrichment of defatted sunflower meal seems to be less attractive.
- Legumes: protein concentrates prepared by dry fractionation from peas and faba beans. The former are already on the market, although lupines are less attractive.

In the longer term, protein enrichment of leafs or grasses might deliver attractive feed ingredients. Grass protein concentrate in particular shows promise, because its development is already initiated; processing lucerne and sugar beet leafs are less advanced.

Processing to enhance the protein content of the aquatic resources algae and duckweed is still in its infancy but they may offer opportunities in the long term (more than 10 years).

Nutritional aspects

Oil seeds

Proteins derived from oil seeds are very useful in pig and poultry diets; there is already a widespread use of soybean, rape seed, and sunflower seed expeller in these diets. Chemical composition and nutritive value of these feeds are well known and it is assumed the nutritional characteristics of European cultivated soybean expeller will be similar to the that cultivated in South America, but until now this has not been proven. Less information is available with respect to other oilseeds for pigs and poultry and results from one experiment showed rape seed (canola) protein concentrate can be used up to 10 % in piglet diets.

Legumes

Legumes, e.g. *Vicia faba*, lupines and peas, and chickpeas can significantly contribute to the protein supply of poultry, although their anti-nutritional factors have to be considered. Legume protein concentrates are produced using the wind sifting technique, which is relatively simple.

Pea protein concentrate has shown promise as a sustainable European produced high quality protein, especially for organic diets. A product is already commercially available containing 84 % crude protein, a digestible lysine content of 55.5 g/kg and methionine plus cystine contents of 11.9 g/kg and has shown excellent results with housed organic piglets.

The nutritional value of **leaf proteins** for poultry has not yet been studied. Some aquatic proteins, such as micro algae and duckweed, might be valuable feeds for poultry, whereas intact seaweed seems less suitable. In addition to developing processing necessary for these sources, more research is required to determine their nutritional characteristics, cell wall degradation, feed safety and legislative aspects.

Cereals and pseudo cereals

Oat protein has a good nutritional value for monogastrics and can be used as high quality protein in diets for young poultry. Although **quinoa** might show promising nutritional properties, current knowledge is insufficient for its utilisation in poultry diets.

Conclusions

Within oil seeds, European produced soybeans seem to be the most promising alternative for imported soya; nutritional value, especially protein digestibility, is very good. Yield of soybeans produced in Europe need to be further increased to make this crop attractive for growers. To realize this, varieties have to be selected with an ultra-short growth season.

Within grain legumes, pea protein concentrate seems the most promising alternative for soybean expeller, at least in the short-term. The protein yield is reasonably high, but could be further improved. This concentrate has a high nutritional value and can contribute in the dietary methionine supply - the first limiting amino acid in organic poultry diets. In long-term, leaf and aquatic proteins probably might replace soybean imports but more knowledge in protein separating techniques and nutritional evaluation are necessary.

Further reading

Van Krimpen, M. M., P. Bikker, I. M. Van der Meer, C. M. C. Van der Peet-Schwering, and J. M. Vereijken (2013). Cultivation, processing and nutritional aspects for pigs and poultry of European protein sources as alternatives for imported soybean products. Edited by Wageningen UR Livestock Research Report 662, Lelystad, The Netherlands

Veldkamp, T., G. Van Duinkerken, A. Van Huis, C. M. M. Lakemond, E. Ottevanger, G. Bosch, and M. A. J. S. Van Boekel (2012). Insects as a sustainable feed ingredient in pig and poultry diets - a feasibility study. In Report 638. Edited by Wageningen UR Livestock Research. Lelystad

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Author

Marinus van Krimpen, Wageningen UR Livestock Research,
PO Box 65, 8200 AB Lelystad, The Netherlands,
E-mail marinus.vankrimpen@wur.nl

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Gillian Butler, Newcastle University, UK

Title photo

Peas promote biodiversity, help to enhance soil fertility, and are an important feedstuff. Photo: Klaus-Peter Wilbois, FiBL

LowInputBreeds

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