ProRefine final project summary

Press juice of red clover and leaf stripper fraction of lucerne

Project purpose
The aim of the research project ProRefine was to improve local production of protein feed in organic production, in particular for monogastrics, in different regions in Europe and Turkey, through improved forage processing. The processing methods studied were leaf stripping and juice pressing of forage legumes. Both methods produce protein-rich fractions with high digestibility suitable for monogastrics and fibre-rich fractions suitable for ruminants.

Final project summary

The project addressed this through field experiments with different forage legume species in Sweden, Norway and Turkey, development of mathematical models for protein supply from forage legumes, feeding experiments with pigs in France and lambs in Italy to evaluate the feed value of protein- and fibre-rich fractions produced in Denmark, conceptualisation of local value chains based on forage legume fractionation, in depth and focus group interviews with farmers and stakeholders in the value chain, and assessment of social, economic and environmental aspects of sustainability.

In Turkey two varieties of lucerne were compared and harvested and processed seven times in 2019. At first harvest we found on average 43% of the dry matter yield in the juice fraction and when using manual leaf stripping, we found 53% of the dry matter yield in the leaf fraction. Mean crude protein (CP) concentrations in whole plant, juice, leaves, and leaf juice were 18%, 23%, 25% and 26%, respectively. This indicates that both methods can be used to produce fractions with increase CP concentration, and combination of both methods may give an additional, but rather small effect. In Sweden and Norway red clover gave higher yields than lucerne and were harvested and processed 3 to 4 times. The electric experimental leaf stripper developed in the project (PremAlfa Mini, Trust'ing – Alf'ing) also performed well in mixed stands of clover and grass. Results for mass balances, chemical composition and in vitro digestibility of the fractions are available in draft report and papers and will be published as a part of a PhD thesis. The methods (leaf stripper and screw press) produced products that were significantly different to each other and to the pre-harvest sward. The protein fractions (juice and leaf) had similar CP concentrations – in some cases the juice concentration was lower, and in some cases higher. The NDF concentration of protein fraction was always higher in leaves than juice – this is a key determinant of how these protein fractions can be utilised for livestock.

A full-scale leaf stripper (MRF2, Trust'ing – Alf'ing) and the pilot biorefinery plant at Aarhus university were used to fractionate lucerne and red clover crops. Leaves were mixed with barley meal and ensiled, stems were ensiled after short wilting period, press juice was precipitated to a protein concentrate and pulp was ensiled. The feeds were shipped to France and Italy. In fattening pigs, protein concentrate was assessed to be a good protein source, whereas leaf silages can be considered more an energy source. Especially in lucerne leaves, degradation of protein during fermentation was extensive. Ensiling experiments showed that use of additives can further improve the quality of preserved products.

Silages of stems and pulp had undergone a strong acetic fermentation process but were well accepted and consumed by lambs in the feeding experiments. Diets containing pulp silage resulted in better growing performance than diets containing stem silage, but both were considered valuable feeds for ruminants.

Implementation of leaf stripping can be done at farm level. For the production and stabilisation of press juice and inclusion in feed rations involvement of the feed industry is necessary. Currently, dairy farmers are sceptical to sell forage-based protein from their farms. The assessment of concepts and models of local food systems showed that animal productions with monogastrics can benefit from forage legume fractionation and cooperation by increase the level of self-sufficiency in feed. Whether dairy farmers have economic benefits depends highly on investment cost, production costs and price of protein concentrate. Estimates of Net Present Value (difference between the present value of cash inflows and the present value of cash outflows over a period of time) suggest that implementation of both fractionation methods can be feasible. Possible environmental benefits are related to less import of protein feeds and local protein production based on perennial forages.

The design of local food systems must be adapted to regional environmental conditions for plant and animal production, structures in agriculture and the views and attitudes of farmers and stakeholders. Preliminary results from the ProRefine project have been disseminated through stakeholder group meetings, conference contributions, newsletter and field days. Several manuscripts of scientific articles have been prepared and others are planned to be published in the near future.

The project has contributed with new knowledge about fractionation of forage legumes into feeds for animals from different species with different requirements. The project has also contributed with new knowledge about concepts of local food systems and actors' thoughts about self-sufficiency in feed in different regions. The project has also contributed with documentation of knowledge gaps that must be addressed in future projects.

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