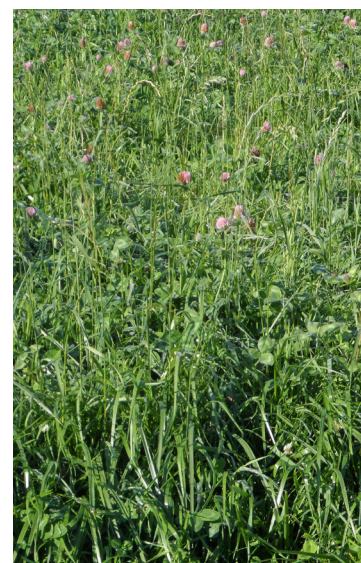

FORAGE AS PROTEIN SOURCE

For dairy cows

Forage is an important locally produced protein source for dairy cows, but the utilization of forage protein in ruminants remains a challenging topic. A large part of the protein in ensiled forage is available in the form of free amino acids, ammonia and other simple nitrogen compounds as well as other rumen degradable protein (RDP). To capture the free amino acids and ammonia for microbial protein synthesis, instant energy sources, such as sugars, are needed, and for the other RDP, also digestible fibre is needed.

This is important as the majority of the metabolisable protein (MP) from forage, which is used for milk production and growth in the cow, originates from microbial protein in the rumen, whereas only a smaller part originates directly from the feed undegradable protein. As a result, the energy content of the forage is at least as important as its crude protein (CP) content.

To increase the use of forage protein, thereby decreasing the need for protein from concentrates with imported soybean meal, attention is needed for several plant and management factors that affect both the content and quality of the forage CP.



Legumes

Legumes have a high CP content and can fix free nitrogen from the air, but they differ in protein quality. Lucerne and white clover contain more soluble protein but less rumen undegradable protein than red clover and birdsfoot trefoil. Therefore, it is important to combine silages containing much lucerne and white clover with maize silage or whole-crop cereal silage, which contain starch and sugars as energy sources for the microbial protein synthesis from ammonia and free amino acids in the rumen. Silages of mixtures of red clover/grass and birdsfoot trefoil/grass may need to be mixed with a grass silage, maize silage or whole-crop cereal silage if the legume proportion in the silage is high to avoid overfeeding of protein and insufficient amounts of structural fibre in the diet. The ratios between the different types of forages depend on the nutrient composition and digestibility of each forage. Protein-rich forages also can be supplemented with concentrates high in energy and rumen undegradable protein but proportions of structural fibre from forages in the diet need to be considered.

Forage maturity

More mature grasses and legumes have relatively lower CP contents and higher fibre contents. Also the proportion of rumen undegradable protein is higher in more mature forage plants since proteins are less soluble and more fibre-bound in these forages. However, as the degradability of fibre generally decreases more rapidly than that of protein with advancing maturity, and since this indigestible fibre decreases feed intake and milk production by the cows, an early harvest of forages is recommended.

Nitrogen fertilization of grass

An increased nitrogen (N) fertilization rate up to 200 kg N/hectare in the spring before the first cut can increase the DM yield to 5,500 kg/hectare, and the CP content of a grass sward up to 160 g/kg dry matter (DM), resulting in an increased CP yield of 880 kg CP/hectare when harvested in the early heading stage of maturity in the first cut. In case of these high N fertilization rates the CP content of grasses can even increase to a level similar to that of legumes. However, at the same time, the sugar content of the grasses decreases, which gives less substrate for lactic acid bacteria during ensiling. Also, there is a risk for increases in soluble protein content and the buffering capacity of grasses, which diminish the ensiling ability of the grass. In a mixed grass/legume ley, increased nitrogen fertilization rate increases the DM yield of the grass, resulting in a decreased legume proportion.

Wilting

During wilting of forages that are to be ensiled, plant enzymes start to break down protein to ammonia-nitrogen and other simple nitrogen compounds. A longer wilting time in rainy weather, especially when wilting occurs in big swaths, increases this protein breakdown. Therefore, rapid and even wilting, by use of wide-spreading or narrow single swaths, is important to limit this breakdown of protein during wilting. Wilting up to 24 hours in sunny and warm weather even increases the protein quality of grass/legume swards by converting the soluble true protein to slowly degradable and undegradable protein in the rumen.



FORAGE AS PROTEIN SOURCE

For dairy cows

Ensiling and use of silage additives

During the first weeks of ensiling, protein is broken down by both plant enzymes and bacteria. If Clostridia are present in the silage during anaerobic conditions, high levels of ammonia-nitrogen can be found in the silage, which decreases feed intake by the cows. Both chemical and biological additives can reduce break-down of protein during ensiling. Inoculants restrict proteolysis of forages with moderate to high sugar concentrations whereas a chemical additive can be more effective in forages with low sugar concentrations. More information on this can be found in the Technical Leaflet '**Reducing nutrient losses: use of additives in silage production**'.



FARMER CASE

Per Larsson's strategy for forage as a protein source for his dairy cows

Per is a EuroDairy pilot farmer, located in Tibro in south-west Sweden. Per is running a 200-cow organic herd operation. The 250-hectare farm includes a 30-hectare grazing platform and 120 hectares used for forage and silage production.

He uses a seed mixture of red clover, white clover, timothy, meadow fescue and perennial ryegrass and a 3-year duration of the ley. He fertilizes with 30 tonnes of slurry plus magnesium sulfate per hectare in the spring. Per takes three cuts per year, wilts the forage by wide spreading and windrows before precision chopping of the forage, which is ensiled in bunker silos.

His goal is to have 150 g CP/kg of DM and 11 mega joule metabolizable energy/kg DM. Per feeds the cows with silage from the first cut during the whole indoor period and complements with silage from the second and third cuts and with whole-crop cereal



silage and a little straw. Per feeds the cows with as much forage as possible, which is 13-14 kg DM/day. The annual milk yield is 10,000 kg energy-corrected milk per cow.

Webinar on www.eurodairy.eu: The role of forages as protein sources in dairy systems

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