## Perspectives of grass biorefining for livestock farms in the Netherlands

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### Abstract

The Netherlands has more than one million ha of grassland, which is mainly used for livestock farming. The aim of this study was to provide insight into the perspectives of grass biorefining for livestock farms in the Netherlands. In grass biorefining the harvested grass is pressed, with two products being the result: fibres and nutrient-rich juice. Proteins can be obtained from this juice. The protein, particularly, can be valorised as an alternative to imported protein-rich animal-feed raw materials such as soybeans. A SWOT-analysis was carried out. The analysis showed that grass biorefining is still in its infancy, yet it has prospects. The base product, grass, is amply available and by progressing technology it is expected that increasingly more components of grass can be valorised economically. In operating grass biorefining at a large scale, economic, ecological and social considerations at individual livestock farms as well as considerations at regional and national levels play a part. One can think of, for example, integration into the landscape and a reduction in grazing. A new way of livestock farming may arise, where grass is no longer produced for livestock only, but also for other applications.

Keywords: biorefining, grass, livestock

### Introduction

The Netherlands has more than one million ha of grassland, which is mainly used for livestock farming. The question arises whether there are other possibilities for using the available grass. Biorefining may be an option.

Biorefining is the processing of plants and plant residues into several components for different applications. The sum of the added value of these different components is assumed to be greater than the value of the whole plant. In biorefining, the individual components can be extracted and the remainder may be used for energy production. In grass biorefining the harvested grass is usually pressed, with two products being the result: fibres and nutrient-rich juice. From this juice proteins can be obtained. The protein in particular can be valorised as an alternative to using imported of protein-rich raw materials for animal feed, such as soybean extracts. The protein-poor residue can be used as a fodder for dairy cows, while the refined protein can be used in pig and poultry feed. Products of grass biorefining can also be used for energy production (Grass, 2004; Schmer *et al.*, 2008). A special feature of grass biorefining is the very wet biomass. The freshly harvested grass product contains 80-90% water. High-speed processing is required to prevent degradation of this wet product.

The idea of biorefining grass is not new. About 35 years ago, possible applications of different grass fractions were examined (e.g. Houseman, 1976). Thus far the technology has not yet been sufficiently well developed to create a profitable activity at a large scale. Recently, however, grass biorefining has received increased attention in the Netherlands. The aim of this study was to provide insight into the perspectives of grass biorefining for livestock farms in the Netherlands.

## Materials and methods

A desk study was carried out to assess the strengths, weaknesses, opportunities and threats of grass biorefining in the Netherlands. This SWOT-analysis included grass biorefining at both a small and a large scale.

## Results and discussion

When looking at the perspectives of grass biorefining on livestock farms in the Netherlands, several strengths can be seen. Grass is a major crop in the Netherlands with over 50% of the total land area (CBS, 2012). The majority of this grass is on peat soils and heavy clay soils that cannot be used for other crops. Furthermore, many dairy farms have a surplus of grass and there is no market for this surplus. Grass refining can increase the added value in those situations. Another strength is that the dry matter production of the grass can be increased (Prochnow *et al.*, 2009) by improving the grassland management; for example, by using precision harvesting and fertilization. Increases of 20% are possible. A further increase by 20-25% is possible by changing the current mowing/cutting regime (which is commonly practised in the Netherlands) into a regime of cutting only (Handboek Melkveehouderij, 2011). Grass refining may avoid environmental problems. In the Netherlands, the protein in the grass often exceeds the needs of the cow. Grass refining will lead to a feed with less protein for dairy cattle, and thus reduced losses to the environment. Since the protein can be fed, for example, to pigs and poultry, it can also lead to reductions in imports of protein feeds (e.g. soybeans from South America). Other sustainable aspects of grass biorefining are a decreasing use of fossil energy and more C sequestration as a result of an increasing grass area. Finally, grass refining could be carried out at farm scale.

However, there are also weaknesses of grass biorefining. The techniques of grass biorefining are in development, as are the markets to valorise each product of grass biorefining. The seasonality of grass production throughout the year is also a weakness. As a result of changing weather conditions production of grass is not constant throughout the year. The biorefining capacity should be harmonized with the grass supply. During winter only ensiled grass is available. It is not clear yet whether the traditional way of ensiling is also the most optimal way of preserving grass for grass biorefining. The effect of grass ensiling on the quality of the refined products is not yet known. First results in the Netherlands with biorefining of ensiled grass show that the protein-poor fibre can be fed to dairy cows (Klop *et al.*, 2012). A further weakness is that the combination of livestock production and grass biorefining leads to fragmentation of tasks for the farmer. This may lead to lower efficiency and lower profits (this is of course not true in those situations where the farm completely switches from livestock production to grass biorefining). Adjustment of the existing grassland use (mowing / grazing) to mowing-only can be a bottleneck. Currently, approximately 70% of the dairy farms in the Netherlands practise grazing (CBS, 2012). For grass biorefining it is necessary to cut the grass, which means that dairy farms have to adapt to a new situation. Also, in general, cutting grass requires more hours of labour than grazing. A further threat is the logistical implications of grass biorefining. If individual dairy farms refine grass, many small quantities of products would need to be collected in order to have sufficient quantity for commercial use. If grass biorefining is done at a central location, the high moisture content of grass will lead to many transport movements with associated costs and environmental impact. Finally, the farmers' knowledge of grass biorefining is still limited and there are uncertainties about costs and revenues of grass biorefining.

When evaluating the perspectives of grass biorefining for livestock farms in the Netherlands, not only strengths and weaknesses should be studied, but also opportunities and threats. Several opportunities can be identified. First of all, through fermentation of residuals from

grass biorefining, green energy can be generated, which is a positive outcome since the supply of fossil fuels is finite. Breeding could lead to higher grass yields per hectare and higher profits, and also to grass varieties with a composition favourable for biorefining. The growing season has extended during recent decades. Further extension of the growing season will contribute to higher grass yields. There is also plenty of grass available from outside the farm at low prices (e.g. roadside grass, grass from nature preserves). Other relatively wet green crops might be similarly refined, e.g. alfalfa, clover, beet leaves, and residues from the food industry. Grass biorefining is also an option for arable farms. Grass fits well into an arable crop rotation and improves soil quality. Products of grass biorefining could be applied in different industries (Chiesa and Gnansounou, 2011), for example, protein in animal husbandry, fibre in the paper industry, and the residual juice could be used as fertilizer. Further technological development could lead to additional added value of grass components, e.g. via innovative industrial applications for fibres such as housing, wind turbine blades or computer equipment. In time, use in the human food chain is also a possibility.
Finally, there are threats. Some of these are rather specific for Dutch circumstances. The current manure legislation in the Netherlands complicates the sale of fertilizer products from grass biorefining. Society does not support technological innovations in general, especially not if refinery plants and storages are very visible in the landscape. Furthermore, society in the Netherlands favours grazing (Van den Pol-van Dasselaar *et al.*, 2008). Grass biorefining will, however, lead to less grazing if it becomes widely practised. And finally, grass biorefining may compete with the grass supply for animal nutrition and/or lead to higher prices for forages.

## Conclusion

Grass biorefining is still in its infancy, yet it has prospects. The base product, grass, is amply available and by progressing technology it is expected that increasingly more components of grass can be valorised economically. In applying grass biorefining at a large scale, economic, ecological and social considerations at individual livestock farms as well as considerations at regional and national levels play a part. One can think of, for example, integration into the landscape and a reduction in grazing. A new way of livestock farming may arise, where grass is no longer produced for livestock only, but also for other applications.

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