FOOD & BIOBASED RESEARCH

WAGENINGEN UR

BIOREFINERY OF GRASS AND LEAVES

Marieke E. Bruins, Peter Geerdink

Background

- Sustainably food for 9 billion humans needs a shift from animal to plant based protein.
- Plant proteins are increasingly being used, e.g. from pulses and grains.
- Grass and leaf protein is still hardly valorised.
- How can we use all these proteins effectively?

Grass protein for Feed

Animals need a specific amount of protein in their diet depending on animal type and age, etc. Protein is relatively costly and also has large environmental impacts in production and use (consider GHG impacts of fertilizer production, N_2O emissions, land use, etc.). It is therefore important that animals use proteins as building blocks and not for energy.

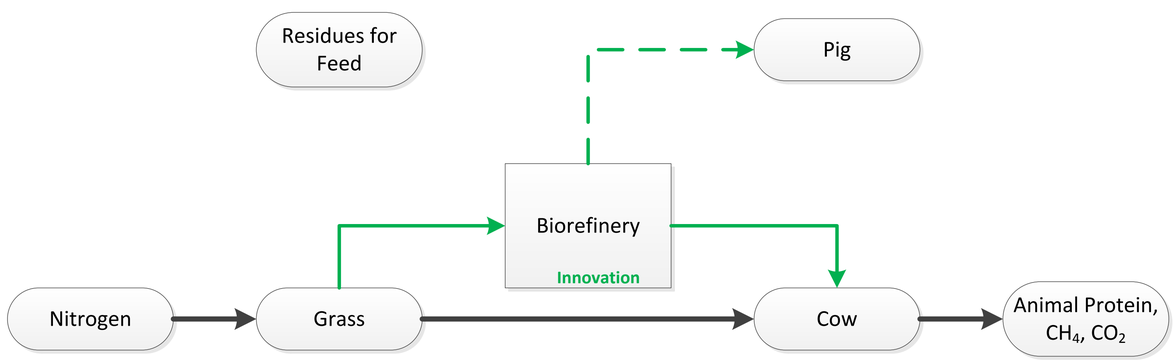


Figure 2. Concept of grass biorefinery for feed, in which grass is separated in a fibre fraction for cows and a protein rich fraction for pigs that replaces other protein rich streams like imported soy.

Biorefining grass into a lower protein, high fibre fraction for cows and a higher protein, low fibre fraction for chickens or pigs can lead to more animal production per hectare and lower GHG emission per animal product produced. Currently this biorefinery technology is in most cases too expensive to be attractive for farmers while protein is relatively cheap. Monetarizing the GHG benefits of the biorefinery system could make the technology viable.

At WFBR several routes towards grass and leaf proteins were developed and tested, using e.g. mechanical disruption, alkaline extraction, and with the aid of hydrolytic enzymes. In the case of proteins for feed, focus is on high yields and preservation of nutritional value.

Figure 1. Mobile grass biorefinery at GRASSA!.

Pilot scale grass refineries have been operated in Germany and the Netherlands[1,2]. By grinding, bruising, and pressing grass, fibres and grass juice are separated. Afterwards, protein is separated from the liquid by precipitation or coagulation to yield a high protein product. Filtration of residual grass juice produces a juice concentrate. Both grass refineries have been developed for small-scale and local application.

Functional protein from leaves

Plant proteins that can replace functional animal-based proteins are hard to come by. Especially in combination with a high the nutritional value in terms of amino acid composition.

RuBisCO is the most abundant protein on earth, and has a great potential in replacing animal-derived functional proteins, in terms of functionality, digestibility and nutritional value. This protein can be found in plants, algae, cyanobacteria. However, RuBisCO is not yet commercially available.

A patented[3] process has been developed to produce white, odourless functional protein from leaves and this process has been demonstrated on a pilot plant level at 50 kg/hr input.

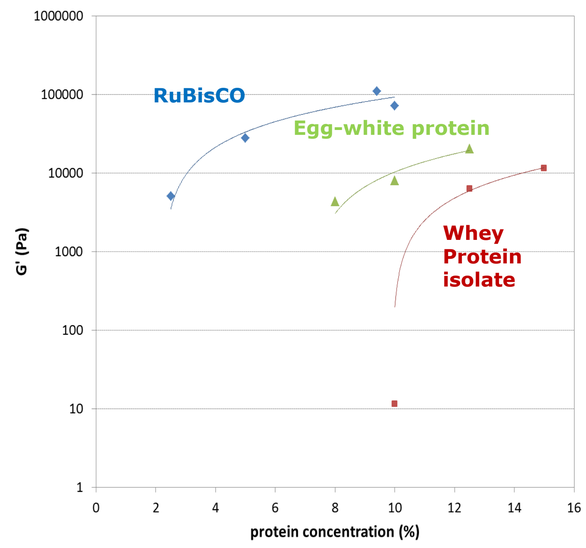
Figure 3. Wageningen Pilot Facilities

RuBisCO as a food ingredient

Recent studies have shown that the functional properties of RuBisCO which are essential for applications in food are in some cases even better than those from animal derived sources. RuBisCO can therefore be used to replace for instance egg and milk proteins in several applications.

Currently, RuBisCO protein extracts from different plant sources undergo tests to get them approved under the Novel Food Regulation and acceptance of the first products is not far away.

Figure 4. Comparing the gel-strength of RuBisCO with commercial animal-derived proteins[6]



Functional properties[4]
Excellent gelling (Figure 4)
High foam performance
Good emulsification properties
High solubility (pH dependent)

Nutritional value[5]
AAS: 87%
Excellent digestibility
No known allergenicity

Outlook

Read our vision document on future research in the field of protein and technology
https://www.wur.nl/en/project/More-and-Better-Protein.htm

References

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WUR, Wageningen
Contact: Marieke.Bruins@wur.nl