Protein feed from clover grass for pigs and poultry.

Results from Danish innovation projects

Erik Fog

SEGES Organic Innovation

Tagung: Grünland nutzen und erhalten, Saarbrücken
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SEGES is one of Europe's leading agricultural innovation companies

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Scope of activities

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SEGES is the bridge-builder between research and practical farming

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We innovate and disseminate knowledge to:

37,000

Farms

900

Horticulturists or nurseries

7,000

Small or medium-sized companies

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650
employees

8 out of 10
have an academic background

70
different educational qualifications

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Why proteins from grass are so interesting - changing annual crops into grass land

- EU animal production is largely dependent on imported proteins (mainly soya).
  - A strategic plan for more EU produced protein is launched this week.
- The climate load from animal production has to be reduced – more carbon sequestration in grass.
- Less nitrate leaching from grassland
  - Danish environmental programs for coastal waters.
- Difficult to supply organic pig and poultry with organic and locally produced proteins. Combined with nitrogen deficiency in organic plant production.
- Better conditions for insects and wildlife / higher biodiversity.

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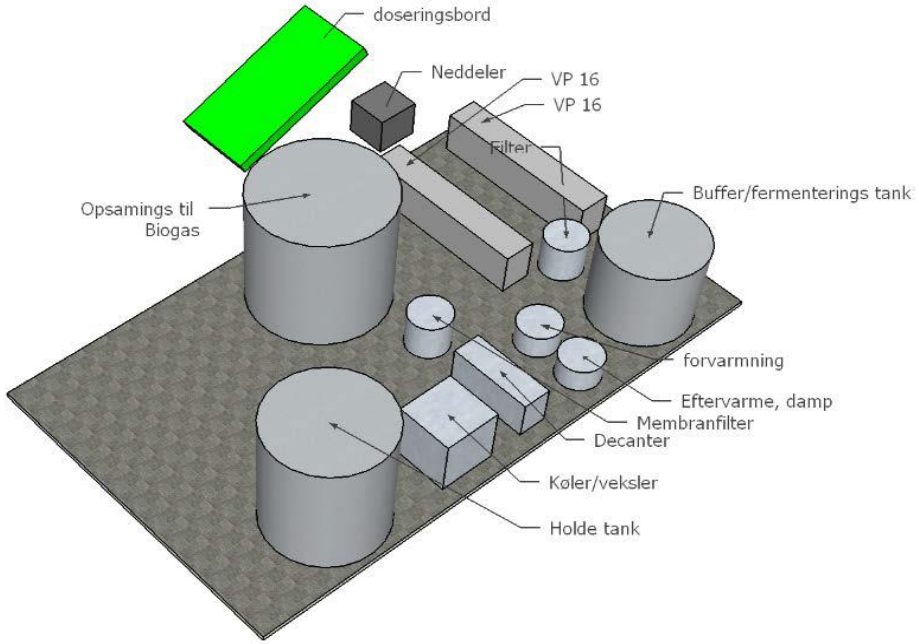
Danish research and innovation projects on grass proteins

- **Biobase**: A pilot plant for green biorefinery has been established at Aarhus University, Foulum.

- Expanding in 2019 to demonstration scale (10 x pilot scale) – Project: **Grønbioraf**



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M. Ambye-Jensen, Aarhus University

Danish research and innovation projects on grass proteins

- **OrganoFinery**: Developing a concept for grassprotein supply for organic animals combined with biogas production and digestate fertilizer for organic crops
- **BioValue**: Broard research platform on biorefinery

Mutual big scale trials with grass protein production for feeding trials.

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Aalborg and Aarhus Universities

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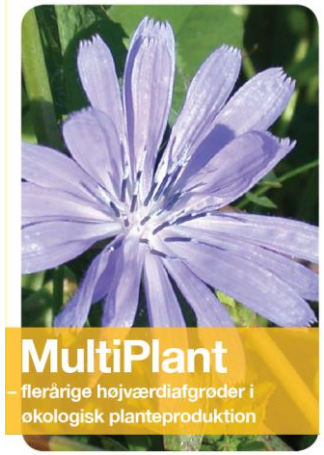
Danish research and innovation projects on grass proteins

- **MultiPlant**: Developing a multi species concept of forage for grass protein and biogas.
- **SuperGrassPork**: Feed value of grass protein for pigs and further development of the biorefining process.
- **GreenEggs**: Egg quality and production on grass protein combined with green leaves from willows in the hen yard.



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Danish implementation projects on grass proteins

- Grass Protein Factory: A Danish consortium setting up a factory concept for grass protein production. Including Aarhus University, engineering company, machinery suppliers, feed company and farmers.
- Biomass Protein: A project with similar goals.
- Bioraf-Business: Optimizing grass supply and business plans.

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Bio-refinery as improvement of Danish organic production

More grass clover -
More Nitrogen

Extraction of grass protein
Less protein import

Biogas from residues and household waste
Bio-energy and nutrient recycling

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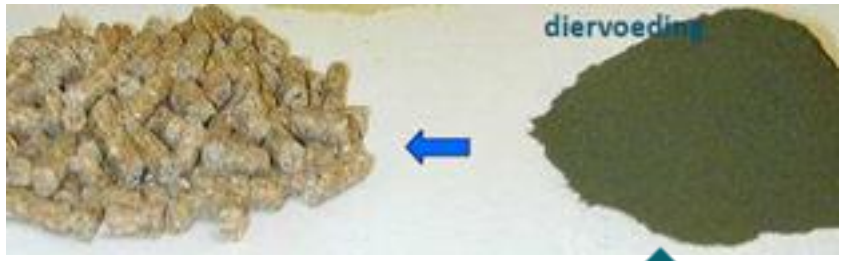
THE GRASS BIOREFINERY CONCEPT

Harvest of fresh grass clover

Juice press

Press cake

Cattle feed



Feed for pigs
and poultry

Fermenting

Biogas

Digestate fertilizer

Protein separation

Recidue liquid

High protein yields in legume rich forage

Crop	Yield (ton DM / ha)	Protein Kg / ha	Lysine Kg / ha	Methionine Kg / ha
Grass – clover mixture	13	2600	200	90
Alfalfa	12	2600	200	90
Peas	6	1300	92	13
Field bean	6	1500	92	11
Soy-bean (US)	3	1050	65	14

Modified from S. Krogh Jensen, Aarhus University

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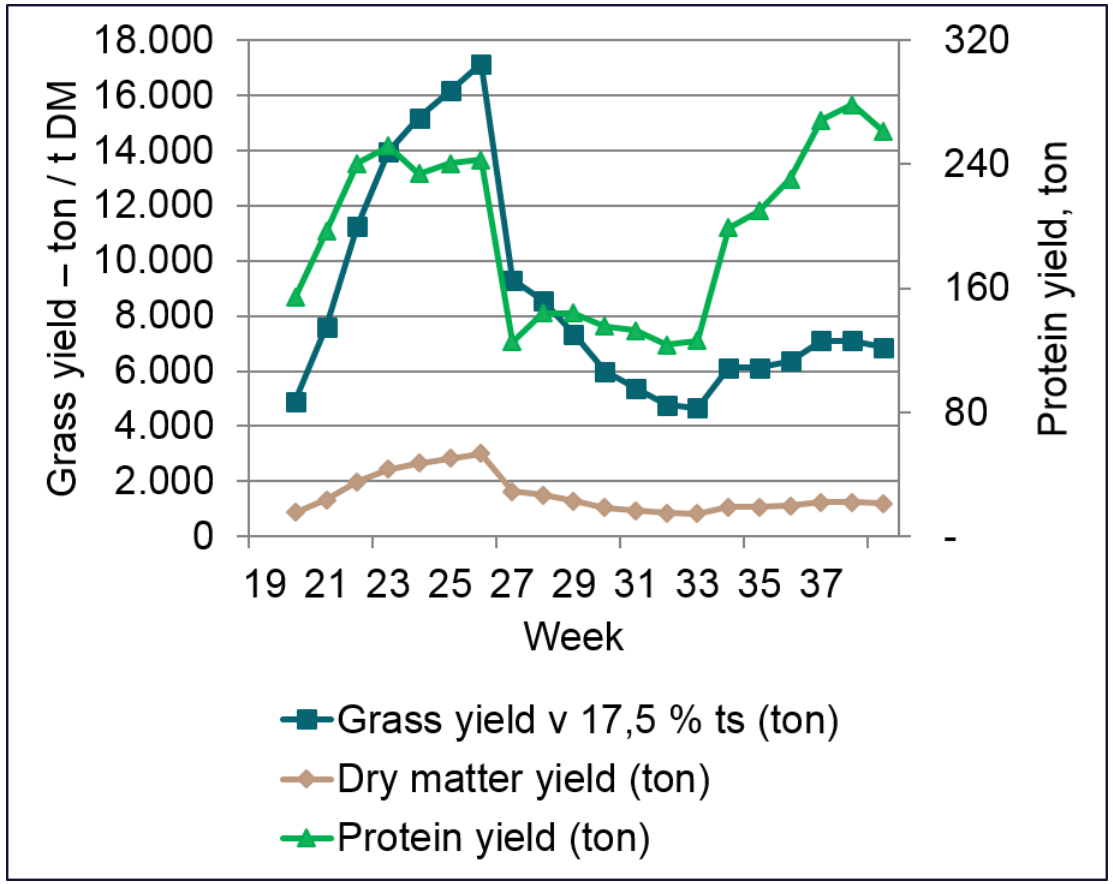
Season variations have to be managed

- Calculated yields during the grass season.
  - 3000 ha
  - 5 cuts
  - 4 blocks of 750 ha



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Harvest technic is important for protein yield and quality

Foto: T. Frandsen - SEGES


Foto: Pöttinger.AT

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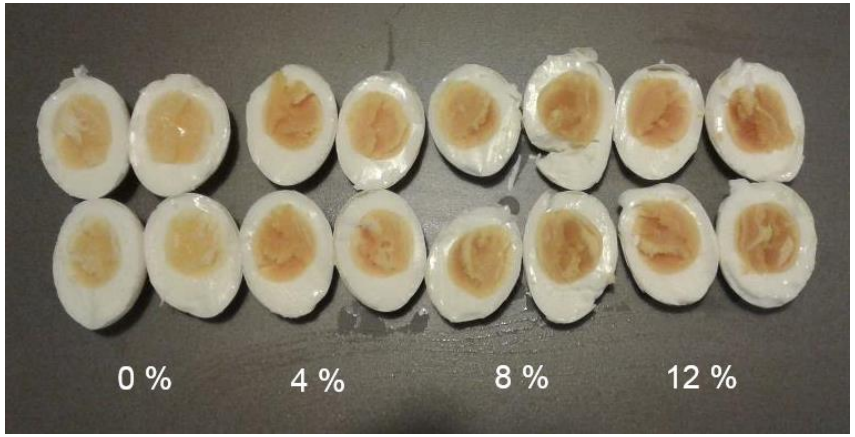
Feed value – Grass protein concentrate

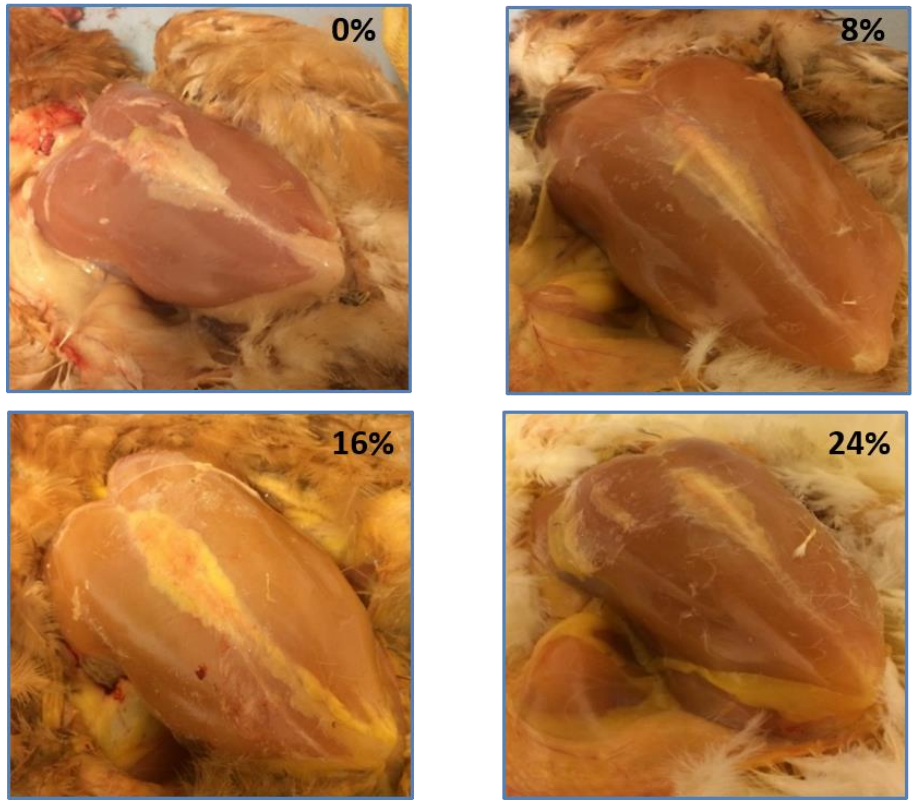
- Hens (OrganoFinery)
  - Feed with 4, 8 or 12 percent grass protein concentrate gave the same egg yield as the control feed. – And more yellow yolks.



(Stenfeldt et al. 2017, Aarhus University)

Feed value – Grass protein concentrate

- Chicken (MultiPlant)
  - Up to 3 % of crude protein (8 % protein concentrate) can come from grass protein without influencing the growth rate. (Trial with relatively low protein concentration in test feed)
  - Yellow pigments from the grass embedded in the chickens.
  - Higher levels of omega-3 fatty acids in chicken fat with higher levels of grass protein in feed.



(L. Stødkilde, Aarhus University)

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Feed value – Grass protein concentrate

- Pigs (Biobase & Feed-a-gene / SuperGrassPork)
  - Pigs had good appetite to feed with grass protein.
  - The protein digestibility of protein from test feed with low protein content (35 % crude protein) was lower than in soy-concentrate.
  - Expected to be better in grass protein concentrate with higher protein content.
  - Feeding trial with slaughter pigs started November 2018. Test feed with 48 % protein in grass protein concentrate.

(L. Stødkilde, Aarhus University)

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Feed value – Press cake from grass protein production

- Milking cows (BioValue)
  - Test feeding with press cake compared to grass silage.
  - Lower dry matter content and higher fiber content in the press cake compared to the grass silage.
  - Good appetite to the press cake silage, higher in vivo digestibility and a higher milk yield with press cake.

(Vinni K Damborg phd work, Aarhus University)

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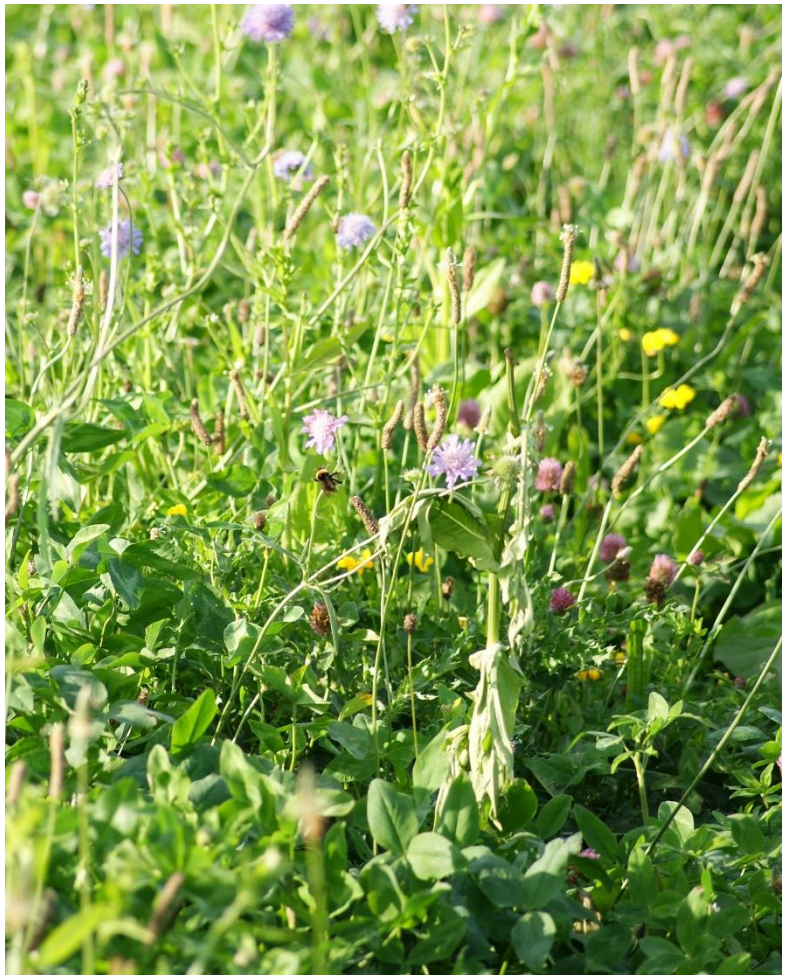
Grass protein and biodiversity

- Project MultiPlant has tested different mixtures of grass, legumes and fobs.
  - Similar drymatter yield and even higher biogas yield in mixtures with fobs.
  - Nitrogen fixation follows the amount of legumes.
  - Different plant species promote different insect species.



J. Eriksen, Aarhus University

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Economy in green biorefinery
- only profitable in organic farming

	Conventional (k-DKK / year)	Non- GMO (k-DKK / year)	Organic (k-DKK / year)
Total income	22,078	26,423	31,095
Total costs	29,780	29,781	29,730
Result	**-7,702**	**-3,358**	**1,365**

Model calculation on a biorefinery plant processing 20,000 tons DM grass-clover per. year and producing 3,600 tons dried protein concentrate.

Source: M. Gylling (2018), Copenhagen University, IFRO.

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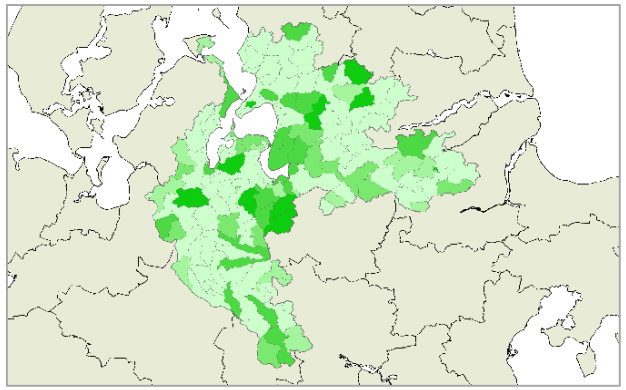
Great perspectives in grass land for biorefinery

- Prospect for more conversion to organic farming
  - Especially in areas with few cattle.
- Environmental benefits
  - Less nitrate leaching, higher biodiversity
- Greenhouse gas mitigation
  - More carbon sequestration in the soil (humus)



Pct. area converted into grass to mini-malize nitrate leaching

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Thank you for your attention

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