

English



Title of Paper

Bio-refining of proteins from grass clover as innovative solution to a truly sustainable organic production.

Subtitle

Presenter Name

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Bio-refining of proteins from grass clover as innovative solution to a truly sustainable organic production

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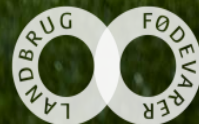
OWC 2017, New Delhi, November 9, 2017



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The project OrganoFinery - Organic growth with biorefined organic protein feed, fertilizer, and energy.

- Will create new solutions to:
 - Low yields.
 - Supply organic protein feed to monogastric animals.
 - Problematic crop rotations.
 - Climate performance.
- By utilizing grass-clover for bio-refining and producing protein concentrate for pigs and poultry.

Harvest of 3-4 cuts of fresh grass-clover



Plant juice pressed within a few hours



Fermented with lactic acid bacteria



Precipitated proteins are separated from the juice



Dried and used as protein concentrate



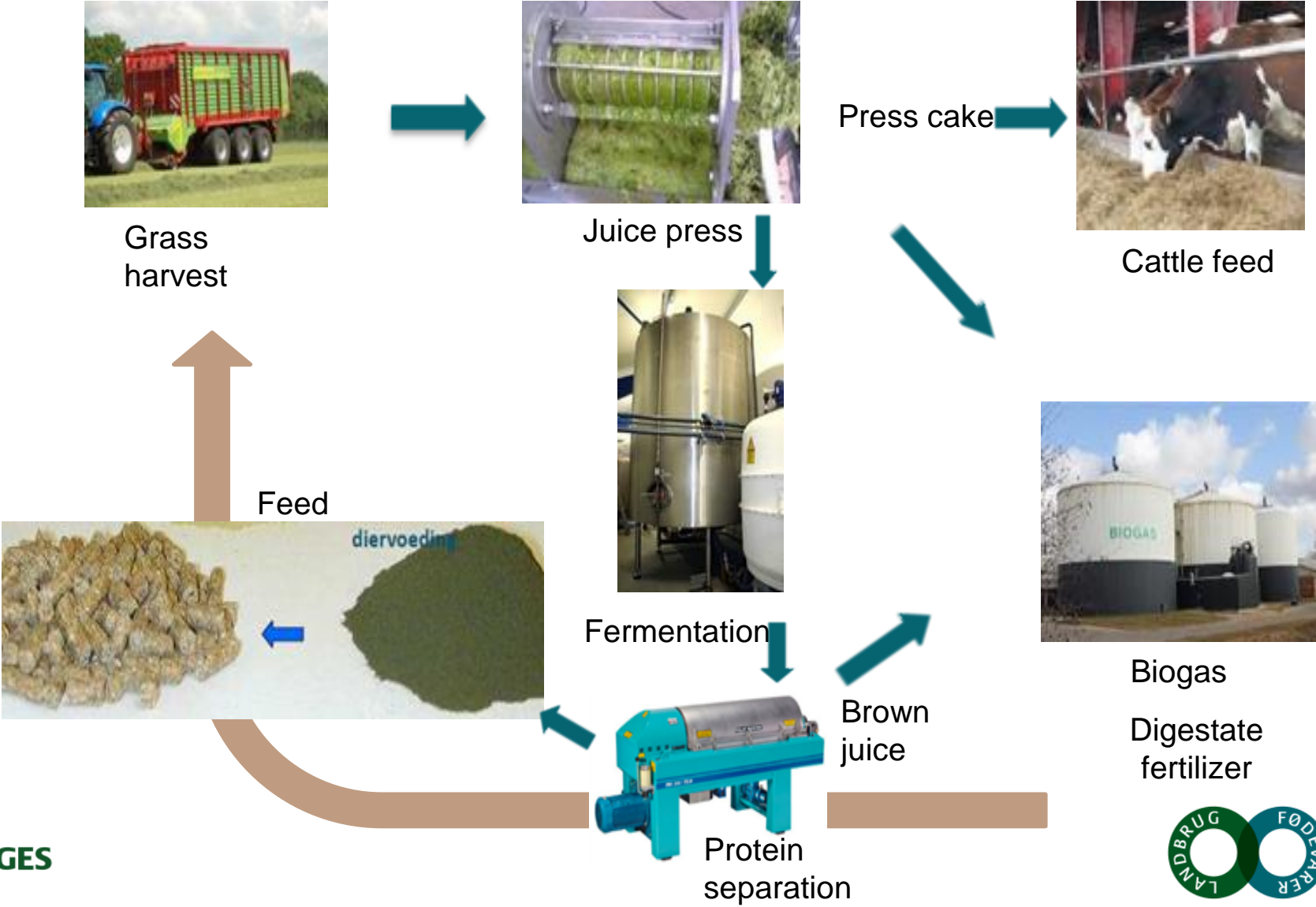
Plant and protein yields (two trials in Denmark)

Yield (ton ha ⁻¹)	Crop DM	Crop protein	Protein conc.*)
White clover / Ryegrass	6.26	0.88	0.31
Red clover	8.82	1.47	1.47
Red clover / cock's foot	9.50	1.36	1.36

Yield (ton ha ⁻¹)	Crop DM	Crop protein	Protein conc.*)
Alfalfa	13.31	2.53	0.89
Red clover	16.45	2.86	1.00
Grass clover mixture	19.23	2.95	1.03

*) The yield of protein concentrate is estimated to 35 % of the crop protein.

Biogas as part of the system



Biogas yields from residues (press cake and brown juice)

Yield (Nm ³ ha ⁻¹)	Est. methane yield.*)
White clover / Ryegrass	3,056
Red clover	2,392
Red clover / cock's foot	3,090

Yield (Nm ³ ha ⁻¹)	Est. methane yield.*)
Alfalfa	3,492
Red clover	4,460
Grass clover mixture	6,254

*) The methane yield is estimated from methane yields of press cake and brown juice from similar crops.

Grass protein as feed (laying hens)

- Feeding trial with laying hens showed that grass clover protein concentrate (GPC) can substantially substitute organic soybean.

Partial replacement of organic soybean and soya cake with GPC (4, 8, and 12 %) didn't influence the egg production, compared to the control diet.

Total digestibility of dry matter wasn't influenced, but the digestibility of methionine and lysine decreased significantly.

The yellowness of the yolk increased significantly with GPC in the diet.

(Khanal, Tanka and Steinfeldt, Sanna (2017) Effect of Clover grass protein concentrate on performance, digestibility and egg quality of laying hens fed 100% organic diet. Organic Eprints.)



Grass protein as feed (milking cows)

- Silage of press cake from production of grass clover protein concentrate was compared with silage of grass clover from the same field as forage for dairy cows.

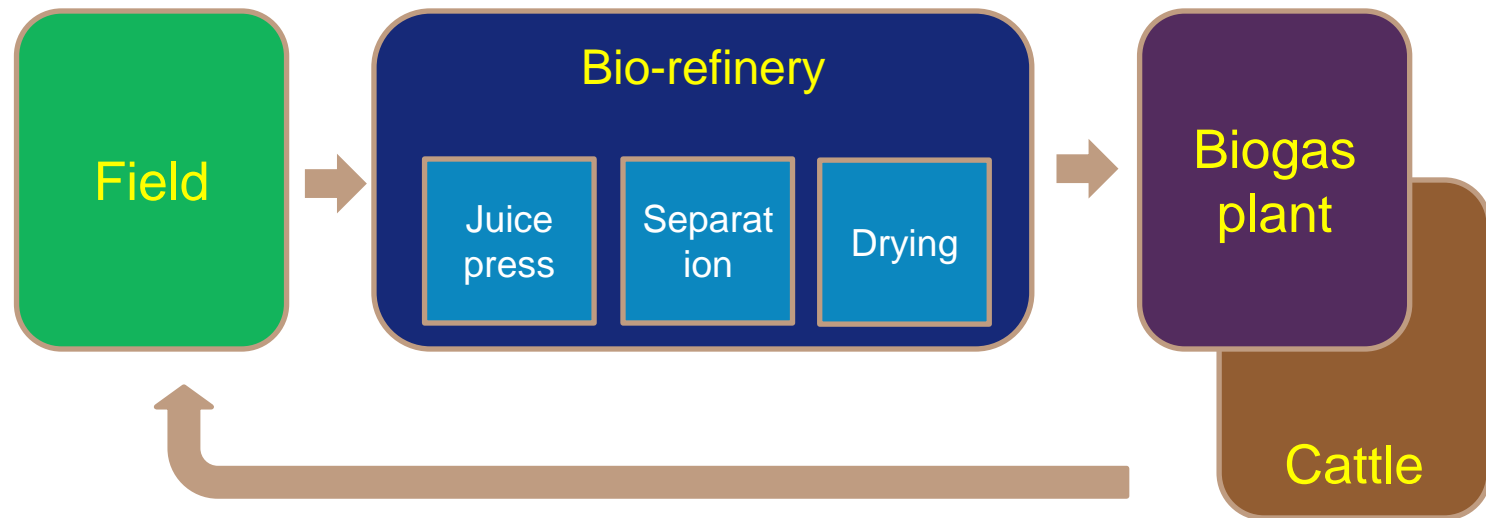
	Press cake silage	Grass clover silage
In vitro digestibility	70.7 %	67.6 %
Crude protein concentration	16,8 %	13,6 %
Daily DM intake	23.1 (\pm 0.3) kg/d	22.6 (\pm 0.3) kg/d
Daily milk yield	37.4 (\pm 0.9) kg/d	34.6 (\pm 0.9) kg/d

(V.K. Damborg, S.K. Jensen, M.R. Weisbjerg: Value of pulp from green protein extraction of grass clover as forage for dairy cows. 2017 ADSA Annual Meeting.)



Economic calculations

- Production model



Economic results (model calculation on Danish conditions)

	Economic result (€ / ha green crop)
Standard conditions *)	201
Without drying (wet feed)	540
20 % lower / higher protein price **)	-94 / 496
10 % lower / higher biogas price **)	24 / 378
10 % lower / higher protein yield **)	58 / 343

*) Standard conditions: 0.7 ton protein / ha; 2,900 Nm³methane / ha; 0.8 € / kg dry protein concentrate; 0.6€ / Nm³bio-methane.

**) Dried protein concentrate.

Conclusions

- Protein concentrate can be extracted from fresh grass-clover juice.
- Approximately 700 kg of crude protein / ha is realistic.
- The concentrate can substitute soy protein in the diet.
- Silage of grass press cake is a valuable forage for dairy cows.
- Press cake and residual juice are valuable for biogas production
- Grass bio-refining must be optimized to get a profitable production / a realistic protein price.
- More nitrogen in the crop rotation is part of the benefits.

Thank you for your attention

- **And thank you to the partners in the OrganoFinery project:**

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- Biotest Aps.
- SEGES
- Copenhagen University
- Aarhus University
- IFAU – Institute for Food Studies & Agroindustrial Development ApS
- Danish Technological Institute



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