

Feeding toasted field beans to dairy cows

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Background

- Most organic dairy farms in Denmark have medium to high input of concentrated feed
- Concentrate feed: The protein sources are imported soy cake and rapeseed cake.
- The price of soy cake has reached extremely high levels
- Homegrown protein feed?
 - Reduce feed cost?
 - Maintain production level?
 - Improve sustainability, traceability and feed safety

Project EcoProtein

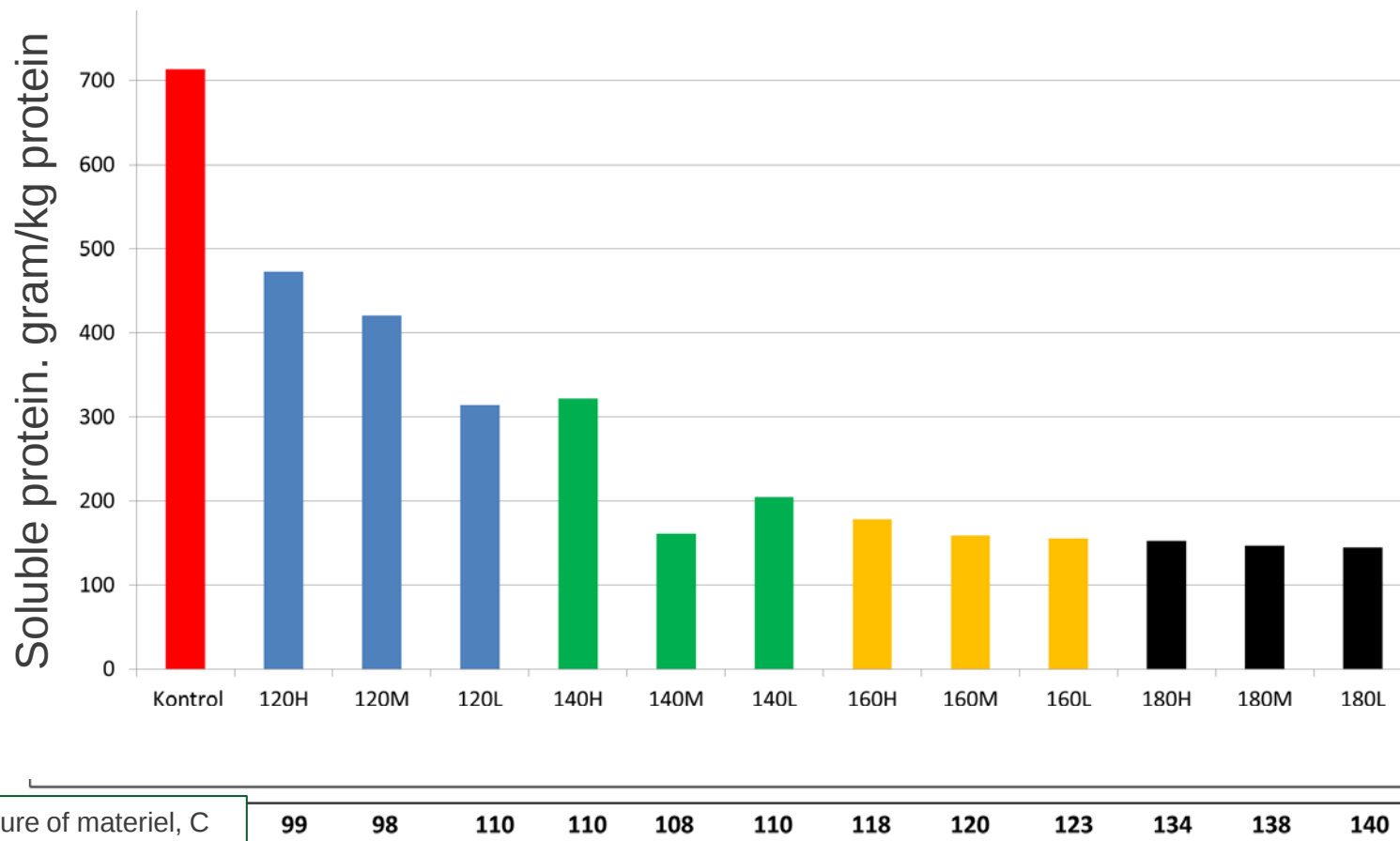
- A 4-year GUDP project with the aim of increasing the amount of danish grown protein sources (legumes) fed the organic husbandry, by:
 - improving the yield and the protein quality in the field
 - Improving the protein quality by processing

Preliminary studies-

Testing how a Dielts-Wetzel farm toaster affects protein quality i field beans when toasting at different temperatures



Effect of heat treatment on the solubility of protein. Field beans toasted with Dielts-Wetzel farm toaster



Protein value based on *in sacco* results

	Field beans untreated	Field beans toasted (120 °C)	Rape seed cake, coldpressed	Soy cake, toasted
Crude protein, g pr kg DM	331	329		
Soluble protein, g pr kg protein	713	159		
Degradation rate in the rumen, %/hour	10.6	3.9	-	-
Effective protein degradation, EPD	78.0	53.2		
AAT (Amino Acids available in the inTestine) g pr kg DM	110	190	79	216
PBV (Protein Balance in the rumen) g pr kg DM	145	46	184	203

Feed demonstrations in 2 organic dairy herds

Objective:

Can we replace soy cake with toasted field beans?

- Effekt on milk yield and milk quality

- **Herd 1:** 270 Danish Holstein (2 x 90 cows).
yield level 9500 kg ECM
- **Herd 2:** 115 Danish Holstein(2x 55 cows).
yield level 10500 kg ECM

Test design

HERD 1

Time frame

Group A	Control	Test	Control	Test	
Group B	Test	Control	Test	Control	
	4 weeks	4 weeks	4 weeks	4 weeks	16 weeks

HERD 2

Group A	Control	Test	Control	Test	
Group B	Test	Control	Test	Control	
	4 weeks	4 weeks	4 weeks	4 weeks	16 weeks

Feed demonstrations

Took place: December 2012 to April 2013

Sampling:

- Individual milk yield, fat and protein
- Feed control

Treatment of the field beans

The field beans harvested with a high water content (31 %).

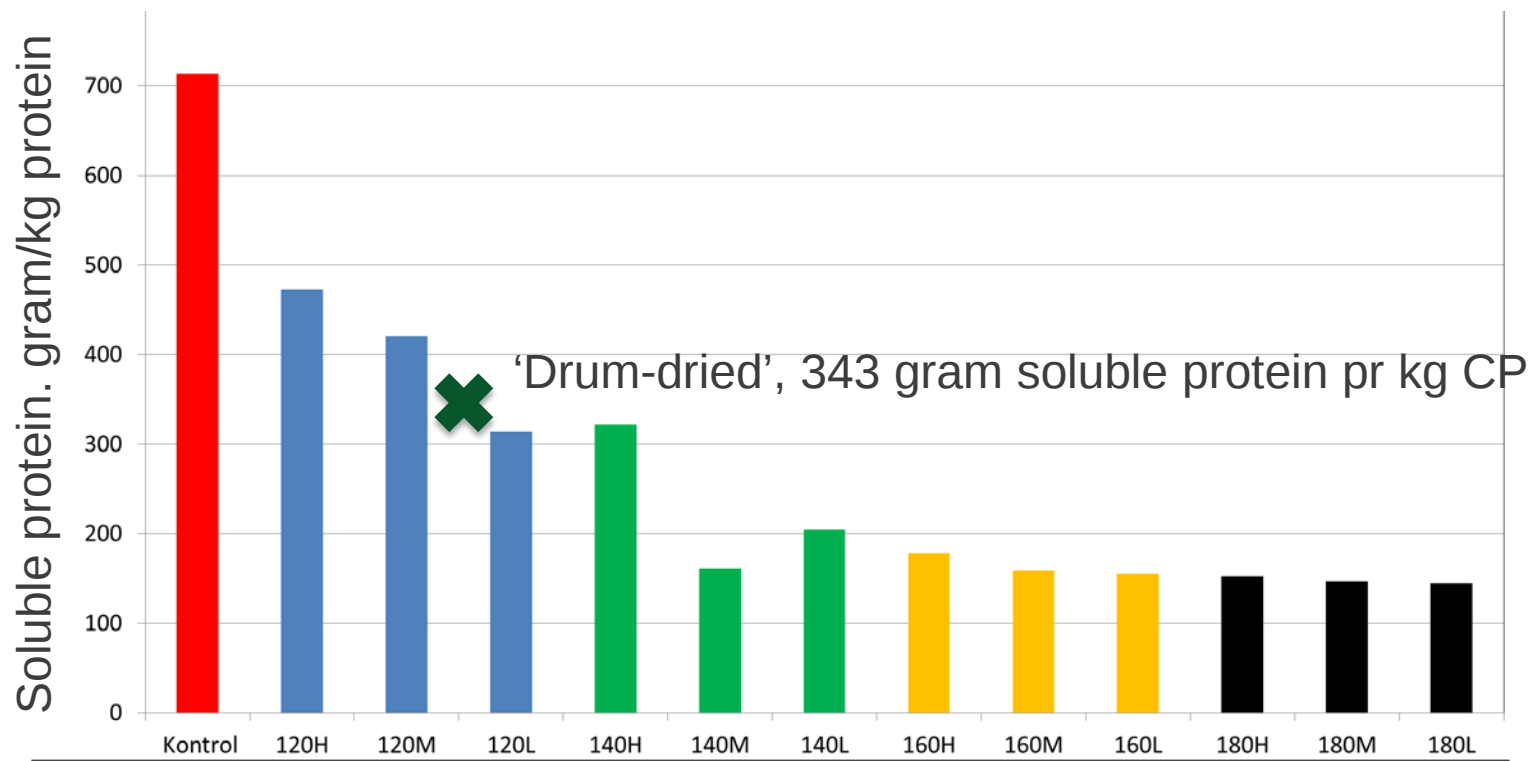
Danish Agro processed the field beans:

Dried in a 'drum drier' with the temperature at a maximum

However, temperature in the kernels only reached 110-115 °C (optimum is 120-130 °C) and the effect of the heating was only half of an optimal toasting proces.

Cost ~ 6.7 euro/100 kg delivered

Effect of heat treatment on solubility of protein



Temperature of material, C

99

98

110

110

108

110

118

120

123

134

138

140

Effect of treatment (*in sacco* results)

	Field beans untreated	Field beans Heat treated (drum-dried)	Field beans Toasted (120 °C)
Soluble protein . g/kg crude protein	618	343	159
Degradation rate in the rumen %/hour	10.8	8.5	3,9
AAT (Amino Acids available in the inTestine) gram/kg DM	121 →	144	190
PBV (Protein Balance in the rumen) gram/kg DM	121 →	84	46

Planned feed rations Herd 1

	Price dKr (euro) /kg		Ration with soy cake	Ration with Field beans
Barley	2.50 (0.33)	Kg	6.9	3.5
Soy cake	6.10 (0.81)	Kg	2.0	0.4
Field beans heat treated	3.50 (0.47)	Kg	0	4.9
Concentrate (25% crude protein)	3.45 (0.46)	Kg	2.3	2.3
Cost of concentrate			37.39 dkr/day (4.99 euro/day)	36.28 dkr/day (4.84 euro/day)
Cost difference				1.11 dkr./ko /day (0.15 euro/day)

4.9 kg field beans replaces 1.6 kg soy cake and 3.4 kg barley

Optimization of feed ration in Herd 1

Equal energy levels

		Ration with soy cake	Ration with field beans
Planned ECM-yield	kg/dag	38.5	38.5
Protein	g/kg DM		
AAT	g/MJ	15.1	15.1
PBV	g/kg DM	27	35
Fatty acids	g/kg DM	26	21
NDF	g/kg DM	298	296
Starch	g/kg DM	198	189

Results Herd 1

	Kontrol Soy cake	Test Field beans	<i>P-value</i>
DM intake, kg	23,9	20,9	$< 0,09$
Energy, MJ/day	156,1	139,3	$< 0,10$
Crude protein, g/kg DM	168,7	177,2	$< 0,01$
AAT, g/MJ	16,9	13,9	$< 0,06$
PBV, g/ kg DM	22,9	35,9	$< 0,01$
Fatty acids, g/kg DM	24,5	22,5	<i>Not available</i>
Starch, g/kg DM	215	210	<i>Not available</i>

Results Herd 1

	Kontrol Soy cake	Test Field beans	<i>P-value</i>
Milk yield, kg	30.32	30.22	<i>ns</i>
Fat%	4.43	4.47	<i>ns</i>
Protein%	3.47	3.41	<i>p<0.03</i>
ECM, kg	31.87	31.86	<i>ns</i>
Feed cost pr kg ECM, dkr	1,71	1,54	<i>0,17 dkr in favour of the FB ration</i>
Feed cost pr kg ECM, €	0,23	0,21	<i>0,02 € in favour of the FB ration</i>

Planned feed ration in herd 2- Period 1+2

	Price dKr (euro) /kg		Ration with soy cake	Ration with Field beans
Soy beans. toasted	7.2 (0.96)	Kg	0	0.4
Field beans crimped	2.3 (0.31)	Kg	2,5	1.2
Field beans heat treated	3.5 (0.47)	Kg	0	4.6
Concentrate (33 % CP)	5.2 (0.70)	Kg	3.7	0
Grain	2.1 (0.28)	kg	5,6	5,5
Cost of concentrate			36.9 dkr/day (4.92 euro/d)	33.3 dkr/day (4.44 euro/day)
Cost difference				3.60 dkr./ko /day (0.48 euro/day)

4.6 kg Field beans replaces 3.7 kg concentrate. 1.3 kg crimped field beans.
but 0.4 kg soy beans are added to supply with fatty acids

Optimization of feed ration in Herd 2 - Period 1+2

Equal energy levels

		Ration with soy cake	Ration with field beans
Planned ECM-yield	kg/day	36.7	36.7
Protein	g/kg DM		
AAT	g/MJ	15.3	15.4
PBV	g/kg DM	29	21
Fatty acids	g/kg DM	30	22
NDF	g/kg DM	342	337
Starch	g/kg DM	177	215

Ration in Herd 2 - Period 3+4

	Price dKr (euro) /kg		Ration with soy cake	Ration with field beans
Soy beans. toasted	7.2 (0.97)	Kg DM	0	0.4
Field beans heat treated	3.5 (0.47)	Kg DM	0	3.4
Concentrate A(33% protein)	5.2 (0.70)	Kg DM	3.6	0.4
Concentrate B (14% protein)	2.90(0.39)	Kg DM	5.8	4.9
Cost of concentrate			39.8 dkr/day (5.38 euro/d)	35.2 dkr/day (4.76 euro/d)
Cost difference				4.6 dkr/cow/d (0.62 euro/d)

3.4 kg field beans replaces 4,1 kg concentrate, but 0.4 kg soy beans are added to supply with fatty acids

Results Herd 2

	Period 1+2			Period 3+4		
	Kontrol Soy cake	Test Field beans	<i>P-value</i>	Kontrol Soy cake	Test Field beans	<i>P-value</i>
DM intake, kg	28,6	26,5	<i>ns</i>	28,1	26,3	<i>ns</i>
Energy, MJ/day	176,1	167,0	<i>ns</i>	172,7	163,2	<i>ns</i>
Crude protein, g/kg DM	167,7	164,4	<i>ns</i>	162,9	159,4	<i><0,01</i>
AAT, g/MJ	17,4	17,4	<i>ns</i>	17,8	16,9	<i>ns</i>
PBV, g/ kg DM	19,6	18,1	<i>ns</i>	12,8	12,7	<i>ns</i>
Fatty acids, g/kg DM	28,5	22	<i>na</i>	29	19	<i>na</i>
Starch, g/kg DM	171	193	<i>na</i>	161	184	<i>na</i>

Results Herd 2

	Period 1+2			Period 3+4		
	Kontrol Soy cake	Test Field beans	P-value	Kontrol Soy cake	Test Field beans	P-value
Milk, kg	36.71	34.09	<.0001	37.26	35.39	<.0001
Fat%	4.12	4.08	ns	3.98	4.10	<.0002
Protein%	3.36	3.24	<.0001	3.37	3.36	ns
ECM kg	36.91	33.67	<.0001	36.81	35.41	<.0003
Feed cost pr kg ECM, dkr	1,50	1,48	<i>0 dkr</i>	1,65	1,50	<i>0,15 dkr in favour of the FB ration</i>
Feed cost pr kg ECM, €	0,20	0,20	<i>0 €</i>	0,22	0,20	<i>0,02 € in favour of the FB ration</i>

Conclusions

- Using a drum-drier as heat treatment did not result in the optimal effect on protein quality.
- In Herd 1 with a yield level of 9500 kg ECM heat treated field beans could replace some of the soy cake concentrate without reducing milk yield. The DM intake tended to be reduced with the FB ration. The feed cost pr kg milk produced were reduced with the FB ration.

Conclusions

- In Herd 2 with a yield level of 10500 kg ECM heat treated field beans could not replace soy cake concentrates without reducing the milk yield. DM intake was numerically, but not statistically lower in the FB ration.
- In the first period, reduced feed cost could not counteract the loss in milk production. In the second period even with a significantly reduced milk production, the lower feed cost seemed to counteract the loss in milk with the FB ration.

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