



Hempseed Cake as a Protein Feed for Ruminants

Doctoral Thesis Defence

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Outline

Background

Description of hemp

Overview of protein metabolism

Objectives

Paper I-IV

Conclusions



Background

Animals in northern European production systems are often fed imported protein feed

Protein crops that can be locally produced are requested



Hemp (*Cannabis sativa* L.)

Can be cultivated at high latitudes (>60° N)

Historically an important agricultural crop

Fibre and seeds

EU regulations - only approved varieties

Industrial hemp was legalised in Sweden in 2003

260 ha cultivated in Sweden in 2010



Hemp (*Cannabis sativa* L.)

The Finola variety:

Seed production in boreal regions

1.5 meters tall

Early blooming

Dioecious

1000-1400 kg seed/ha



Photo: Michael Finell

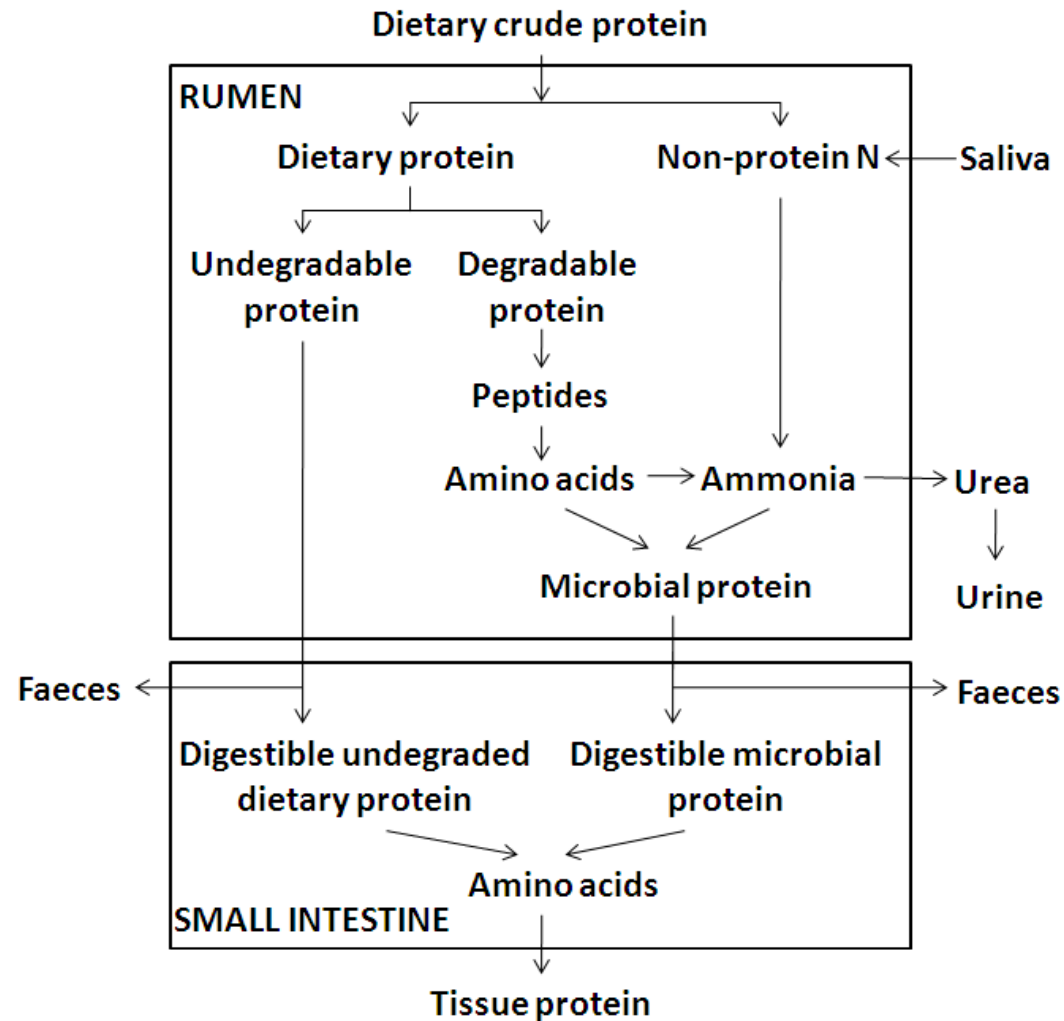
Hempseed cake

- the residue from oil extraction of hempseed



Photo: Linda Karlsson

Protein metabolism in ruminants





Objectives

Investigate the possibilities of using hempseed cake as a protein feed for ruminants

- I. Develop further the *in vitro* gas production technique to estimate rumen protein degradation of protein feeds.



Paper I

Modifications of the *in vitro* gas production technique (Raab et al. 1983)

Estimates of *in vitro* degradable CP by measurements of gas production and ammonia-N

Enable estimations of the effective protein degradation (EPD)



Photo: Märten Hetta



Paper I

	EPD (<i>in vitro</i>)
Hempseed cake	0.33
Rapeseed cake	0.59
Rapeseed expeller	0.46
Rapeseed meal	0.36
Soybean meal	0.67

Paper I

	EPD (<i>in vitro</i>)	EPD (<i>in situ</i>)
Hempseed cake	0.33	0.84
Rapeseed cake	0.59	0.89
Rapeseed expeller	0.46	0.40
Rapeseed meal	0.36	0.37
Soybean meal	0.67	0.65



Objectives

Investigate the possibilities of using hempseed cake as a protein feed for ruminants

- I. Develop further the *in vitro* gas production technique to estimate rumen protein degradation of protein feeds.
- II. Study effects of increasing amounts of hempseed cake in the diet of dairy cows on the production and composition of milk.



Paper II

Forty dairy cows (Swedish Red)

5-week dose-response feeding trial

4 levels of hempseed cake inclusion:

- 0 g/kg DM
- 143 g/kg DM
- 233 g/kg DM
- 318 g/kg DM

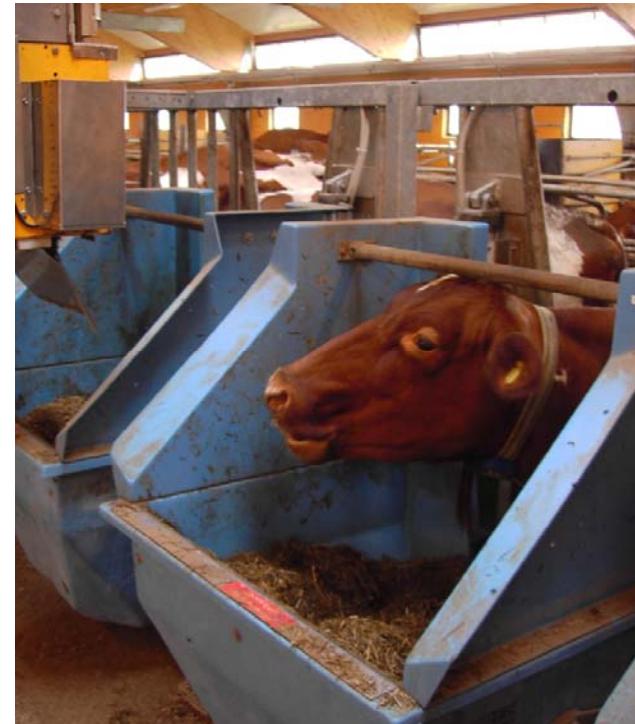


Photo: Linda Karlsson



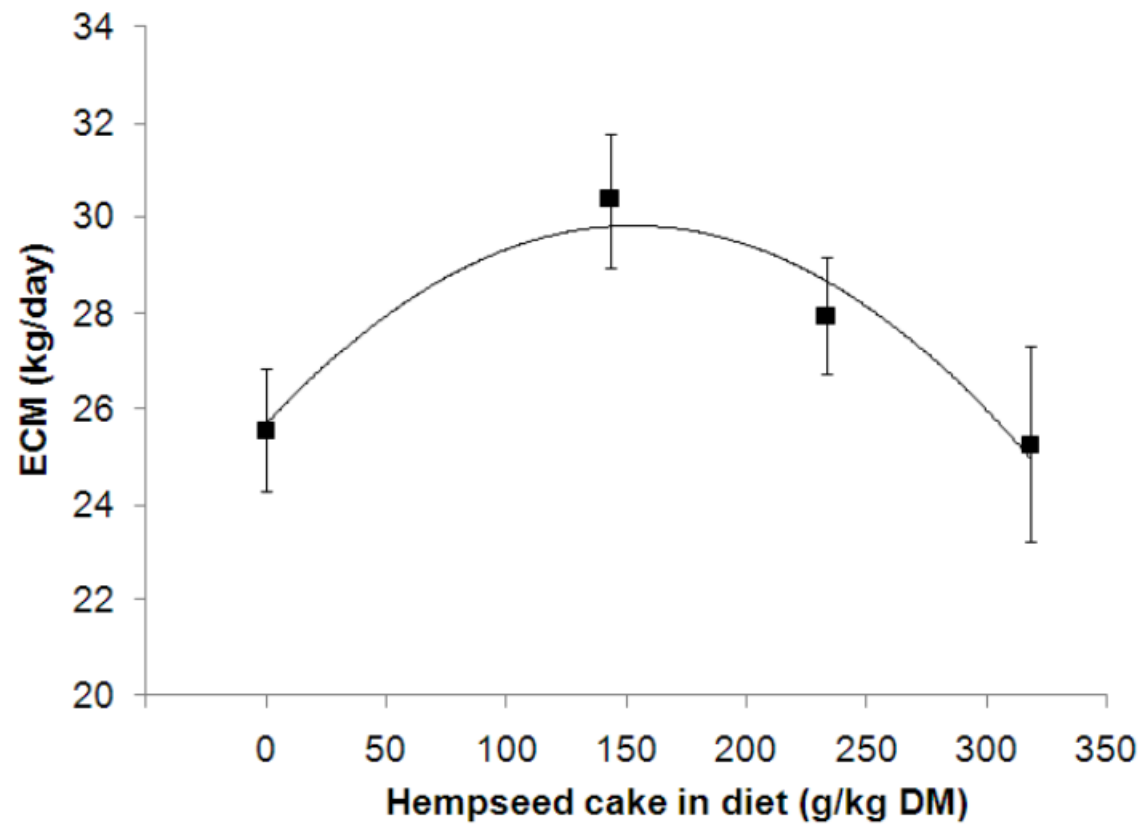
Paper II

Increasing proportion of hempseed cake in the diet resulted in:

- Higher intake of CP, fat and NDF and lower intake of starch
- Curvilinear responses on yields of milk and milk protein and fat



Paper II





Paper II

Increasing proportion of hempseed cake in the diet resulted in:

- Higher intake of CP, fat and NDF and lower intake of starch
- Curvilinear response on yields of milk and milk protein and fat
- Linear decrease in the concentration of milk protein and fat
- Linear increase in milk urea and linear decrease in CP efficiency (milk protein/CP intake)



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- III. Compare growth performance of lambs fed peas, rapeseed cake or hempseed cake as their protein supplement.



Paper III

48 crossbred ewe lambs

8 weeks continuous trial

4 treatments (diets):

- Barley Control
- Barley + Peas
- Barley + Rapeseed cake
- Barley + Hempseed cake



Photo: Linda Karlsson



Paper III

No significant differences in DM intake

The CP intake was higher for lambs fed peas and hempseed cake

The metabolisable energy (ME) intake was higher for lambs fed peas

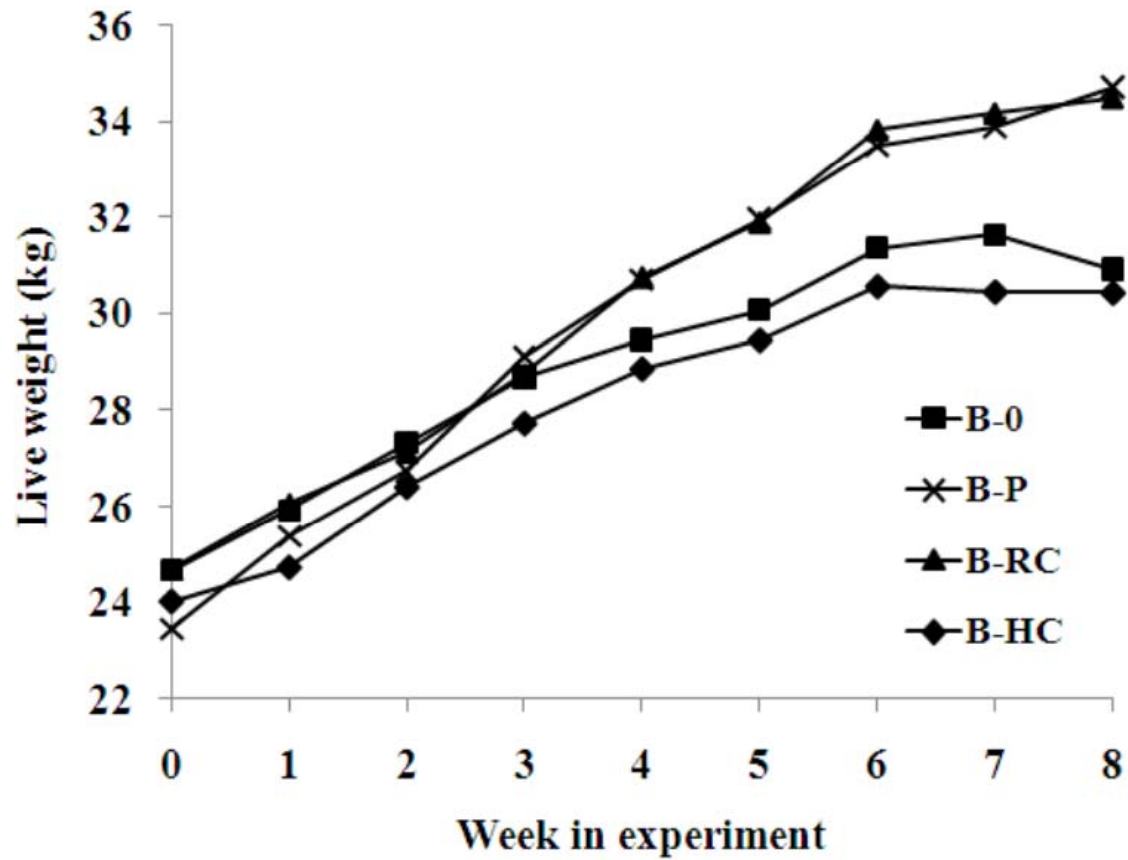
Live weight gains 115-209 g/day

- highest for lambs fed peas followed by lambs fed rapeseed cake

No differences in in growth performance between lambs fed hempseed cake and those fed the control diet



Paper III





Objectives

Investigate the possibilities of using hempseed cake as a protein feed for ruminants

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- III. Compare growth performance of lambs fed peas, rapeseed cake or hempseed cake as their protein supplement.
- IV. Study effects of temperature during moist heat treatment on the *in situ* ruminal degradability and *in vitro* intestinal digestibility of crude protein (CP) and amino acids (AA) in hempseed cake.



Paper IV

Cold-pressed hempseed cake moist heat treated for 30 min

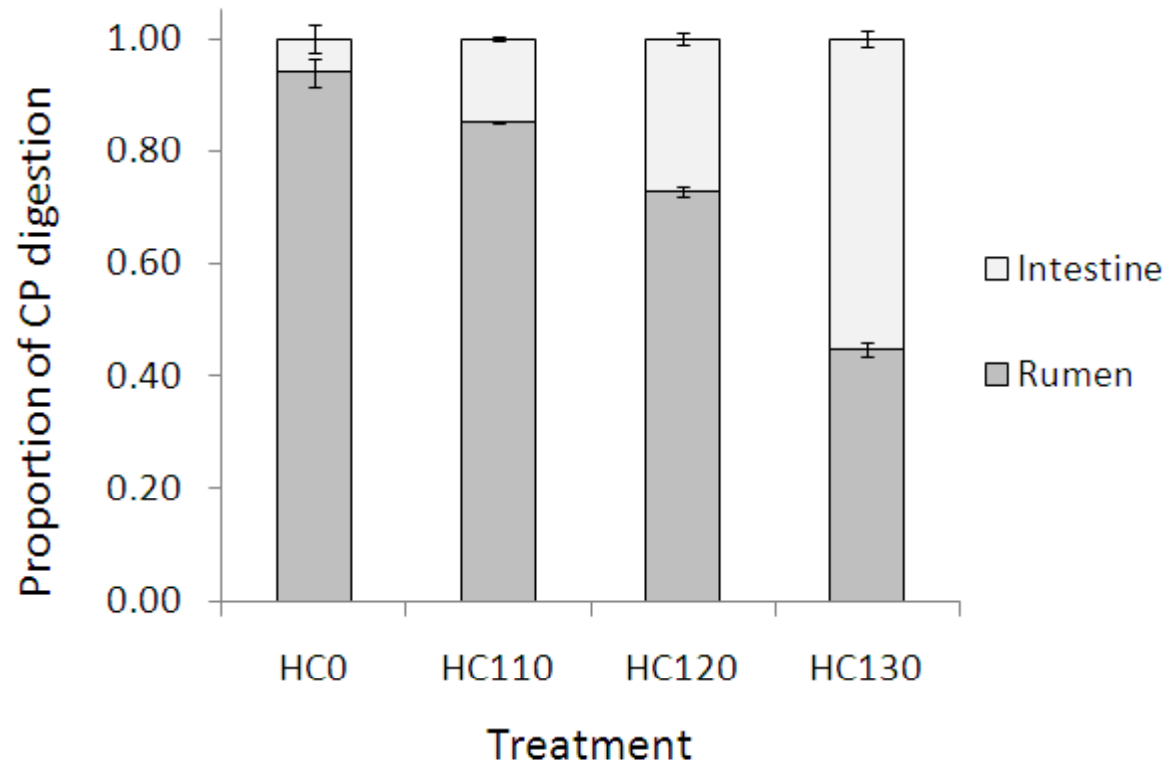
- 110°C
- 120°C
- 130°C
- Control (untreated)

Increased temperature during heat treatment resulted in:

- Decreased *in situ* ruminal CP and AA degradability
- Increased *in vitro* intestinal CP and AA digestibility (three-step procedure)



Paper IV



Composition of oilseed feeds

	Hempseed cake	Rapeseed expeller	Soybean meal
Crude protein(g/kg DM)	344	339	510
Fat (g/kg DM)	124	169	10
Starch (g/kg DM)	10	6	62
NDF (g/kg DM)	393	311	95
Indigestible NDF (g/kg NDF)	845	379	61
Metabolisable energy (MJ/kg DM)	9.5	15.5	14.6
Metionine (g/kg CP)	20.1	20.0	14.2
Histidine (g/kg CP)	25.6	24.0	26.2
Lysine (g/kg CP)	29.1	51.0	62.1



Feed value in summary

- High CP concentration
 - Limited in lysine
 - Low *in vitro* ruminal CP degradability
 - High *in situ* ruminal CP degradability
 - Low *in vitro* intestinal CP digestibility
 - Low in fermentable carbohydrates
 - High content of indigestible NDF
- } • Low AAT value and high PBV value
- } • Low ME value



Conclusions

The results from the studies underlying this thesis indicate that the nutritional value of hempseed cake will limit its use as a protein feed for ruminants.

Finding alternative protein crops suited to production in Northern Europe will maintain an important issue.

Techniques for evaluating the protein value of feeds for ruminants need further improvement.



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Thank you
for your interest!