



Final Report (Status Report 2004)

For research projects financed by grants from
The Directorate for Food, Fisheries and Agro Business
under the Danish Ministry of Food, Agriculture and Fisheries

1. Research program

Research in organic farming 2000-2005 (DARCOF II)

2. Project title and number

Organic production of steers and use of bioactive forages in livestock (No. II.3) (*Acronym: PROSBIO*)

merged with

Product quality of organic beef and pork in relation to grazing system and feeding with bioactive crops (No. II12) (*Acronym: PROSQUAL*)

'Complementary research to: WP8: 'Organic production of steers and use of bioactive forages in livestock' in DARCOF II' (Acronym: PROSBIO)

PROSQUAL is now included as part b of WP 8 (i.e., WP8b)

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6. Project period (month, year)

Start of project: **01.05.2000**
End of project: **31.10.2004**

7. Final report (Status 2004)

A. Project summary

Organic meat production in Denmark covers mainly beef and pork. The present market share of organic beef and pork is only 2.1% and 0.5%, respectively. The demand for organic high quality beef and pork is thus restricted despite a large number of organic dairy farms and a growing number of organic pig farms. Economic profitability is seen as the major constraining factor. However, the interest in organic meat production is increasing and the need for reliable information on production parameters and strategies is evident. The objective of this project is to contribute to the development of environmentally and economically viable farming systems for the production of high quality organic beef and pork. The investigations include the use of selected bioactive crops (e.g. chicory roots) with a possible positive influence on health, meat and eating quality in organic beef (steers) and pork. Therefore, the project attempts to improve the internal and external quality of organic produce, thereby illuminating both challenges and possibilities connected to integration livestock in organic productions systems.

Emphasis is on steer production that attempts to improve animal health and welfare, product quality and improved nature value of marginal areas through grazing. This may provide a scientific basis for decision support to organic beef producers and provide future guidelines for management of marginal areas to increase biodiversity. One of the major achievements in part of the project in 2002 was the development of a model for steer production making use of results from the entire project. The model was developed to optimise the grazing strategy, feed level in winter and time of fattening and slaughter in organic steer production with regard to economic output at steer level. The steer model is a 4-level hierarchical Markov process with decisions defined at three levels. Decisions taken in the model include grazing strategy (permanent or ryegrass/clover pasture), feed level in winter (high and low), time for beginning of fattening (age 19-27 months) and time of slaughter (age 19-30 months). Overall optimal strategies were low feeding level in the winter period, grazing on permanent pastures in the first grazing season, whereas use of ryegrass/clover pastures gives the optimal net return per steer in the second and third grazing season. The optimal strategies from the model suggested that the effect of fattening in steer production might be overstated. However, results from

modelling have to be proved under practical conditions. It was concluded that the natural well-defined phases in organic steer production are well suited to be analysed by a multi-level hierarchic Markov processes.

The approach of using selected forage species to improve meat quality and health of animals, particularly parasite control, is novel and may amongst others limit the unwanted use of medication. Some plants contain compounds that may affect establishment, fecundity or expulsion of parasitic worms (nematodes). The preliminary conclusions on the experiments with sheep as a ruminant model indicate it is possible to substantially reduce the nematode faecal egg excretion when infected lambs are moved to a paddock with bioactive forage, e.g. sainfoin (*Onobrychis viciifolia*). A remarkable reduction in abomasal nematode counts was observed following the move to new pasture whether it was grass or a bioactive crop. This may provide new information on the effect of repeated moves for control. In 2001, the establishment of abomasal nematodes in lambs while grazing chicory was significantly reduced (by 85%). A reduction was also noted in 2002 but it was not significant. There are also clearly promising prospects for use of selected bioactive crops to improve product quality, in particular eating quality. Overall, groups of pigs fed chicory roots were perceived as more acceptable relative to the other feeding treatments. This was not least the case with entire male pigs having less boar taint. In steers finished on chicory or barley before slaughter, there was a clear difference in the sensory perception, although it is too early to define what is best!

Table A.1: Work package list (from application)

No.	Work package title	Participants*	Budget (1,000 DKK)	Start	End	Deliverable no(s):
WP 1	On-farm description and analysis of production and management strategies for steers	<u>SMT</u> , TK, BN	411	4/2000	2/2003	D19, D20, D21, D22, D23
WP 2	Production strategies for steers on clover grass pastures	<u>SMT</u> , TK, BN	94	4/2000	2/2003	D13, D24
WP 3	Grazing systems for steers on marginal land	<u>HRA</u> , TK, BN, LLH, BN	1,997	4/2000	12/2003	D15, D29, D30
WP 4	Influence of different grazing strategies on biodiversity on marginal land	<u>ABH</u> , KS	810	4/2000	12/2002	D2, D15, D18, D27, D28
WP 5	Preparation of extracts for estimation of direct anthelmintic effect of plant species	<u>KB</u> , RN	376	8/2000	12/2003	D1, D5, D6, D10
WP 6	Influence of bioactive forages on animal health with emphasis on parasitic infections	<u>SMT</u> , AR	1,242	4/2000	6/2004	D7, D14, D16, D35, D37
WP 7	Test and large scale cultivation of bioactive forages	<u>CO</u>	376	4/2000	6/2004	D8, D9, D31
WP 8a	Influence of bioactive forages on meat and eating quality (PROSBIO)	<u>LLH</u> , MM, AR, MV; CO, TK, SMT, DB	1,264	1/2001	6/2004	D17, D34, D36
8b1	Sensory eating quality of pork and beef from steers in relation to the influence of bio-active forage feeding (chicory) (PROSQUAL)	<u>LLH</u> , JHN, (DIAS) and DVB, (KVL)	534	2/2002	6/2004	D34 and D36
8b2	Content of conjugated linoleic acid (CLA) in beef from steers produced on pasture (PROSQUAL).	<u>MV</u> , TK, Søren Krogh Jensen (DIAS) and Mie Strårup (DTU)	230	1/2002	12/2003	D29, D30 and D34

* Responsible participants are underlined

B. Objectives and expected achievements

The overall objective is to develop and document economically viable production systems for organic meat of beef and pork with emphasis on steer production that attempts to improve animal health and welfare, product quality and the natural value of marginal areas by grazing. Furthermore, bioactive forages with a possible influence on health and meat quality will be investigated. Specific goals:

1. To describe and develop steer production on organic farms with focus on pasture based production, particularly grazing strategies
2. To evaluate the effect of different management strategies on production, and health and welfare of organic steers.
3. To compare production, parasitism and herbage intake in steers and heifers grazing marginal areas at different stocking rate or grazing systems.
4. To examine the interaction of grazing, forage production, and development in biodiversity in marginal areas of different initial richness of species.
5. To investigate the use of bioactive forages and products for improvement in health with particular reference to parasitic infections.
6. To improve meat and eating quality in relation to fattening strategies and bioactive forages.

The investigations related to steer production will provide a scientific basis for decision support to organic beef producers and provide future guidelines for management of marginal areas. Emphasis will be on improvement of animal health and welfare and product quality of steers, and on utilisation and conservation of the biodiversity of marginal areas by grazing. The perspective of having bioactive plants controlling parasitic infections and/or improving meat quality and flavour are fascinating. It may limit the unwanted use of medication and prolonged withdrawal times may be avoided. Also the combination of steer production with improvements and conservation of biodiversity of marginal land in low-lying areas seems beneficial for nature conservation as well as environment. All of these different aspects may improve economy of organic steer production or will help justify the higher prices of organic products and improve the image of organic farming systems as being special compared to conventional farming systems. Nevertheless, concepts and ideas developed in the present study regarding use of bioactive forages will be equally applicable in conventional farming.

Item 6 (and item 2) above is specifically addressed in WP8a,b which comprise part of the PROSBIO project and the entire PROSQUAL project. These items deserve a more detailed description. The overall objective of the studies in WP8a,b was to improve the meat and eating quality, including an increase in the content of matters with a potentially beneficial effect on human health in organic meat from cattle and pigs raised outdoors and (or) finished with bioactive crops.

Compared with conventional pork production, organic pork has diverging quality parameters such as higher content of polyunsaturated fatty acids due to organic foodstuffs (protein sources and use of forage as e.g. clovergrass and clovergrass silage) and sometimes lower tenderness due to production systems resulting in lower daily gain. Although a higher content of polyunsaturated fatty acids is a positive aspect from a human health perspective, the higher disposition to rancidity as a result of oxidation is a negative aspect. This oxidation can be a problem with meat products used in catering products as they involve reheated meat. However, antioxidant substances such as vitamin E and enzyme systems selenium (glutathione peroxidase) with antioxidative activity can inhibit the oxidation of polyunsaturated fatty acids in meat.

Lacking economic profitability is seen as a major constraining factor in using dairy-type calves and young bulls in organic beef production. However, the interest in organic beef production is increasing and the need for reliable information on production parameters, feeding strategies, and ways to increase the domestic market share of organic beef from dairy-type steers is evident. Also knowledge of the effect of production system on the product composition that may confer health benefits to human consumers is important, e.g. the content of conjugated linoleic acid (CLA).

The following specific objectives from PROSQUAL are included in WP8a,b:

1. to examine the eating quality and the content of vitamin E and selenium (glutathione peroxidase) and fatty acid composition in pork from pigs fed bioactive crops, i.e. chicory roots.
2. to examine the eating quality and to determine the fatty acid composition and CLA content in meat from extensively raised steers finishing-fed by use of different combinations of clover-grass silage, concentrates, and chicory roots
3. to compare the fatty acid composition including CLA in tallow and meat from steers and young bulls raised in various production systems

C. Progress and results

C.1 Description (summary) of main results and conclusions

WP1: On-farm descriptions and analysis of production and management strategies for steers

All work was terminated in 2003.

WP2: Production strategies for steers on clover grass pastures

All work was terminated in 2002.

WP3: Grazing systems for steers on marginal land

All work was terminated in 2002.

D15 (Paper: Grass intake, liveweight gain and parasite load in steers and heifers compared to grazing strategy, sward structure and herbage quality) is ready (1.2.2005) for submission to Animal Science, with the title "*Production and parasitism of dairy breed heifers and steers grazing wet marginal grasslands in two grazing systems and stocking rates*". Production and endoparasitism in first grazing season of Holstein heifers and steers were investigated in two grazing seasons, at low-lying peaty soil. In year 2000, forty animals were included in a 2 x 2 factorial, replicated experiment with two sexes (steers vs. heifers) and two stocking rates (SR): normal vs. low (840 vs. 420 kg live weight per ha at turn out) in a set stocking grazing system. Mean grass height over the entire season were 6.3 ± 4.8 cm (mean \pm SD) at normal SR and 9.8 ± 6.1 cm at low SR. Mean daily live weight gain during grazing was significantly ($p < 0.001$) lower at normal SR (256 ± 147 g) compared to low (468 ± 142 g) but sex did not significantly affect the daily gain. Serum-pepsinogen levels, indicating uptake of gastrointestinal nematodes, were higher at normal SR and consistently higher in steers compared to heifers, although not significant. In 2001 the experiment included 80 animals in a 2 x 2 factorial

experiment with two sexes (steers vs. heifer), two grazing systems (set stocking and 2-paddock rotation) and four replicates. Pasture quality was low, average DOM 57% and 13.9% crude protein in DM independent of grazing system. Mean daily live weight gain was not significantly affected by grazing system. A tendency ($p=0.07$) to lower daily gain for the heifers than for steers was observed (427 ± 161 g vs. 474 ± 138 g). Lower levels of pasture contamination with parasites were observed in the paddocks spelled up to mid July but otherwise rotation did not prevent parasite infections.

It is concluded that first grazing season steers and heifers have the same potential for growth when grazing at marginal areas with low pasture quality. Set stocking or the two-paddock rotation scheme did not affect productivity or level of parasite infection at the end of season. Parasite infections can become a problem at high SR. SR is an important factor for both daily live weights gain per animal and total production per ha. However, due to the very heterogeneous structure of marginal areas there is a need for other indicators than kg live weight per ha at turn out in order to defined a clear relationship between stocking rate and production.

WP4: Influence of different grazing strategies on biodiversity on marginal land

All work was terminated in 2002.

WP5: Preparation of extracts for estimation of direct anti-parasitic effects of plant species

All work was terminated in 2002-3.

D5: The work on determination of condensed tannins in forages is now ready for publication. It partly covers the development of a gut mimetic system which was not successful and therefore not used any further (cf. WP6 and section D).

Nørbæk, R. Christensen, L.P., Guldborg, C., Thamsborg, S.M. & Brandt, K. (2005). Quantitative determination of tannins by HPLC for comparison of different plant species. Submitted February 2005 to *Journal of Agricultural and Food Chemistry*

WP6: Influence of bioactive forages on animal health with emphasis on parasitic infections

Evaluation of anti-parasitic activity of plant extracts (*in vitro* studies)

A series of plant extracts were produced using an enzymatic system that mimics the stomach and small intestine of the pigs. For comparison both acetone and water extracts were also produced. The extracts were then tested against free-living larvae in a Larval Development Assay (LDA), in which parasite eggs were incubated in a plant extract along with a medium that promotes the bacterial growth that the hatched parasite larvae feed on. However, some steps in the digestion process proved more deleterious to the parasite larvae than the extracts themselves. After several modifications of the extraction process and LDA, plant extracts were tested against the sheep nematodes *Teladorsagia circumcincta* and *Haemonchus contortus*. Though there was much variation between replicates the results suggest that acetone extractions of chicory and sulla inhibit the development of both species while an acetone extraction of white clover inhibited the development of *H. contortus* but not that of *T. circumcincta*. In addition, buffer extractions of 'Hvidmelet Gåsefod', *Lotus spp.*, 'Gåsepotentil' and 'Rejnfan' also inhibited the larval development of both species. In comparison, previous testing sug-

gests that the development of the pig nematode *Oesophagostomum dentatum* is generally more susceptible to interruption by these extracts. This may be due to inherent differences between the species or may result from the extraction process since the buffer extraction method was modelled after the pig digestive tract.

Due to the many problems with the LDA it was decided to test the plant extracts in a second test system. For this a Larval Migration Inhibition Assay (LMIA) was established in the laboratory in 2004. In brief, approx. 400 *O. dentatum* L₃-larvae were incubated in 2 ml plant extract for 3 hours. The larvae were then washed several times and finally transferred in ½ ml water to a small tube with fine mesh in the bottom (approx. 20 µm). The tube had previously been placed in a slightly larger tube filled with 1 ml water, so that mesh touched the surface of the water. After 4 hours the number of larvae still present in the smaller tube and the number of larvae that had migrated into the larger tube were counted. As for the LDA there was a large variation between LMIA replicates making it difficult to evaluate the overall effect of individual extracts. The anthelmintic Levamisole was used as a positive control and it effectively killed the larvae preventing larval migration. Water was used as a negative control but in one of two tests the variation was large and inhibition as high as for some of the extracts. However, there was a tendency for water and digestion extracts of *Lotus* spp., chicory, and sainfoin to inhibit larval migration. The same was noted for water extracts of white clover and sulla. Acetone extracts generally did not affect larval migration.

Anti-parasitic activity of bioactive forages: grazing trial with lambs in 2002

All work was terminated in 2003.

Pig experiment with chicory 2002/2003

All work was terminated in 2003.

WP7: Test and large-scale cultivation of bioactive forages

All work was terminated in 2003.

WP8: Influence of bioactive forages on meat and eating quality of pork and beef (PROSBIO and PROSQUAL merged: WP8a, WP8b1 and WP8b2)

Due to interesting results regarding specific boar taint and eating quality results and results from WP6 during the 2 trials with female and entire male pigs in 2001-2002 (Experiment 1) and 2002-2003 (Experiment 2) we (DIAS and KVL) are presently involved in a patent application. For this reason, we have in 2004 made a product maturing experiment about feeding percentage with dried chicory roots financed by DIAS and KVL. Publication of the experimental results is on going for the moment.

C.2 Fulfilment of deliverables and milestones

WP1: On-farm description and analysis of production and management strategies for steers		
	Time schedule according to application	Deviations, if any*
Task		
1 Description and evaluation of existing steer production	5/2000-9/2002	OK
2 Examination of different winter feeding regimes	11/2000-4/2001; 11/2001-4/2002	OK
3 Investigation of grazing strategies including adaptation to grazing	5/2000-10/2000; 5/2001-10/2001	OK
Deliverables		
19 Report: Production strategies in steer production: A model	11/2002	OK
20 Report: Grazing strategies for dairy breed steers with focus on calves	11/2002	OK
21 Paper: Effect of different finishing strategies on steer production on organic farms	11/2002	OK, published together with D23
22 Paper: Supplementation and adaptation of calves to grazing	11/2002	OK
23 Paper: Evaluation of different winter feeding strategies for steers on organic farms	11/2002	OK, published together with D21
Milestones		
1 Comparison of grazing strategies for steers and calves	12/2000 + 12/2001	OK
2 Comparison of winter feeding strategies in steer production	2/2001 + 7/2002	OK
3 Evaluation of models of welfare and production strategies	6/2002	OK
<i>* Deviations are to be further discussed at C3</i>		
WP2: Production strategies for steers on clover grass pastures		
	Time schedule according to application	Deviations, if any*
Task		
4 Estimation of herbage intake following different winter feeding levels	6-7/2000	OK
5 Developing a model for feeding management and time for slaughter	5/2000-4/2002	OK
Deliverables		
13 Paper: Feed intake in dairy breed steers on clover grass pasture and on wet riparian pasture	12/2001	OK
24 Popular paper: Body condition as a management tool in organic steer production	11/2002	Cancelled (cf. section D)
Milestones		
4 Estimation of feed intake by steers on clover grass pasture	9/2000	OK
5 Development of a model for using body condition score as a management tool in steer production	6/2002	Cancelled (cf. section D)
<i>* Deviations are to be further discussed at C3</i>		
WP3: Grazing systems for steers on marginal land		
	Time schedule according to application	Deviations, if any*
Task		
6 Evaluation of different stocking rates and grazing strategies	5-10/2000; 5-10/2001	OK
7 Estimation of herbage intake following different winter feeding levels	6-7/2001	OK
8 Evaluation of different grazing strategies and finishing diets including bioactive forages	5/2001-2/2003	OK
9 Examination of meat quality from steers in task 8	11/2002-2/2003	OK
Deliverables		

15 Paper: Grass intake, liveweight gain and parasite load in steers and heifers compared to grazing strategy, sward structure and herbage quality	6/2002	OK, 2/2005 (submitted to Animal Science)
29 Paper: Liveweight gain, parasite load and slaughter results in steers grazing in rotational versus continuous grazing systems.	6/2003	OK: part merged with D15 Delayed: part on slaughter, 5/2005 (cf. D)
30 Popular paper: Steer production on marginal land	6/2003	OK (cf. E)

Milestones

6 Comparison of herbage intake in co-grazed steers and heifers	8/2001	OK
7 Comparison of performance of 1-year grazing steers and heifers	12/2001	OK
8 Evaluation of the effect of different grazing strategies on production and health of steers	3/2003	OK
9 Establishment of the relationship between finishing strategy and fatty acids in meat, including CLA (PROSQUAL-added activities to this milestone)	5/2003	OK

* *Deviations are to be further discussed at C3*

WP4: Influence of different grazing strategies on biodiversity on marginal land

Task	Time schedule according to application	Deviations, if any*
10 Evaluation of sward production and herbage quality under different grazing strategies	5-10/2001; 5-10/2002	OK
11 Evaluation of effect of grazing heterogeneity on sward structure	5-10/2001; 6-8/2002	OK
12 Examination of biodiversity dynamics	11-12/2000; 6-12/2001; 6-7/2002	OK
13 Inventory of plants	7-12/2001	OK
14 Occurrence of bioactive plants in swards under different grazing strategies	6-7/2001; 6/2002	OK

Deliverables

2 Delivery of plant species from WP4 to WP5	7/2000	OK
15 Paper: Grass intake, liveweight gain and parasite load in steers and heifers compared to grazing strategy, sward structure and herbage quality	6/2002	OK, 2/2005 (submit. Animal Science)
18 Popular paper: A challenge for organic farmers: steer production for maintenance of biodiversity including bioactive plants of low-lying marginal areas (In Danish)	6/2002	OK
27 Paper: Organic steer production for maintenance of biodiversity of low-lying marginal areas	12/2002	OK (cf. E)
28 Paper: Bioactive plants in long-term swards with a high or low botanical diversity	12/2002	Cancelled (partially fulfilled, cf.D)

Milestones

10 Evaluation of sward structure dynamics	11/2001	OK
11 Evaluate the content of bioactive plants in the swards with different botanical composition	12/2001	Delayed, 12/2002
12 Evaluation of bioactive plants, forage production and quality in relation to grazing strategy	12/2001 + 12/2002	Partially fulfilled
13 The dynamics in biodiversity are analysed	3/2002 + 12/2002	Partially fulfilled

* *Deviations are to be further discussed at C3*

WP5: Preparation of extracts for estimation of direct anthelmintic effect of plant species

Task	Time schedule according to application	Deviations, if any*
15 Development of controlled degradation procedure	5/2002	OK (modified, cf. report 12/2003)

16 Estimation of secondary metabolites e.g. condensed tannins in the gut mimetic procedure	12/2002	OK (modified, cf. report 12/2003)
17 Analysis of inulin and tannin content in bioactive forages	(continuously)	OK

Deliverables

1 Determinations of inulin and condensed tannins in forages	2000-2003	OK
5 Report: Development of a gut-mimetic system for extraction of bioactive secondary metabolites	4/2002 (delayed 12/2002)	OK (modified, cf. C1 and report 12/2003)
6 Extracts of cultivated plants	4/2002	OK
10 Extracts of wild plants	4/2002	OK

Milestones

14 Development of a gut-mimetic system for extraction of bioactive secondary metabolites	5/2002	OK
15 Extracts of cultivated and wild plant species for testing of anthelmintic activity	5/2002	OK

* *Deviations are to be further discussed at C3*

WP6: Influence of bioactive forages on animal health with emphasis on parasitic infections

Task	Time schedule according to application	Deviations, if any*
18 Evaluation of anthelmintic activity of plant extracts (<i>in vitro</i> studies)	5/2000-12/2001	OK (completed)
19 Evaluation of anthelmintic effect of bioactives forages in grazing ruminants	5-10/2000; 5-10/2001; 5-10/2002	OK (completed)
20 Evaluation of anthelmintic effect of bioactives forages fed to pigs	5-10/2001; 5-10/2002	Cancelled, incorporated into task 21
21 Studies on antiparasitic effect of chichory in pigs after palatability test	11/2001-2/2002; 11/2002-2/2003	OK

Deliverables

7 <i>In vitro</i> assays for anthelmintic activity of plant extracts	12/2000	OK (12/2005)
14 Paper: <i>In vitro</i> studies of the anthelmintic effect of bioactive plants on infective larvae of bovine and porcine parasites	12/2001	OK, report in Section C (Int. paper cancelled)
16 Paper: <i>In vivo</i> studies of the anthelmintic effect of bioactive plants on helminth parasites in sheep	6/2002	Partially fulfilled, final paper in prep. 5/2005
35 Identification of plant/forages with short or long term anthelmintic effects	6/2004	OK (cf. WP5/6 in section D)
37 Paper: <i>In vivo</i> studies of the anthelmintic effect of bioactive plants on helminth parasites in pigs	10/2004	OK, final paper in prep. 5/2005

Milestones

16 Development of <i>in vitro</i> methods for evaluating anthelmintic activity	12/2000	OK
17 Comparison of <i>in vitro</i> anthelmintic activities of different plant extracts	12/2001	OK
18 Evaluation of anthelmintic effects of inulin-rich chicory in pigs	4/2002 + 12/2003	OK
19 Assessment of anthelmintic effects of different forages/plants in lambs	12/2002	OK
20 Screening of anthelmintic effects of different forages/plants in pigs	12/2003	Cancelled, incorporated into M18

* *Deviations are to be further discussed at D3*

WP7: Test and large scale cultivation of bioactive forages

Task	Time schedule according to application	Deviations, if any*
22 Evaluation of limiting factors for establishing bioactive forages (laboratory test)	5-12/2000	Cancelled
23 Evaluation of culturing bioactive forages (plot study)	5-10/2000; 5-10/2001	Phase in 2001 OK

24 Field testing of bioactive forages grazed by lambs	5-10/2001; 5-10/2002	OK 2001/2002: exp. at KVL only
25 Evaluation of chicory fed to slaughter pigs and steers	5-9/2001; 5-9/2002; 5-9/2002	Cancelled, included in WP8
Deliverables		
8 Forage for lambs	7/2001 + 7/2002	OK 2001/2002: exp. at KVL only
9 Silage for pigs and steers	8/2001 + 002 + 003	OK
31 Paper: Growth and quality of bioactive plants	10/2003	Cancelled
Milestones		
21 Laboratory establishment of bioactive crops completed	12/2000	Cancelled
22 Analysis of data collected from large scale production of silage to pigs and steers	10/2001+10/2002+ 10/2003	OK 2001, 2002, 2003
23 Evaluation of bioactive stands from small plots or grazing studies	10/2002	OK

* *Deviations are to be further discussed at C3*

WP8: Influence of bioactive forages on meat and eating quality

	Time schedule according to application	Deviations, if any*
Task		
26 Evaluation of meat and eating quality and putative anthelmintic effect of bioactive forages fed to pigs	11/2001-2/2002; 11/2002-2/2003	OK
27 Evaluation of effect of bioactive forages in the finishing ration for steers on sensory quality at slaughter and fatty acids composition	11/2002-1/2003	OK
Deliverables		
17 Report: Preliminary report on the effect of a bioactive forage on meat and sensory quality in pigs	6/2002	OK
34 Paper: Effect of different finishing strategies and a bioactive forage on meat and sensory quality in steers	12/2003	Delayed, submission in mid 2005 (two papers instead of one)
36 Paper: Effect of chicory on meat and sensory quality in pigs (There will be 3 papers and possibly more papers)	10/2004	Delayed, submission in mid 2005
Milestones		
24 Assessment of the influence of chicory (and a related bioactive species) on meat and sensory quality in pigs	4/2002 + 4/2004	Completed
25 Evaluation of the effect of different finishing strategies on fatty acids composition and sensory quality in steers fed a bioactive forage	6/2003	Completed

* *Deviations are to be further discussed in D*

D. Description of deviations and subsequent adjustments of plans

Comments on changes in staffing:

The departments of TK+KS are now merged (Dept. of Agroecology). KB, LN and CO are no longer employed at DIAS and have left the project. KS has taken over the main responsibilities of CO/LN. RN took over the responsibilities of KB but RN has now left DIAS.

WP2:

This WP has been finalized a part from D24 (Popular paper: Body condition as a management tool in organic steer production). The objective was to collect data from a number of experiments in the project period with information about live weight, body condition, carcass conformation and other production factors. When the data was put together, there was a quit uniform structure, which made the interpretation of the data difficult and also with low power due to a must lower number of animals than expected from the start. Therefore it has been concluded that further analysis is useless, and the idea can not be fulfilled.

WP3:

D15 merged part of D29 – see below WP8 for rest of D29.

WP4:

D18: The deliverable (a popular paper on *A challenge for organic farmers: steer production for maintenance of biodiversity including bioactive plants of low-lying marginal areas*) has been fulfilled by the 2 publications:

- Nielsen, L. & Buttenschøn, R.M. Naturpleje på enge baseret på stude. Skov & Landskab, Park- og Landskab Videnblade, Landskabspleje blad nr. 6.2-12.
- Nielsen, A.L., Kristensen, T. & Badsberg, J.H. Animal production from dairy breed steers at extensively managed grasslands in riverside areas. *Grassland Science in Europe*, 7, 938-939.

D28: This deliverable is basically cancelled, for several reasons: Lisbeth Nielsen's resignation, cut-back in supplementary funds at DMU and last but not least: a low content of the relevant plant species at Fussingø. However, this issue has been discussed in several of the associated popular papers on plant biodiversity and effects of grazing on riparian meadows.

WP5/6:

D14: As mentioned at in previous status report, we have had serious problems with the establishment of the *in vitro* assay (LDA) to assess the possible anti-parasitic effects of different bioactive plants, following extraction through the gut-mimetic system. We have in 2004 introduced another test system (Larvae Migration Inhibition Assay). The brief report in Section C in report will serve as D14. The results are so inconsistent that the work is deemed not publishable.

D16 (Paper: *In vivo* studies of the anthelmintic effect of bioactive plants in sheep) has partly been communicated in Thamsborg and Roepstorff (2003). A final paper is in preparation in association with the termination of the EU-project WORMCOPS (5/2005).

D35 (Identification of plant/forages with short or long term anthelmintic effects) has been communicated in two related international publications on the general use of bioactive forages in the control of parasite infection of ruminants. The publications are listed in full in the E section (Waller and Thamsborg, 2004; Githiori et al., 2005).

D37 (Paper: *In vivo* studies of the anthelmintic effect of bioactive plants in pig) has been delayed due to the patent (see below). The paper forms part of Helena Mejer's Ph.D.-thesis and will be finalized within 5/2005. Draft version uploaded on Organic e-print.

WP7

D31: Cancelled due to problems under cultivation of most of the bioactive crops (see status report 2002 and 2003), which has reduced the value of the results. There were over-wintering problems with Jerusalem artichoke and Big trefoil and inoculation problems with Sainfoin and Sulla. It is therefore concluded, that the news value of results are too low for publishing.

WP8a,b1

D36: The publications of the 2 PROSQUAL/PROSBIO pig experiments (deliverable October 2004) have been delayed some time due to a Danish patent application No. PA 2003 00453 with the title: *Methodologies for improving the quality of meat, health status of animals and impact on environment* and one further patent-related product development experiment executed in 2004 with the title: *The effect of feeding different concentrations of dried chicory for 7, 14 or 21 days prior to slaughter on the chemical and sensory attributes of meat from entire male pigs*, financed by DIAS and KVL. As a result of the promising findings in the first and the second pig experiment of PROSBIO/ PROSQUAL and the production development experiment more publications than originally planned are expected . Preliminary version has been uploaded to E-print.

WP8b2

D34/D29: Based on a discussion among the participants, D34 has been split into two papers: one on the sensory profile data (Byrne *et al.*, manuscript in prep. 2005), and one on the production performance during finishing feeding including IMF, fatty acid profile and CLA in the meat (Vestergaard *et al.* in prep.).The second paper also fulfills D29. However, the parasite load and live weight part have been excluded from D29 because these results have been published in D15.

E. Project publications and other products

Der må gerne nævnes produkter, som kun er delvist finansieret af FØJO. Der er 3 klasser: 1) 75-100% uden markering. 2) 25-75% markeres med *. 3) 5-25% markers med **]

1. Products from Organic E-prints archive

(Alle produkter under 1 skal kopieres fra Organic E-prints)

<http://orgprints.org/view/projects/da2b03.html> - PROSBIO

Nielsen, Dr. B.; Thamsborg, Dr. S.M.; Andersen, Dr. H.R. and Kristensen, Dr. T. (2003) [Effect of winter feeding level and season on herbage intake in dairy breed steers on perennial ryegrass/white clover pasture](#). *Animal Science* 76: 341-352

Nielsen, Dr. B.; Thamsborg, Professor S.M.; Andersen, Dr. H.R. and Kristensen, Dr. T. (2003) [Herbage intake in Danish Jersey and Danish Holstein steers on perennial ryegrass/white clover pasture](#). *Livestock Production Science*. 86: 261-267 (draft)

Nielsen, Dr. B.K.; Kristensen, Dr. A.R. and Thamsborg, Professor S.M. (2003) [Optimal decisions in organic steer production - a model including winter feed level, grazing strategy and slaughtering policy](#). *Livestock Production Science*. 88(3):239-250 (draft)

Nielsen, Dr. B.K.; Kristensen, Dr. T. and Thamsborg, Professor S.M. (2003) [Organic steer production based on dairy breed bull calves - a farm study in Denmark](#). *Acta Agriculturae Scandinavica. Section A. Animal Science*. (rejected – to be resubmitted in another journal)

Nielsen, Ph.D. stud. B.K.; Thamsborg, Professor S.M. and Kristensen, Dr. T. (2003) [Feed Supplements for Young Dairy Breed Calves After Turn-Out to Pasture: Effect on Weight Gain and Subclinical Coccidiosis in Organic Production Systems](#). *Acta Agric. Scand. Animal Science* 53:pp. 1-10.

Nielsen, Ph.D. student Bea Klinzing (2003) [Organic Beef Production with Emphasis on Welfare, Health and Product Quality](#). Paper presented at European Association of Animal Production, Rome, Italy, 31 August - 3 September 2003.

Nielsen, Bea; Thamsborg, professor Stig Milan; Hermansen, senior researcher John; Kristensen, senior researcher Troels and Enemark, Peter Stamp (2001) [Økologisk oksekødsproduktion baseret på tyrekalve fra malkekvægsbesætninger](#) [Organic beef production based on dairy breed bull calves]. FØJO-rapport no. 13, Danish Research Centre for Organic Farming.

<http://orgprints.org/view/projects/da2b12.html> - **PROSQUAL**

*Vestergaard, M. (2003) [Fodringen kan påvirke fedtsyremønstret i oksekød – og måske gøre kødet sundere](#). In *Nyhedsbrevet Danmarks JordbrugsForskning*, nr. 3, juni 2003 p. 4., No 3, page pp. 4-4. Danish Institute of Agricultural Sciences.**

*Vestergaard, M. and Andersen, H. Refsgaard (2003) [Produktionssystemet kan påvirke indholdet af specielle fedtsyrer \(CLA\) i kød og talg fra stude](#). In *Kalveproducenten* 21 (3), 10-12, Volume 21, No 3, page pp. 10-12. Landsforeningen af danske slagtekalveproducenter.**

1.1 Articles in international, scientific journals with review procedures (but not yet available on Organic e-print)

** Githiori, JB, Athanasiadou, S., Thamsborg, S.M., 2005. Use of plants in novel approaches to control of gastrointestinal helminths in livestock with emphasis on small ruminants. Submitted to *Veterinary Parasitology*.
Draft version uploaded to Organic e-print but not released on site.

Hansen, L.L., Jensen, M.T., Mejer, H., Roepstorff, A., Thamsborg, S.M., Byrne, D.V., Karlsson, A.H., Hansen-Møller, J. & Tuomola, M., 2005. Influence of chicory roots (*Cichorium intybus* L) on boar taint in entire male and female pigs (close to submission).
Draft version uploaded to Organic e-print but not released on site.

Jensen, M. T. and Hansen, L. L., 2005 Feeding with chicory roots reduce amount of odorous compounds in colon contents of pigs (submitted *Animal Science*).
Draft version uploaded to Organic e-print but not released on site.

Mejer, H., A. Roepstorff, S. M. Thamsborg, L. L. Hansen, and K.E. Bach Knudsen, 2005. The effect of *Cichorium intybus* on helminth infections in pigs (close to submission). Draft version uploaded to Organic e-print but not released on site.

Kristensen, T., Thamsborg, S.M., Søgaard, K., Andersen, H.R. & Nielsen, L., 2005. Comparison of production, parasitism and health in Holstein heifers and steers grazing marginal areas at different stocking rate and grazing systems (submitted Animal Science). Draft version uploaded to Organic e-print but not released on site.

Nielsen, B.K., Thamsborg, S.M. Welfare, health and product quality in organic beef production – a Danish perspective. Livestock Production Science, 2005, in press. Draft version to be uploaded to Organic e-print.

** Thamsborg, S.M. & Roepstorff, A., 2003. Parasite problems in organic livestock and options for control. Journal of Parasitology, 2003, 89 (Suppl.): S277-S284. Final version uploaded to Organic e-print but not released on site.

**Waller, P.J., Thamsborg, S.M.: Nematode control in ‘green’ ruminant production systems. Trends in Parasitology 2004, 20(10):493-497. Final version uploaded to Organic e-print but not released on site.

1.2 Articles for international, scientific journals with review procedures - in preparation

Byrne, D.V. Vestergaard, M, & Hansen, L.L., 2005 Sensory profiling of the influence of chicory (bioactive) feeding on eating quality of steer meat.

Byrne, D.V. & Hansen, L.L., 2005. Sensory profiling and chemical investigations of the eating quality of pork in relation to the influence of bioactive feeding: Part I. crude chicory

Byrne, D.V. & Hansen, L.L., 2005. Sensory profiling and chemical investigations of the eating quality of pork in relation to the influence of bioactive feeding: Part II chicory (crude and dried) and inulin.

Vestergaard, M., Andersen, H.R., Lund, P., Kristensen, T., Hansen, L.L. & Sejrsen, K. Production performance of steers during finishing, including consequences for intramuscular fat, fatty acid profile and CLA in the meat. (In preparation).

2A. Other products (oral presentations, public meetings, field days, etc.)

Hald, A.B. 2004. *Restoration steps of agriculturally improved grassland on humic soil – management, seed bank and scale*. Proceedings 20th General Meeting of the European Grassland Federation Luzern 2004, Grassland Science in Europe **9: 174-176. (ppt presentation on EGF2004 website)

*Hald, A.B., Nielsen, A.L., Deboz, K. & Badsberg, J.H., 2001. Genopretning af ferske enge - potentielle indikatorer. Konf.: Græsning som drift og pleje af naturområder, Gl. Avernæs, Helnæs, Fyn, 8-9 October 2001. 8 pp.

*Hald, A.B., Nielsen, A.L., Deboz, K. & Badsberg, J.H. 2002. Restoration of agriculturally improved grassland on humic soil - scale, management, role of persistent seed bank, and indicators of potential botanical nature. Theme 5. Ecological basis of restoration. 3rd European Conference on Restoration Ecology, Budapest 25-31 August 2002: 88.

Hansen, L.L., Jensen, M.T., Mejer, H., Roepstorff, A., Thamsborg, S.M., Byrne, D.V., Karlsson, A.H., Hansen-Møller, J. & Tuomola, M., 2005. Influence of chicory roots (*Cichorium intybus L*) on boar taint in entire male and female pigs (abstract submitted to EAAP meeting, Uppsala, 2005)

Kristensen, T. 2003. Studeproduktion. Efteruddannelse for økologiske landmænd. Koldkær-gaard 29 januar (D30)

Kristensen, T. 2003. Studeproduktion på marginalarealer. Demonstration for landmænd og konsulent på Fussingø, 24. september (D30)

**Mejer, H. Alternative control of intestinal worms in Danish organic pigs. Paper presented at the conference on Organic Farming, Food Quality and Health, Newcastle, January 6-9.

**Mejer, H. & Roepstorff, A., 2003. Parasites in organic swine production in DK and options for control. Workshop on organic farming and novel approaches to control of parasites. WAAVP 2003, New Orleans, August 10-14.

**Nielsen, A.L. & Andersen, H.R., 2001. Husdyrenes behov i forhold til målet for naturforvaltningen. Konf.: Græsning som drift og pleje af naturområder, Gl. Avernæs, Helnæs, Fyn, 8-9 October, 2001. 3 pp.

**Nielsen, A.L. & Søgaard, K., 2000. Forage quality of cultivated and natural species in semi-natural grassland. *Grassland Science in Europe*, 5, 213-215.

*Nielsen, B and Thamsborg, S.M. 2003 Organic beef production with emphasis on welfare, health and product quality. Paper presented at 54th annual meeting of EAAP in Rome.

**Nielsen, A.L., Hald, A.B. and Badsberg, J.H. 2002. *Sward structure measurements to monitor the effect of grazing in nature management situations* - EGF 2002 Multi-Function Grasslands: Quality Forages, Animal Products and Landscape. *Grassland Science in Europe* 7:822-823.

**Roepstorff, A., 2003. Summary: Parasites in organic swine production. Workshop on organic farming and novel approaches to control of parasites. WAAVP 2003, New Orleans, August 10-14.

**Thamsborg, S.M. and Larsen, M., 2003. Introduction to organic farming and parasite control. Workshop on organic farming and novel approaches to control of parasites. WAAVP 2003, New Orleans, August 10-14 (SMT workshop convenor).

**Thamsborg, S.M. Parasitbekæmpelse på græs – får og geder (Parasite control in sheep and goats on pasture), Forum for Sheep and Goats, Danish Cattle Farmers yearly meeting, Herning, 24 February 2003. (oral presentation)

**Thamsborg, S.M. & Kapel, C.M.O. Options and practices for parasite control in organic livestock production. Meeting of the French Food Safety Agency (AFSSA) on: How to evaluate the nutritional value and health benefits and risks of organic foods? Paris, 18 October 2002

*Thamsborg, S.M., Mejer, H., Bandier, M. & Larsen, M. Influence of different forages on gastrointestinal nematode infections in grazing animals. Proc. 19th Int. Conf. of the WAAVP, New Orleans, USA, 2003, p. 189.

Vestergaard, M., Andersen, H.R., Lund, P., Kristensen, T., Hansen, L.L. & Sejrsen, K. 2005. Effects of chicory roots on finishing performance and CLA and fatty acid composition in longissimus muscle of Friesian steers. In: Y.van der Honing (Ed-i-ch.) Book of Abstracts of the 56th Annual Meeting of the EAAP, Wageningen Academic Publishers, The Netherlands. (Accepted).

2B. Reports, articles in agricultural journals, etc. (not in *Organic e-print*)

**Buttenschøn, R. M. & Nielsen, L. Regulering af lysesiv. Skov & Landskab, Park- og Landskab Videnblade, Landskabspleje, Blad nr. 6, 2-13.

**Badsberg, J.H., Nielsen, L. & Hansen, H.H. Spiser kvæg som en grønthøster, eller er de kræsne. I Kristensen, K. (ed) Biometrianvendelse i planteforskningen. DJF Intern rapport nr. 184, 14-26.

**Hoffmann, C.C., Jacobsen, O.S., Nielsen, L. & Debosz, K. Lavbundsarealerne ved Fusingø. DJF rapport Markbrug nr. 91, 15-27.

**Nielsen, A.L., Kristensen, T. & Badsberg, J.H. Animal production from dairy breed steers at extensively managed grasslands in riverside areas. Grassland Science in Europe, 7, 938-939.

**Nielsen, L. & Buttenschøn, R.M. Naturpleje på enge baseret på stude. Skov & Landskab, Park- og Landskab Videnblade, Landskabspleje bladnr. 6.2-12.

**Andersen, H.R., Kristensen, T., Bliggard, H.B., Madsen, N.T., Nielsen, B. 2003. Produktionssystemer for kontinuert produktion af efterårsfødte stude. DJF-rapport Husdyrbrug nr. 48. DJF-Foulum, 90 pp.

**Hald, A.B. 2002. Botanisk udvikling. In: Nielsen, A.L., Hoffmann, C.C. & Thamsborg, S.M. (eds.) Ferske enge – ekstensiv landbrugsproduktion, natur og miljø. DJF intern rapport nr. 154, 34-39.

*Hald, A.B. 2002. Økologisk jordbrug og natur. Jord og Viden 15: 14-17.

**Hald, A.B. & Nielsen, L. 2004. Aktive børn og unge på engen - en naturoplevelse for livet. Månedsmagasinet Skolen, 10(4): 22-23.

**Hald, A.B. 2004. En økologisk botaniker-vinkel på forvaltning for engfugle. URT 28(2): 64-71.

**Hald, A.B. 2003. Plantediversitet som funktion af slæt, afgræsning og driftsophør – In: Hald, A.B. Hoffmann, C.C. & Nielsen, A.L. (eds.): Ekstensiv afgræsning af ferske enge - Botanisk diversitet, småpattedyr, miljø og produktion. - DJF rapport Markbrug nr. 91. p. 29-57.

Kristensen, T. 2002. Muligheder i at producere øko-stude. Økologisk Jordbrug, nr 257, 6. (D30)

Nielsen, B. 2003. Dairy breed bull calves in organic beef production – with emphasis on rearing and fattening of steers. Ph.D. Thesis. Royal Vet. and Agric. Univ. Copenhagen, Denmark.

Nielsen, B., A. R. Kristensen, and S. M. Thamsborg. 2003. Optimal decisions in organic steer production - A model including winter feed level, grazing strategy and slaughtering policy. Report in Ph.D. course: Advanced Herd Management at KVL.

**Nielsen, L. & Hald, A.B. 2004. Blomstrende enge og græssende dyr - kan det betale sig ? Familielandbruget Gl. Viborg Amt, 1: 11.

**Nielsen, L., Hoffmann, C.C. & Thamsborg, S.M., 2002. En multidisciplinær undersøgelse af ferske enge med ekstensiv landbrugsdrift. DJF intern rapport nr. 154, 2-6.

**Nielsen, L., Hansen, H.H., Badsberg, J.H. & Søgaard, K., 2002. Planteproduktion og fødevalg. DJF intern rapport 154, 7-13.

*Nielsen, A.L., Hald, A.B., Kristensen, T., Thamsborg, S.M. & Olsen, H. 2004. Fra kultureng til natureng – et samspil af natur, miljø og landbrugsproduktion. *Jord og Viden* 1: 8-10.

Vestergaard, M., Kristensen, T. & Andersen H.R. 2005. Alternativ slutfedning af økologiske stude med cikorierødder. *Kalveproducenten* 23 (1). (In press).

Vestergaard, M. 2005. Slutfedning af økologiske stude med cikorierødder. *Ny Kvæg-Forskning*. 3. årgang, nummer 1, februar 2005. (In press).

F. Scientific education (whole project)

WP1+2+3 formed part of the Ph.D. study of Bea Nielsen, terminated in June 2003 with the thesis: Dairy breed bull calves in organic beef production – with emphasis on rearing and fattening of steers. Affiliated to the SOAR research school.

WP5+6+8 form part of the Ph. D. study of Helena Mejer, in collaboration with the DARCOF II project MANORPIG. Affiliated to the SOAR research school (plan finishing April 2005).

M.Sc. (agriculture) student Diana Thomsen has been associated with WP3 and she graduated with a thesis on Herbage intake and botanical composition of the diet on 12 July 2002.

M.Sc. (biology) student Christina Guldborg Hansen has been associated with WP5 and WP6 in 2001/2002 and graduated in April 2003 (Thesis: The effect of bioactive forages on gastrointestinal nematode infections in sheep, KVL, 81 pp + appendices)

M.Sc. (veterinary science) student Michala Bandier has been associated with WP5 and WP6 in 2002. She graduated in January 2002 (Thesis: The effect of chicory (*Cichorium intybus*) and sainfoin (*Onobrychus viciifolia*) on establishing nematode infections in grazing lambs, KVL, 146 pp.).

G. National and international cooperation

LLH and the Dept. of Food science, DIAS co-operate with the project leaders Chris Claudi-Magnussen and Patricia Barton-Gade at the Danish Meat Research Institute and consultant Hanne Maribo, The National Committee for Pig Production, Dept. of Nutrition and Reproduction in projects concerning the meat and eating quality of organic pork, among other things in the project 'The importance of organic pig production for meat and eating quality'.

The Dept. of Animal Nutrition and Physiology, DIAS already has collaboration with DTU (Mie Strårup replaces the late Carl-Erik Høy) concerning CLA analyses in cow's milk. HEF also has a well-established collaboration with the Danish Meat Research Institute (DMRI) (Ina Clausen and Niels T. Madsen) concerning all types of meat production experiments in cattle.

Dept. of Food Science also co-operates among others with head of the project Martin Tang Sørensen and project members Søren Krogh Jensen and José Fernandez, Dept. of Animal Nutrition and Physiology, DIAS, and Chris Claudi-Magnussen the Danish Meat Research Institute and Hanne Maribo, The National Committee for Pig Production, Dept. of Nutrition and Reproduction in projects in the project 'Pig feeding under organic conditions with emphasis on nutrient utilisation, product quality and health (II.7)'.

Bio-active crops form part as an essential element of a project within the 5th EU framework programme: 'Worm control in organic production systems for small ruminants' (WORMCOPS) (2001-2004) in a co-operation between KVL (SMT, HM), Swedish University of Agricultural Sciences (SLU), University of Utrecht, Moredun Research Institute, Scottish Agricultural College and others.

SMT participates in the Sustaining Animal Health and Food Safety in Organic Farming (SAFO) concerted action of EU FP5 (2003-2005). HM, AR and SMT are in a EU FP6 project: Food Quality and Safety in the European Organic Supply Chain QLIF), starting in 2004.

The Dept. of Food Science, DIAS has started a co-operation with Ph.D. Mika Tuomola, University of Turku Finland concerning androstenone measurement in blood plasma from male pigs and Jens Hansen-Møller, Dept. of Animal Nutrition and Physiology, DIAS concerning skatole measurement in blood plasma from male and female pigs. The WP8 in PROSBIO and the WP1 in PROSQUAL has no funding for this measurement of androstenone and skatole in blood plasma.

H. Critical reflection on the project (PROSBIO/PROSQUAL)

Scientific content and methodologies

The section was detailed discussed in the last status report. We would like to add that the recent study in steers has clearly indicated that you are able to manipulate the quality of the product (i.e. meat sensory profiling) by feeding small amounts of bioactive forages but appar-

ently the high-barley fed group was preferred. Further analysis is needed. The results of using bioactive forages in the feed for pigs have again been promising, and we have now patented some of our findings. We have increased the scientific value of the two PROSBIO and PROSQUAL pig experiments by further investigations and by that increased the quality of the patent application through funding from DIAS and KVL. Although this may represent a commercialisation of our findings, we are confident it will feed back new ideas and better solutions in the field of sensory eating quality of pork from female, (castrated) and entire male pigs (boar taint) and technologies to organic as well as conventional livestock production.

Despite the fact that we have to realize that a few deliverables will not be fulfilled, the project still has had a high level of publication.

Research development

We can only one more time state that the project has opened up for new perspectives and collaborative links. Last year, we mentioned our participation in the QLIF and WORMCOPS EU-project and in 2004 the group has applied once more for several projects, including DARCOFIII.

Relevance of the project in relation to recent development in the farming community and structural changes

Our thoughts on integrity in organic farming have been reflected in the recent developments within the DARCOF, including the new strategy and the DARCOFIII.

Major adjustments and deviations

This has been discussed in the report. Similar to last year, we have to note that the project has suffered from 2-3 researchers leaving the project thereby creating a vacuum of knowledge and enthusiasm difficult to fill in by other personnel, despite good intentions to do so.

Future prospects

We intend to continue much of the present line of research, i.e. the concept of natural functional feeds for animals for health and improved quality and the coupling of nature preservation and animal production on marginal land. The ideas were basic behind this project, and they are still important.

8. Budget

A. Account for any change in budgets

B. Budget for the whole project (1.000 DKK)

Total consumption of funds from DARCOF and expected consumption this year and coming years

PROSBIO + PROSQUAL

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel	69.0	39.3	18.1	9.2	66.6
Technical personnel	66.6	52.2	16.8	3.1	72.1

Year:	Original Budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	2590	1472	672	346	2490
Technical personnel	1605	1296	434	84	1814
Other operational costs	1570	1255	124	92	1471
Equipment	54	47	63	0	110
Others (please specify)	293	113	86	29	228
Direct costs	6112	4183	1379	551	6113
Indirect costs (20% of direct costs)	1222	837	276	110	1223
Total	7334	5020	1655	661	7336

Comments:

9. Signatures and stamps

Name	Institute	Date	Signature
Head of project Stig Milan Thamsborg	DCEP, KVL	14-2-2005	

Appendix I. Detailed budget

A. Budget for each participating institute (1.000 DKr)

PROSBIO + PROSQUAL

Name of Institute: Danmarks Jordbrugsforskning (DJF)

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel	37.9	22.7	9.6	5.6	37.9
Technical personnel	34.4	24.5	6.8	3.1	34.4

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	1576	930	443	230	1603
Technical personnel	842	605	167	84	856
Other operational costs	924	745	65	80	890
Equipment	13	47	0	0	47
Others (please specify)	177	59	55	24	138
Direct costs	3532	2385	730	418	3534
Indirect costs (20% of direct costs)	706	477	146	84	707
Total	4238	2862	876	501	4240

Comments:

A. Budget for each participating institute (1.000 DKr)

PROSBIO

Name of Institute: National Environmental Research Institute (DMU)

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel	5.1	5.1	0	0	5.1
Technical personnel	1.7	1.7	0	0	1.7

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	188	188	0	0	188
Technical personnel	40	40	0	0	40
Other operational costs	3	35	0	0	35
Equipment	0	0	0	0	0
Others (please specify)	32	0	0	0	0
Direct costs	263	263	0	0	263
Indirect costs (20% of direct costs)	53	53	0	0	53
Total	315	315	0	0	315

Comments:

A. Budget for each participating institute (1.000 DKr)

PROSBIO + PROSQUAL

Name of Institute: The Royal Veterinary and Agricultural University (KVL)

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel	26.0	11.5	8.5	3.6	23.6
Technical personnel	30.5	26	10	0	36

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	826	354	229	116	699
Technical personnel	722	651	267	0	918
Other operational costs	612	475	59	12	546
Equipment	41.5	0	63	0	63
Others (please specify)	116	54	31	5	90
Direct costs	2318	1534	649	132	2315
Indirect costs (20% of direct costs)	463	306	130	26	462
Total	2781	1840	778	158	2776

Comments:

B. Budget for each participating department (1.000 DKK)

PROSBIO

Name of Institute and department: Afdeling for Prydplanter og Vegetabiliske Fødevarer, DJF (Kirsten Brandt)

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel	3.3	2.8	0.5	0	3.3
Technical personnel	4.2	4	0.2	0	4.2

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	158	131	27	0	158
Technical personnel	98	92	6	0	98
Other operational costs	55	49	7	0	56
Equipment	0	0	0	0	0
Others (please specify)	2	2	1	0	3
Direct costs	313	274	40	0	314
Indirect costs (20% of direct costs)	63	55	8	0	63
Total	376	329	48	0	376

Comments:

B. Budget for each participating department (1.000 DKK)

PROSBIO

Name of Institute and department: Afdelingen for Plantevækst og jord, DJF (Karen Søegaard)

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel	5.4	5.4	0	0	5.4
Technical personnel	4.7	4.7	0	0	4.7

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	225	225	0	0	225
Technical personnel	122	122	0	0	122
Other operational costs	60.5	60.5	0	0	60.5
Equipment	0	0	0	0	0
Others (please specify)	5	5	0	0	5
Direct costs	412.5	412.5	0	0	412.5
Indirect costs (20% of direct costs)	82.5	82.5	0	0	82.5
Total	495	495	0	0	495

Comments:

B. Budget for each participating department (1.000 DKK)

PROSBIO

Name of Institute and department: Afdeling for Plantevækst og Jord, DJF (Christer Ohlsson)

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel	2.5	1.5	1.0	0	2.5
Technical personnel	4.0	4.0	0	0	4.0

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	112	65	47	0	112
Technical personnel	101	101	0	0	101
Other operational costs	83	83	0	0	83
Equipment	0	0	0	0	0
Others (please specify)	17	13	3	0	16
Direct costs	313	262	51	0	313
Indirect costs (20% of direct costs)	63	53	10	0	63
Total	376	315	61	0	376

Comments:

B. Budget for each participating department (1.000 DKK)

PROSBIO + PROSQUAL

Name of Institute and dept.: Dept. of Food Science, DJF (Laurits Lydehøj Hansen)

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel	11.2	4.0	3.6	3.6	11.2
Technical personnel	14.5	6.8	5.1	2.6	14.5

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	442	155	168	146	469
Technical personnel	324	149	117	72	338
Other operational costs	231	119	44	80	243
Equipment	13	0	0	0	0
Others (please specify)	75	18	6	10	34
Direct costs	1085	441	335	308	1084
Indirect costs (20% of direct costs)	216	88	67	62	217
Total	1301	529	402	370	1301

Comments:

B. Budget for each participating department (1.000 DKK)

PROSBIO

Name of Institute and department: Afdeling for Husdyrernæring og Fysiologi (Refsgaard Andersen), DJF og Afdelingen for Jordbrugssystemer, DJF (Troels Kristensen)

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel	13	8	4	1	13
Technical personnel	5	4	1	0	5

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	543	316	182	46	543
Technical personnel	149	117	32	0	149
Other operational costs	494	433	14	0	447
Equipment	0	47	0	0	47
Others (please specify)	30	18	3	10	30
Direct costs	1217	931	231	56	1217
Indirect costs (20% of direct costs)	243	186	46	11	243
Total	1460	1117	277	67	1460

Comments:

B. Budget for each participating department (1.000 DKK)

PROSQUAL

Name of Institute and department: Afdeling for Husdyrernæring og Fysiologi, DJF
(Mogens Vestergaard)

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel	2.5	1.0	0.5	1.0	2.5
Technical personnel	2.0	1.0	0.5	0.5	2.0

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	95	38.0	19.0	38.0	95.0
Technical personnel	48	24.0	12.0	12.0	48.0
Other operational costs	0	0	0	0	0
Equipment	0	0	0	0	0
Others (please specify)	48.8	2.8	41.8	4.2	48.8
Direct costs	191.8	64.8	72.8	54.2	191.8
Indirect costs (20% of direct costs)	38.4	13.0	14.6	10.8	38.4
Total	230	77.8	87.4	64.0	230.0

Comments:

B. Budget for each participating department (1.000 DKK)

PROSBIO

Name of Institute and department: Afdeling for Landskabsøkologi, DMU (Anna Bodil Hald)

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel	5.1	5.1	0	0	5.1
Technical personnel	1.7	1.7	0	0	1.7

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	188	188	0	0	188
Technical personnel	40	40	0	0	40
Other operational costs	3	35	0	0	35
Equipment	0	0	0	0	0
Others (please specify)	32	0	0	0	0
Direct costs	263	263	0	0	263
Indirect costs (20% of direct costs)	53	53	0	0	53
Total	315	315	0	0	315

Comments:

B. Budget for each participating department (1.000 DKK)

PROSBIO + PROSQUAL

Name of Institute and department: Mejeri og Levnedsmiddelinstittet, KVL (Derek Byrne)

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel	11	3	8	0	11
Technical personnel	0	0	0	0	0

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	342	123	216	0	339
Technical personnel	0	0	0	0	0
Other operational costs	29	20	0	10	30
Equipment	41.5	0	41.5	0	41.5
Others (please specify)	2	4	0	0	4
Direct costs	414.5	147	257.5	10	414.5
Indirect costs (20% of direct costs)	82.9	29	51.5	2	82.9
Total	497	176	309	12	497

Comments:

B. Budget for each participating department (1.000 DKK)

PROSBIO

Name of Institute and department: Danish Centre for Experimental Parasitology, Department of Veterinary Microbiology, KVL (Allan Roepstorff)

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel	10.0	6.0	0.5	2.5	8.5
Technical personnel	7.0	4.0	5.0	0.0	9.0

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	323	163	13	75	251
Technical personnel	171	99	139	0	238
Other operational costs	82	50	35	2	87
Equipment	0	0	0	0	0
Others (travels)	30	14	15	0	29
Direct costs	607	326	202	77	605
Indirect costs (20% of direct costs)	121	65	40	15	120
Total	728	390	242	92	725

Comments:

B. Budget for each participating department (1.000 DKK)

PROSBIO

Name of Institute and department: Danish Centre for Experimental Parasitology, Department of Veterinary Microbiology, KVL (Stig Milan Thamsborg)

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel	5.0	2.5	0.0	1.1	3.6
Technical personnel	23.5	22.0	5.0	0.0	27

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	161	68	0	41	109
Technical personnel	552	552	128	0	680
Other operational costs	500	405	24	0	429
Equipment	0	0	21	0	21
Others (travels)	84	36	16	5	57
Direct costs	1297	1061	189	46	1296
Indirect costs (20% of direct costs)	259	212	38	9	259
Total	1556	1272	227	55	1555

Comments:

C. Budget for co-financing from each participating institute (1.000 DKK)

None

Appendiks I.

Fyldigt dansk sammendrag af forskningsprojektet og dets resultater

Økologisk kødproduktion i Danmark omfatter hovedsageligt okse- og svinekød. Økologisk okse- og svinekøds nuværende markedsandel af den samlede okse- og svinekødsproduktion er kun på hhv. 0.5% og 2.1%. Der er således en begrænset efterspørgsel efter økologisk højkvalitets okse- og svinekød. Projektets formål er at bidrage til udvikling af økonomisk og miljø-mæssigt bæredygtige produktionssystemer til fremstilling af økologisk okse- og svinekød af høj kvalitet. Forsøgene omfatter studier på gårde, græsningsstudier med drøvtyggere samt eksperimentelle forsøg i stalden. Projektet inkluderer brugen af specielt, ikke-konventionelt foder (eksempelvis cikorierødder) med en forventet positiv effekt på sundhed samt kød- og spisekvalitet i økologisk oksekød (fra stude) og svinekød.

Kun 10-15% af tyrekalvene fra økologiske malkekvægsbesætninger bliver slagtet økologisk. Forventet manglende økonomisk rentabilitet anses for at være den største hindring for at bruge kalve og ungtyre fra malkekvægsproduktionen i økologisk oksekødsproduktion. Interessen for økologisk oksekødsproduktion er dog stigende, og der er et betydeligt behov for pålidelig information om produktionsparametre, fodringsstrategier og metoder til øgning af hjemmemarkedsandelen af økologisk oksekød fra stude af malkekvægstypen. Der vil blive lagt vægt på forbedring af dyresundhed og -velfærd, produktkvalitet fra studeproduktion samt anvendelse og bevaring af biodiversiteten af marginale græsningsarealer.

Visse undersøgelser tyder på, at enkelte afgrøder kan påvirke dyrs parasitstatus i forbindelse med afgræsning og/eller kødets kvalitet efter slagtning. Disse afgrøder betegnes som bioaktive afgrøder, idet effekten tilskrives planternes indhold af bestemte bioaktive stoffer. Muligheden for anvendelse af disse afgrøder og andre relevante planter i økologiske produktionssystemer er ikke tilstrækkeligt belyst

Økologisk svinekød afviger fra konventionelt svinekød mht. visse kvalitetsparametre såsom højere indhold af flerumættede fedtsyrer, hvilket skyldes de økologiske fodermidler (protein-kilder og grovfoder), og i nogle tilfælde lavere mørhed, hvilket skyldes produktionsformer, som resulterer i lavere daglig tilvækst. Til trods for et højt indhold af flerumættede fedtsyrer er positivt set ud fra et humant sundhedsperspektiv, betyder det samtidig, at kødet er mere disponeret for oxidation og dermed for harskning. Denne oxidation kan udgøre et problem i kødprodukter, som anvendes til cateringprodukter, da disse involverer genopvarmning af kødet. Oxidationen af flerumættede fedtsyrer i kød kan imidlertid hæmmes af visse antioxidanter såsom E-vitamin og enzymssystemer med antioxidativ aktivitet.

De komplementerende undersøgelser i PROSQUAL og PROSBIO omfatter effekten af produktionssystemet og anvendelse af udvalgte bioaktive fodermidler (cikorierødder rå og tørrede) med mulig positiv indflydelse på sundhedsegenskaber, kødkvalitet og sensorisk spisekvalitet af kødet fra både stude og slagtesvin (bl.a. conjugere linoleic acid (CLA) og andre fedtsyrer i oksekød samt selen (gluthatione peroxidase), harsked, dryptab og afvigende lugt og smagsstoffer i svinekød). Denne indgangsvinkel har til formål at forbedre kødkvalitet og sen-

sorisk spisekvalitet samt fremme human sundhed. Det formodes at bl.a. CLA kan have sundhedsfremmende egenskaber hos mennesker. Det er således projektets hensigt at udvikle metoder til at forbedre kvaliteten af økologiske produkter.

Mål og resultater

Projektets overordnede formål er således at udvikle og dokumentere økonomisk bæredygtige og sundhedsmæssigt forsvarlige produktionssystemer for økologisk kød (okse- og svinekød). Særlig vægt vil blive lagt på studeproduktion med henblik på at forbedre sundhed og velfærd og produktkvalitet samt at øge naturværdien på marginaljorde ved afgræsning. Anvendelse af udvalgte bioaktive afgrøder til drøvtyggere og svin til forbedring af produktkvalitet og sundhed, primært til forebyggelse af parasitære infektioner, indgår ligeledes i undersøgelserne. Hvad angår kød- og spisekvalitet indgår følgende nye, specifikke mål fra projektet PROSQUAL:

1. at undersøge kød- og spisekvaliteten samt indholdet af E-vitamin og selen (gluthatione peroxidase), samt fedtsyresammensætningen i svinekød fra so- og hangrise fodret med bioaktive afgrøder (rå og tørrede cikorierødder).
2. at bestemme fedtsyresammensætningen og CLA-indholdet i talg og kød fra ekstensivt opdrættede stude slutfedet med forskellige kombinationer af kløvergræsensilage, byg og cikorierødder.
3. at sammenligne fedtsyresammensætningen inklusiv CLA i kød fra stude og ungtyre opdrættet i forskellige produktionssystemer.

Der er opnået mange resultater på kød- og spisekvalitetsområdet i de to svineforsøg (2001/2002 og 2002/2003). Resultater har bl.a. vist, at det har været muligt at reducere problemet ornelugt hos hangrise i væsentlig grad og påvirke spisekvaliteten i tilberedt kød fra de cikorierodsfodrede slagtesvin af begge køn i en mere bitter og sur smagsretning afhængig af concentrationen af cikorierod og tid, men med acceptabel spisekvalitet til følge selv ved højeste concentration (25%) af cikorie i foderblandingen. Desuden ser det ud til, at cikoriefodrede grises kød ikke harskner så let (mindre WOF). En dansk patentansøgning er indsendt til Patent og Varemærkestyrelsen, Erhvervsministeriet.

Undersøgelserne vedr. fedtsyresammensætning inkl. CLA i talg og kød fra stude sluttede med udgangen af 2002. Resultaterne vedr. produktionssystemets betydning for talgens CLA-indhold er publiceret på dansk og viser, at såvel race (Jersey vs. Holstein Friesian) som fodring har væsentlig betydning for talgens CLA-indhold. De sensoriske analyser er gennemført i august 2003, men endnu ikke færdigtolket.

Perspektiver

Projektet vil på længere sigt bidrage til den videnskabelige basis for retningslinier til økologisk oksekødsproduktion og dermed beslutningsstøtte til producenter. Anvendelsen af bioaktive afgrøder til fremme af kød- og spisekvalitet og/eller begrænsning af udegående dyrs parasitbelastning er et nyt perspektiv. Det vil kunne begrænse anvendelsen af lægemidler og dermed undgå lange tilbageholdelsestider. Kombinationen af studeproduktion baseret på afgræsning og bevarelse eller forøgelse af biodiversiteten på marginale arealer må anses for ønskværdig i sammenhæng med naturpleje og miljø. Det forventes, at de planlagte tiltag samlet kan forbedre økonomien i økologisk kødproduktion, primært studeproduktion, eller bidrage til en synliggørelse af de forøgede udgifter ved denne produktion, der retfærdiggør en nødvendig merpris. Samtidig skal projektet bidrage til billedet af økologisk husdyrproduktion som en miljømæssigt fordelagtig produktion.