



Midterm Status Report 2002 and Application for Continuation in 2003

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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

Pig feeding under organic farming conditions with emphasis on nutrient utilisation, product quality and health (II.7)

3. Head of project

Head of Unit Viggo Danielsen
Danish Institute of Agricultural Sciences
Department of Animal Nutrition and Physiology
P.O. Box 50
8830 Tjele
Tlf 89 99 13 76
Fax 89 99 15 25
E-mail: Viggo.Danielsen@agrsci.dk

4. Participating institutes

Danish Institute of Agricultural Sciences
Department of Animal Nutrition and Physiology
P.O. Box 50
8830 Tjele
Tlf 89 99 13 76
Fax 89 99 15 25
E-mail: Viggo.Danielsen@agrsci.dk

Danish Meat Research Institute
P.O. Box 57
Maglegårdsvej 2
4000 Roskilde
Tlf +45 46 30 32 51
Fax: 46 30 31 32
E-mail: ccm@danishmeat.dk

5. Other project staff

Jose A. Fernandez (JAF), Senior Scientist, Ph.D., Department of Animal Nutrition and Physiology, DIAS, Ph.: +45 8999 1374; Fax: +45 8999 1525; E-mail: José.Fernandez@agrsci.dk

Søren Krogh Jensen (SKJ), Senior Scientist, Ph.D., Department of Animal Nutrition and Physiology, DIAS, Ph.: +45 8999 1117; Fax: +45 8999 1166 E-mail: SorenKrogh.Jensen@agrsci.dk

Hanne Damgaard Poulsen (HDP), Senior Scientist, Ph.D., Department of Animal Nutrition and Physiology, DIAS, Ph.: +45 8999 1386; Fax: +45 8999 1525; E-mail: HanneD.Poulsen@agrsci.dk

Martin Tang Sørensen (MTS), Senior Scientist, Ph.D., Department of Animal Nutrition and Physiology, DIAS, Ph.: +45 8999 1554; Fax: +45 8999 1525; E-mail: MartinT.Sorensen@agrsci.dk

Knud Erik Bach Knudsen (KBK), Professor, Ph.D., Department of Animal Nutrition and Physiology, DIAS, Ph.: +45 8999 1143; Fax: +45 8999 1378; E-mail: KnudErik.BachKnudsen@agrsci.dk

Ellen-Margrethe Vestergaard (EMV), Senior Scientist, Ph.D., Department of Animal Health and Welfare, DIAS, Ph.: +45 8999 1315; Fax: +45 8999 1500; E-mail: EllenM.Vestergard@agrsci.dk

Laurits Lydehøj Hansen (LLH), Senior Scientist, Ph.D., Department of Animal Product Quality, DIAS, Ph.: +45 8999 1255; Fax: +45 8999 1564; E-mail: LauritsLydehoj.Hansen@agrsci.dk

Christer Ohlsson (CHO), Senior Scientist, Ph.D., Department of Crop Physiology and Soil Science, DIAS, Ph.: +45 8999 1833; Fax: +45 8999 1839; E-mail: Christer.Ohlsson@agrsci.dk

Karen Søgaard (KAS), Senior Scientist, Ph.D., Department of Crop Physiology and Soil Science, DIAS, Ph.: 45 8999 1834, Fax: +45 8999 1619; E-mail: Karen.Soegaard@agrsci.dk

Hanne Maribo (HMA), Consultant, Department of Nutrition and Reproduction, Danish Bacon and Meat Council, Ph.: +45 3373 2626; Fax: +45 3314 2517; E-mail: hma@danskeslagterier.dk

6. Project period (month, year)

Start of project:	2001 (Quarter 3)
End of project:	2005 (Quarter 2)

7. Midterm description of the project, its results and progress, and application for continuation in 2003

A. Project summary

A knowledge synthesis initiated by DARCOF revealed that some topics in relation to feeding of pigs under organic farming conditions need to be studied. The demand to be self-sufficient in feed for organic animal production is increasing, but pig production is restrained by the difficulty to provide feed ingredients for suitable nutrient supply. In order to meet the demands for protein, amino acids, vitamins and minerals from pigs, alternative feed crops and feed ingredients therefore have to be found. Thus, there is a great need for evaluation of traditional as well as alternative feed ingredients, which have potential as pig feed. The overall objective of this project is to obtain improved knowledge for development of suitable feed formulations and feeding strategies for organic pig production. The work will be conducted in three work packages and involves experiments with breeding sows, as well as weaned pigs and growing-finishing pigs.

The expected achievements comprise:

- Indication of methods and feedstuffs for suitable supplying of pigs with dietary protein and essential amino acids.
- Improvement of the knowledge about requirements for dietary essential amino acids of weaned pigs, growing-finishing pigs and breeding sows.
- Improvement of the knowledge about the demands for dietary supply of vitamins and minerals of pigs under outdoor conditions.
- Development of methods for feeding of piglets in connection with weaning.
- Development of feeding concepts that can be used to improve the animals resistance to infectious diseases of the gastrointestinal tract of growing-finishing pigs.
- Exposure of interactions between the diet composition and the carcass and meat quality in slaughter pigs.

The research is intended to give valuable information on the effect of lupine and dietary protein level on the performance and nutrient utilisation of growing pigs and product quality of organic pork. The effect of lupin on skatole in back fat is included. Thus, if lupin results in lower skatole in fat, this may be a way to reduce boar taint in entire male pigs. Output from the research also intend to comprise new knowledge, that can be used as basis for recommendation of management for efficient utilisation of pastures and silage in feeding of pregnant sows. In this connection and also in some of the other studies, monitoring of the mineral and vitamin status of the animals will give important informa-

tions for the guidance of dietary supplementations. The research will also give a better basis for evaluating the potential of using the diet to reduce digestive disturbances in piglets and infectious diseases in growing pigs. The project will also help to find ways to overcome problems that may occur because of higher infectious pressure for pigs with access to outdoor facilities and straw bedding. Furthermore, the project attempts to provide tools for an environmental friendly production of pigs in Denmark, with minimal use of therapeutic antibiotics and anthelmintics.

Table 1: Work package list (from application)

No.	Work package title	Partici-pants*	Budget (1.000 DKr)	Start	End	Deliverable No:
-	Co-ordination	VDA	248.500	01.04. 2001	30.6 2005	
1	Adequate supply of dietary protein, vitamins and minerals to sows and growing-finishing pigs.	JAF	1.900.000	01.07. 2001	31.12. 2004	D1.2-D1.10
2	Feeding strategies for weaned and growing-finishing pigs with emphasis on gut health.	KEBK	1.900.000	01.07. 2001	30.06. 2005	D2.1-D2.5
3	Effects of nutrient supply for growing-finishing pigs on product quality.	CCM	951.500	01.01. 2002	31.12.2004	D3.1-D3.3
Total			5.000.000			

- Responsible participants

B. Objectives and expected achievements

The overall objective of the project is to obtain new knowledge, that can support the recommendation of suitable dietary composition and feeding strategies for organic pig production. The emphasis will be placed on feedstuffs of organic farmed origin and the nutritional requirements for performance, carcass quality, meat quality and health of the pigs will be studied. Expected achievements comprise:

- Indication of methods and feedstuffs for suitable supplying of pigs with dietary protein and essential amino acids.
- Improvement of the knowledge about requirements for dietary essential amino acids of weaned pigs, growing-finishing pigs and breeding sows.
- Improvement of the knowledge about the demands for dietary supply of vitamins and minerals of pigs under outdoor conditions.
- Development of methods for feeding of piglets in connection with weaning.

- Development of feeding concepts that can be used to improve the animals resistance to infectious diseases of the gastrointestinal tract of growing-finishing pigs.
- Exposure of interactions between the diet composition and the carcass and meat quality in slaughter pigs.

C. Midterm results and progress

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

WP 1. Adequate supply of dietary protein, vitamins and minerals to sows and growing-finishing pigs

Task 1.1. Production experiments with growing pigs

The experiments concerning effects of reduced dietary protein and different levels of lupines are in progress. Two replications out of 8 planned have been carried out so far. The two replications consisted of 50 pigs (25 sows and 25 barrows) reared in pens of 5 pigs each. The preliminary results are though not yet sufficient to allow evaluation of treatment effects. Overall means of initial and final weights of pigs were 30.1 and 101.4 kg, respectively. Daily gain averaged 873 g and overall mean of lean meat in carcass was 59.7 per cent.

Task 1.2. Digestibility and balance experiments

Digestibility and balance studies have been planned in details. Four diets used in the 3. and 4. replication of the production experiments and a batch of organic produced oats respectively lupine will be assayed. These studies will be performed from November this year though March next year. Thus, no results are available.

Task 1.3. Production experiments with pregnant sows

The experiments concerning pregnant sows on pasture have for the present been conducted in three turns. Preliminary results from one turn in 2001 and one turn in 2002 have revealed that sows during pregnancy are able to cover up to 60-65% of their daily net energy requirements by grazing. These results have been obtained by rotational grazing, where three paddocks for each group of sows were in use. Results on feeding of clover grass silage ad libitum to pregnant sows during the wintertime have demonstrated nutritional value in the same proportions as by grazing.

In relation to sows on pasture several measurements of herbage mass and botanical composition of the paddocks have been taken. Furthermore vitamins- and mineral status of the sows are monitored in samples of blood and milk. Our results indicate that the levels of dietary protein, vitamins and minerals in the supplemental concentrate can be reduced in relation to the recommended levels for conventional diets.

WP 2. Feeding strategies for weaned and growing-finishing pigs with emphasis on gut health

Task 2.1. Gut challenge and diet screening

We have now experience from an ongoing project where we have established a gut challenge *E. coli* model for piglets weaned at 4 weeks of age. The next step is to implement the same challenge model on 7 weeks old piglets, which is scheduled for the last quarter of 2002. Thus, no results are yet available.

Task 2.2. Effect of dietary factors on weaning diarrhoea

Based on results from task 2.1, selected diets will be tested in organic farmed piglets.

No results yet.

Task 2.3. Effect of diets varying in digestible and nondigestible carbohydrates on *T. suis* infection

We are now extrapolating our results from conventional diets to diets formulated from organic based feedstuffs. Two diets with contrasting digestibility have been formulated - the diet containing resistant carbohydrates is based on triticale, barley, rapeseed cake and silage as the main ingredients while the diet with fermentable carbohydrates is based on triticale, barley, blue lupines and chicory roots. The two types of diets will be fed to four groups of animals. The experiment will start in the middle of November of 2002 and end in February 2003. No results yet.

Task 2.4. Effect of diets varying in carbohydrate composition on establishment of dual infection with *T. suis* and *B. pilosicoli*.

The activities under this task are expected to be carried out during 2003.

WP 3. Effects of nutrients for growing-finishing pigs on product quality

Task 3.1

The activities are combined with the activities in WP 1, task 1.1 on dietary protein level and inclusion of lupines. For the present carcass samples have been delivered from 20 gilts and 20 male castrates reared in four of the treatments in task 1.1 (2 levels of protein x 2 levels of lupine). For the time being no traits have been analyzed.

C.2 Fulfilment of deliverables and milestones

(To be completed for each work package)

WP number and title: WP1: Adequate supply of dietary protein, vitamin and minerals to pregnant sows and growing-finishing pigs	Time schedule according to application	Deviations, if any*
Deliverables:		
1. Protocol for experiments with pregnant sows, 1 replicate	Quarter 3 – 2001	-
2. Protocol for digestibility experiments	- 3 - 2001 -	-
3. Protocol for experiments with slaughter pigs, 1. replicate	- 3 - 2001-	-
4. Progress report	- 4 - 2001	-
5. Progress report	- 4 - 2002	-
Milestones:		
None		-

WP number and title: WP2: Feeding strategies for weaned and growing-finishing pigs with emphasis on gut health	Time schedule according to application	Deviations, if any*
Deliverables:		
None		
Milestones:		
1. Preliminary evaluation of the procedure for gut challenge and diet screening	Quarter 3 – 2002	-
2. Evaluation of dietary factors on weaning diarrhoea	Quarter 3 - 2002	

WP number and title: WP3: Effects of nutrient supply for growing-finishing pigs on product quality	Time schedule according to application	Deviations, if any*
Deliverables:		
1. Protocol for collecting and analyzing meat samples	Quarter 3 – 2002	-
Milestones:		
None		-

* *Deviations are to be further discussed in D*

D. Description of deviations and subsequent adjustments of plans

No deviations in time schedule according to application have taken place.

E. Project publications and other products

1. Articles in international, scientific journals with review procedures
None.
2. Papers presented at congresses, symposiums, etc.
None.

3. Reports, articles in agricultural journals, etc.
None.
4. Oral presentations, public meetings, field days, etc.
None.

F. Scientific education

By collaboration with the Danish Centre for Experimental Parasitology, KVL and the Danish Veterinary Laboratory a joint Ph.D. student funded by the Research School for Animal Production will use the data generated from tasks 2.3 and 2.4 in WP2 as parts of her Ph.D. thesis. Collaboration with professor Jens Peter Nielsen, KVL about the the challenge model with *E. coli* O 149 to be used in tasks 2.1 and 2.2. is supposed to be implemented as a result of the Ph.D. project – “The influence of feed intake during lactation on piglets susceptibility to post-weaning diarrhoea”, which is funded within the framework of the Research School for Animal Production.

G. National and international cooperation

This project has strong links to the recently appointed EU project QLRT 30162 ”Sustainability in the production of pork with improved nutritional and eating quality using strategic feeding in out-door production” (SUSPORKQUAL) through the project co-ordinator Dr. Anders Hans Karlsson, Head of Research Unit for Muscle Biology and Meat Quality at the Danish Institute of Agricultural Sciences. Furthermore, the co-ordinator of WP1 in this project (JAF) is also the co-ordinator of WP1 (Sustainable Pig Production) in the EU project. The two projects, although with different goals, will complement each other. The ultimate goal of SUSPORKQUAL is to improve the nutritional value, increase eating quality (tenderness), shelf life and technological quality of pork. This will be achieved by combining strategic feeding resulting in compensatory (accelerated) growth in the time up to slaughter, with known feeding strategies (enrichment with E-vitamin, PUFA etc.) that gives rise to improved nutritional value of the out-coming pork.

This project is also linked to the DARCOF II project I.5: ”Grain legumes and cereals – new production methods for increased protein supply in organic farming systems”, which is co-ordinated by Erik Steen Jensen, professor at KVL and in which Knud Erik Bach Knudsen is partner. KEBK is further collaborating with the Danish Centre for Experimental Parasitology, KVL (Allan Roepstorff) and the Danish Veterinary Laboratory (Kristian Møller). Ellen-Margrethe Vestergaard is collaborating with professor Jens Peter Nielsen, KVL about the the challenge model with *E. coli* O 149 to be used in tasks 2.1 and 2.2.

The project in question has links to two other DARCOF projects on organic pig production: II.9 ”Resource use, environmental impact and economy in organic pig production systems”, co-ordinated by John E. Hermansen and II.8 ”Management in relation to health and health safety in organic pig production co-ordinated by Jan Tind Sørensen. Both projects are parts of the same DARCOF research programme as this project. The three projects are complementary, but also synergistic, why the collaboration is relevant for the total output.

The project has also links to the project: “Organic production of steers and bioactive forages for grazing livestock”. The links are through the project co-ordinator Stig Milan Thamsborg and one of the tasks of the project “Influence of bioactive forages on animal health with emphasis on parasitic infections and effects on meat and eating quality” in steers and pigs. There are links to the organic project “Effect of organic pig production on meat and eating quality” too, project co-ordinator Henrik J. Andersen.

Furthermore, the project has links to lupin testing project “Lupinforsøg, Undersøgelser vedrørende kød- og spisekvalitet” by Danske Slagterier (Hanne Maribo).

H. Critical reflection on the project

As a whole, the plan for the project is followed and the progress has been satisfactory. Meanwhile, a modification of the experimental design has been undertaken in task 1.1, as the number of treatment groups has been reduced from six to five (Two levels of lupine at normal dietary protein and three levels of lupine at reduced dietary protein). The reason for this adaptation is that the stable facilities at Rugballegård make it necessary for fulfillment of the time schedules. The justification has no consequences for WP 3 concerning evaluation of product quality. Beyond this, continuation of the project is expected to follow the time schedules and protocols as mentioned in the application.

8. Budget

A. Account for any change in budgets

Total costs were in 2001 18 thousand DKK below budget. Account for transfer of this amount to 2002, where the tranference is included in expected consumption.

B. Budget for the whole project (1.000 DKK)

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

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel	5,1	12,7	13,2	14,9	4,0	49,8
Technical personnel	1,0	9,1	12,3	9,7	0	32,1

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	193,9	511,6	566,4	662,7	176,0	2110,6
Technical personnel	18,6	237,6	348,9	290,4	0	895,5
Other operational costs	81,5	356,0	369,1	321,0	30,0	1157,6
Equipment	-	-				
Others (please specify)	-	-				
Direct costs	294,0	1105,2	1284,4	1274,1	206,0	4163,7
Indirect costs (20% of direct costs)	62,3	221,0	256,9	255,1	41,0	836,3
Total	356,3	1326,2	1541,3	1529,2	247,0	5000,0

Comments: Consumption before 2002 is 18 thousand DKK below budget. Expected to be used in 2002.

9. Signatures and stamps

Name	Institute	Date	Signature
Head of project Viggo Danielsen	Danish Institute of Agricultural Sciences	1 st October 2002	

Appendix I. Detailed budget

A. Budget for each participating institute (1.000 DKr)

Name of Institute: Danish Institute of Agricultural Sciences

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel	5,1	12	12	13,5	4	46,5
Technical personnel	1,0	9	10,5	8	0	28,5

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	193,9	475,0	492,0	574,5	176,0	1911,4
Technical personnel	18,6	234,0	284,0	224,0	0	760,6
Other operational costs	81,5	350,0	304,0	265,0	30,0	1030,5
Equipment	-	-				
Others (please specify)	-	-				
Direct costs	294,0	1059,0	1080,0	1063,5	206,0	3702,5
Indirect costs (20% of direct costs)	62,3	211,7	216,0	213,0	41,0	744,0
Total	356,3	1270,7	1296,0	1276,5	247,0	4446,5

Comments: Consumption before 2002 is 18 thousand DKK below budget. Expected to be used in 2002.

A. Budget for each participating institute (1.000 DKK)

Name of Institute: Danish Meat Research Institute

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel		0.7	1.2	1.4		3.3
Technical personnel		0.1	1.8	1.7		3.6

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel		36,6	74,4	88,2		199,2
Technical personnel		3,6	64,9	66,4		134,9
Other operational costs		6,0	65,1	56,0		127,1
Equipment						
Others (please specify)						
Direct costs		46,2	204,4	210,6		461,2
Indirect costs (20% of direct costs)		9,3	40,9	42,1		92,3
Total		55,5	245,3	252,7		553,5

Comments:

B. Budget for each participating department (1.000 DKK)

Name of Institute and department: Danish Institute of Agricultural Sciences, Department of Animal Nutrition and Physiology

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel	4,6	8	8	10	2,5	33
Technical personnel	0	7	8	7	0	22

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	175,0	316,0	328	425	110	1354
Technical personnel		182,0	216	196	0	594
Other operational costs	65,0	264,0	241	179	20	769
Equipment		-				
Others (please specify)		-				
Direct costs	240,0	762,0	785	800	130	2717
Indirect costs (20% of direct costs)	51,5	152,4	157,0	160,0	26,0	547
Total	291,5	914,4	942,0	960,0	156,0	3264

Comments: Consumption before 2002 is 18 thousand DKK below budget. Expected to be used in 2002.

B. Budget for each participating institute (1.000 DKK)

Name of Institute: Danish Institute of Agricultural Sciences, Department of Animal Health and Welfare

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel	0.5	2	2	2	1.5	8
Technical personnel	1	1	1	0	0	3

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	18,9	79	82	85	66	331
Technical personnel	18,6	26	27	0	0	78
Other operational costs	16,5	41	39	36	10	136
Equipment	0					
Others (please specify)	0					
Direct costs	54,0	146	148	121	76	545
Indirect costs (20% of direct costs)	10,8	29,2	29,6	24,2	15,2	109
Total	64,8	175,2	177,6	145,2	91,2	654

Comments:

B. Budget for each participating institute (1.000 DKK)

Name of Institute: Danish Institute of Agricultural Sciences, Department of Animal Product Quality

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel		1	1	1.5		3.5
Technical personnel			1.5	1		2.5

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel		40	41	64		145
Technical personnel			41	28		69
Other operational costs		45	24	50		119
Equipment						
Others (please specify)						
Direct costs		85	106	142		333
Indirect costs (20% of direct costs)		17,0	21,2	28,4		66,6
Total		102,0	127,2	170,4		399,6

Comments:

B. Budget for each participating institute (1.000 DKK)

Name of Institute: Danish Institute of Agricultural Sciences, Department of Crop Physiology and Soil Science

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel		1	1	0	0	2
Technical personnel		1	0	0	0	1

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel		40	41			81
Technical personnel		26				26
Other operational costs						
Equipment						
Others (please specify)						
Direct costs		66	41			107
Indirect costs (20% of direct costs)		13,2	8,2			21,4
Total		79,2	49,2			128,4

Comments: