



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

Use of antimicrobials and occurrence of resistance in organic cattle herds (II-5)

3. Head of project

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6. Project period (month, year)

Start of project:	2000
End of project:	12, 2003

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

A. Project summary

Methods to perform a continuous surveillance for antimicrobial resistance at herd level will be evaluated and used to compare the occurrence of resistance between organic and conventional dairy herds. In addition the treatment pattern of animals in organic herds will be studied. Based upon an eventual relation between treatment patterns and antimicrobial resistance on herd level or in general guidelines for disease treatment will be developed and implemented as herd specific treatment strategies which meet the demand for animal welfare and minimises the risk for antimicrobial resistance.

The project consists of four work packages

WP1 Monitoring of use of medicine

Establishing of a registration and reporting procedure on the use of drugs for individual animals. Clinical mastitis is described using a protocol which is developed by the research group in another project.

WP2 Occurrence and dynamics of antimicrobial resistance in dairy herds

Antimicrobial resistance of commensal E. coli is assessed in 20 herds by isolates from fecal samples of randomly selected animals in two groups: calves up to 3 month old and cows. Samples are taken at the start and at the end of the project. In five herds samples are taken four times the first year of the study to evaluate the dynamics on herd level and in relation to season.

Data are analysed together with results from ongoing projects from another 20 organic and 20 conventional herds to describe the pattern and dynamics of resistance and develop a scheme for monitoring of antimicrobial resistance on herd level.

Data on antimicrobial resistance is combined with data on use of antibiotics and descriptions of general treatment strategies based on qualitative research interviews.

WP3 Characterization of treatments in organic farms

Systematic clinical registrations of udder health of cows with and without veterinary treatment are implemented on a monthly basis in five herds, to provide data on treatment strategy and outcome of antibiotic treatments.

Herd managers are interviewed on treatment routines using qualitative research interviews. Data are analysed using a triangulation approach, including grounded theory analysis of semi-structured qualitative research interviews and group-meetings. Results of these analyses will be combined with analysis of data on somatic cell counts and milk production and observational data on daily management routines in the herds.

WP4 Use of herd specific plans for control of antibiotic resistance

Plans for reduction of antimicrobial resistance will be formulated in 10 herds. The plans should describe:

- risk areas for antimicrobial resistance
- disease prevention plans
- herd specific treatment strategy.

Five herds are followed for half a year and based on the experiences plans will be introduced in another 5 herds and followed for one year.

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

Work-package No	Work package title	Participants*	Budget	Start	End	Deliverable No
1	Monitoring of use of medicine	<u>SMT, KVL</u> TWB, MV	245	1	33	1
2	Occurrence and dynamics of antimicrobial resistance in dairy herds	<u>FAA, DVI</u> TWB, KVL	868	12	39	3, 6, 8
3	Characterization of treatments in organic farms	<u>MV, DJE</u> TWB, SMT, KVL	314	7	39	5, 9
4	Use of herd specific plans for control of antibiotic resistance	<u>SMT, KVL</u> TWB, MV	277	10	39	9, 10

* Responsible participants are underlined

B. Objectives and expected achievements

- To determine potential differences in the occurrence of antimicrobial resistance between conventional and organic dairy farms
- To investigate the possibility to perform a continuous monitoring of antimicrobial resistance by evaluating the dynamics of antimicrobial resistance.
- To characterise the treatment pattern of organic herds and based on this, develop guidelines for disease treatment which fits the goals for the organic herd, meet the demand for animal welfare and minimise the risk for antimicrobial resistance.

C. Midterm results and progress

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

WP1 Monitoring of use of medicine

A continuous monitoring of medicine usage is carried out in the first five herds in the project. The data shows a considerably variation in the amount and types of antibiotics used in the herds (table 1). Based on the initial discussion with the farmers and veterinarians on herd visits the differences seem to relate more to preferences of the veterinarian than to herd specific factors. These findings are used for the herd plans in wp4. The average number of days of treatment with antibiotics in case of mastitis decreased in most herds after conversion to organic production in June 1999 (table 2). Final analysis for publication will have to await the availability of data for the full group of 20 herds.

Table 1. Mean number of days pr mastitis treatment, five herds.
Data from 1998 to 2002.

Year after conversion	mean	minimum	Maximum
-1	2,2	1,0	3,0
1	1,4	1,0	2,0
2	1,5	1,0	2,0
3	1,6	1,1	2,7

Table 2. Use of antibiotics for mastitis treatment in five herds in 2001.
Percent of treatments with different groups of antibiotics

Antibiotics	Mean	Min	Max
Narrow-spectrum penicillins	29	11	41
Narrow-spectrum penicillins and streptomycin	9	0	29
Broad-spectrum penicillins ²	24	17	26
Cephalosporins	17	1	29
Macrolides	4	1	9
Sulfonamides/trimetoprim	4	0	13
Tetracyclines	6	0	23

² Ampicillin, amoxicillin, cloxacillin

WP2 Occurrence and dynamics of antimicrobial resistance in dairy herds

Initial analysis of data on antimicrobial resistance of commensal *E. coli* shows that the prevalence of antimicrobial resistance is related to age. Table 3 shows the results of the initial analysis for calves up to 23 weeks old. The prevalence of antimicrobial resistance was found to be very low

(<5%) among cows in both organic and conventional herds. The sampling scheme was changed in the first 5 herds based on these findings to sample the same calves at 3 months intervals. The analysis of these samples confirmed the finding that the prevalence of antimicrobial resistance decreases with age. Highest level of resistance is found 1 week after birth. However, the trend of decreasing resistance is broken at the age of 3-4 month. These findings might be related to treatments for diarrhoea and pneumonia respectively. Detailed analysis of the relation between treatment of individual animals and occurrence of resistance will be analyzed. No systematic change in resistance related to season was found.

Working hypotheses for the change in resistance with age are:

- 1) Change in microbial flora at the end of the milk feeding period
- 2) Treatment of calves with broad-spectrum antibiotics
- 3) The use of milk for feeding calves from cows treated with broad-spectrum antibiotics

Only hypothesis 2 can be tested in this study.

The results of the final analysis are expected to be submitted for publication in October 2002.

Table 3. Initial analysis of relation between age and prevalence of antimicrobial resistance of commensal *E. coli* from 40 organic herds, with repeated sampling of animals over time in five herds.

	Week 1	Week 2	Week 14	Week17	Week23
Streptomycin	0.4	0.7	0.2	0.4	0.1
Tetracyclin	0.3	0.6	0.1	0.3	0.1
Ampicillin	0.2	0.5	0.1	0.2	0.1
Sulphamethoxazon	0.5	0.8	0.1	0.4	0.1

WP3 Characterization of treatments in organic farms

The initial interviews were carried out in November-December 2001 based on key figures from herd data and a step-wise identification of treatment criteria on four different levels (symptom level, cow level, and the levels of the herd situation and perception of alternatives, respectively, identified through previous study; Vaarst et al. 2002).

Based on this, expectations and wishes connected to a more explicit future treatment pattern were discussed with the farmer and in most herds the veterinarian on herd visits in February 2002 in five herds.

An initial model for description of success of treatment and graphical presentations of data on udder health and use of veterinary medicine has been developed. These tools are being used and evaluated in the discussion of future treatment strategies in the selected herds, and will form the basis for introduction of the project in the next group of herds.

WP4 Use of herd specific plans for control of antibiotic resistance

The treatment plans are still under development in the first four herds. The character of the plans will be quite variable from herd to herd because of differences in occurrence of antimicrobial resistance and differences in the collaboration between veterinarians and herd managers. One of the five herds has dropped out of the study in July 2002 because of return to conventional production.

C.2 Fulfilment of deliverables and milestones

WP1 Monitoring of use of medicine	Time schedule according to application	Deviations, if any*
Deliverables		
Data on disease, use of medicine and clinical cases of mastitis	Continuos	no
Milestones		
M3 Establishment of a system for registration of use of drugs and disease in herds	May 2000	no
M4 Introduction of registration of clinical mastitis	Feb 2002	March 2002
M13 Termination of data collection	June 2003	August 2003

WP2 Occurrence and dynamics of antimicrobial resistance in dairy herds	Time schedule according to application	Deviations, if any*
Deliverables		
3. Determination of the difference in the occurrence of antimicrobial resistance in conventional and organic dairy herds. (Pu)	June 2002	October 2002
6. Description of the dynamics of antimicrobial resistance over time. (Pu)	July 2002	October 2002
8. Description of changes in disease incidence and antimicrobial resistance after conversion to organic farming. (Pu)	July 2003	October 2003
Milestones		
M1 Determination of the difference in the occurrence of antimicrobial resistance in conventional and new and old organic dairy herds.	Sept 2001	October 2002
M10 Description of the dynamics of antimicrobial resistance over time	July 2002	September 2002
M12 Collection of fecal samples	June 2002 – March 2003	August 2002- June 2003
M14 Evaluation of changes in antimicrobial resistance from conversion until 3½ years after conversion to organic farming.	July 2003	September 2003

WP 3, Characterization of treatments in organic farms	Time schedule according to application	Deviations, if any*
Deliverables		
1 Description of the combination of qualitative studies of treatment choices and quantitative data (pu.)	June 2002	November 2002 (first publication June 2002)
9 Recommendations for treatment strategies in organic dairy herds (Danish Report)	October 2003	October 2003
Milestones		
M1: Selection of herds and implementation of clinical examinations	Nov. 2001	March 2002
M7: Qualitative analysis on herd level of treatment patterns carried out	Feb. 2002	May 2002
M9: Analysis of data from 5 herds (in depth studies) and 40-45 herds (overall level; standardised health and production recordings)	June 2002	Nov. 2002
M15: Recommendations (Danish Report)	October 2003	October 2003

WP 4, Use of herd specific plans for control of anti-biotic resistance	Time schedule according to application	Deviations, if any*
Deliverables		
9 Recommendations for treatment strategies in organic dairy herds (Danish Report)	October 2003	October 2003
10. Description of the effect of change in treatment strategies on the occurrence of anti-microbial resistance	October 2003	October 2003
Milestones		
M2 Selection of herds and determination of initial occurrence of anti-microbial resistance	Nov. 2001	Nov. 2001
M6 Preparation of herd specific plans	Dec. 2001	Feb-Nov. 2002
M8 Midway evaluation and correction of plans	May 2002	Dec. 2002
M11 Final evaluation of plans and status of occurrence of anti-microbial resistance.	April 2003	July 2003
M15 Recommendations (Danish report) including results from WP3	October 2003	October 2003
M17 Analysis of change in antibiotic resistance and changes in use of medicine	October 2003	October 2003

D. Description of deviations and subsequent adjustments of plans

There has been some delay in the plan, due to the fact that all contact to herds has been impossible during the last part of the housing period 2001 (early March-June) because of restrictions in connection with the outbreak of foot & mouth disease. The selection of herds and introduction of registrations has therefore been postponed to the late autumn 2001.

Data on medicine use and resistance in conventional and old organic herds has been delayed because of extensive work on validation of data.

The initial sampling of fecal samples showed a very low prevalence of resistance in samples from cows, whereas calves samples showed a high level of antimicrobial resistance in very young calves (1-3 month) and less in older calves. Based on these findings the sample plan for fecal samples has been changed to sampling of only 20 calves from 0-6 month of age including calves sampled at the previous visit.

One of the five herds has dropped out of the study because of return to conventional production. The herd will not be substituted by another herd.

E. Project publications and other products

1. Articles in international, scientific journals with review procedures

Vaarst, M., Thamsborg, S.M., Bennedsgaard, T.W., Houe, H., Enevoldsen, C., Aarestrup, F. & de Snoo, A. 2002/2003. Farmers' decision making in the first two years after conversion in relation to mastitis treatment.

2. Papers presented at congresses, symposiums, etc.

3. Reports, articles in agricultural journals, etc.

Vaarst, M. 2002. Strategi i stedet for antibiotika [Strategy instead of antibiotics. In Danish]. Økologisk Jordbrug, 14. Juni 2002, s. 11.

Nielsen, K.M. Mange yverbetændelser er forudsigelige. [Many mastitis cases are predictable. In Danish]. Økologisk Jordbrug, 14. Juni 2002, s. 11.

4. Oral presentations, public meetings, field days, etc.

“Reduced use of veterinary drugs in organic dairy herds – potentials and consequences”, Midterm seminar for ph.d. student Torben Werner Bennedsgaard, October 1, 2001, KVL

“Mastitis treatment, success or failure” Presentation at meeting for farmers and veterinarians, The Danish Dairy Board, Rødding, 30. January 2002.

F. Scientific education

Elements of the project is part of Torben Werner Bennedsgaards ph. d. study.

Arno de Snoo, Scottish Agricultural College, completed a Master thesis within the project with Mette Vaarst as supervisor during two stays (4½ months in total) in 2002 at Danish Institute of Agricultural Sciences, Department of Animal Health and Welfare. Master thesis: Farming styles in Danish organic dairy farming and the relations to health strategies with an emphasis on mastitis treatments. DIAS, pp. 89.

G. National and international cooperation

Research stay at Paul Bartlett, Michigan State University by Torben Werner Bennedsgaard march-april 2001.

H. Critical reflection on the project

The monitoring of antimicrobial resistance has been successful giving new information on the dynamics of resistance of commensal *E. coli* on herd level and in relation to age of dairy calves. The ability to change in sampling scheme has given a data set which is better suited for describing the marked variation in prevalence of resistance with age. However, to describe the level of resistance in a given herd a sampling scheme in which a few calves at a given age (2-3 weeks old would be optimal) was sampled would give a more comparable picture. Such a sampling scheme is not easy to implement in the actual research project since it would require a largely increased number of herd visits which should be planned after the birth of calves in the single herd. The budget of the project does not allow such a change.

The rapid decrease in prevalence of antimicrobial resistance means that only a limited number of animals can be used in the analysis of relations between antibiotic treatment and antimicrobial resistance.

The initial meetings with farmers and veterinarians have given important knowledge in the different roles in the decision process before eventual antibiotic treatment. The risk of development of antimicrobial resistance is normally not a subject in this decision process, and the research group places an important role in the introduction of this new problem to the process. The role of the

research group in the process in the single herd will have to be evaluated together with the contributions from the farmer and the veterinarian in the evaluation of the project.

The combination of research methodology (quantitative and qualitative) and the use of participatory methods are very depending on the collaboration between researches, an well-described distribution of tasks and responsibilities, and a group of farmers and veterinarians, who contribute to the project in the way which is beneficial for the project.

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	4,5	4	5,5			
Technical personnel	1,5	14,5	14,5			

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	159,5	186	214,5			560
Technical personnel	31,9	264,5	262,5			558,9
Other operational costs	13,5	110	86,5			210
Equipment						
Others (please specify)						
Direct costs	204,9	560,5	563,5			1118,9
Indirect costs (20% of direct costs)	41	112,1	113			265,78
Total	246	672,6	676			1594,68

Comments:

9. Signatures and stamps

Name	Institute	Date	Signature
Head of project Frank Aarestrup	Danish Veterinary Institute	3/10-02	

Appendix I. Detailed budget

A. Budget for each participating institute (1.000 DKr)

Name of Institute: Den Kgl. Veterinær og Landbohøjskole

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel	2,25	2	4			9,25
Technical personnel	0	2,5	2,5			5,2

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	74	115	157,5			346,5
Technical personnel	0	55	53			108
Other operational costs	3,5	40	26,5			70
Equipment						
Others (please specify)						
Direct costs	77,5	210	237			524,5
Indirect costs (20% of direct costs)	15,5	42	47,4			104,9
Total	93	252	284,4			629,4

Comments: Due to the delays in the consumption in 2001 and 2002 has been reduced and the budget for 2003 increased

Name of Institute: Danmarks Jordbrugsforskning,

Year:	Con- sumption before 2002	Expected consump- tion 2002	2003	2004	2005	Total
Man-months						
Scientific personnel	2,25	2	1,5			5,75
Technical personnel						

Year:	Con- sumption before 2002	Expected consump- tion 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	85,5	71,0	57,0			213,5
Technical personnel						
Other operational costs	10	20	10			40
Equipment						
Others (please specify)						
Direct costs	95,5	91	67			253,5
Indirect costs (20% of direct costs)	19,1	18,2	13,4			50,7
Total	114,6	109,2	80,4			304,2

Name of Institute: Danish Veterinary Institute

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel						
Technical personnel	1,5	12	12			25,5

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel						
Technical personnel	31.887	209.524	209.805			451.216
Other operational costs		50.000	50.000			100.000
Equipment						
Others (please specify)						
Direct costs	31.887	259.524	259.805			551.216
Indirect costs (20% of direct costs)	6.377	51.905	51.961			110.243
Total	38.264	311.429	311.766			661.459

Comments:

B. Budget for each participating department (1.000 DKK)

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