



## **Progress Report 2007 and Application for Continuation in 2008**

for research funding under the research programme:

**Research in Organic Food and Farming**  
International Research Co-operation and Organic Integrity  
(DARCOF III 2005-2010)

Funded by the Ministry of Food, Agriculture and Fisheries  
under the Finance and Appropriation Act, Sections 24.33.02.10

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1. Project title and acronym

**Organic Aquaculture – the linkage between sustainable production and superior products  
[ORAQUA]**

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2. Project journal number

- J. no. 3304-FOJO-05-35-01
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3. Project period (month, year)

**Start of project: 2007**  
**End of project: 2010**

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4. Head of project

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5. Participating institutes

- Partner 1. Technological University of Denmark  
Danish Institute for Fisheries Research (DIFRES), Department of Marine Ecology and Aquaculture (DIFRES-HØKa-Hirtshals and DIFRES-HØKb-Frederiksberg).
- Partner 2. Technological University of Denmark  
Danish Institute for Fisheries Research (DIFRES), Department of Seafood Research (DIFRES-FF).

Partner 3. BioMar A/S.

Partner 4. Danish Technological Institute, Center for Food Technology (DTI).

Partner 5. The Danish Aquaculture Organisation (DAO).

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## 6. Project staff

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## 7. Midterm description of the project, its results and progress, and application for continuation in 2008

### *Midterm description of the project*

The project address's some of the major challenges to a successful development of sustainable organic fish farming in Denmark, which primarily relates to organic fish feed. Specifically, there are a need for competitive vegetable protein sources with a high protein content (preferably up to  $\pm 70$  % protein) and relevant amino acid composition compared to that in fish meal (72 % protein).

Fish discard and cut-offs have been proposed as potential alternative components, but such ingredients conflict the Danish environmental regulations because of their high phosphorous content. Intuitively, substitution of fishmeal and fish oil by sustainable organic plant protein and oil sources seems a good alternative, since fish feed (including organic) contains more than 60% fishmeal on a fat free basis. The substitution of fish meal has, however, constraints because of the low protein content in suitable vegetable products. Trout, furthermore, are carnivorous (piscivorous) and alternative plant proteins may have a negative impact upon feed digestibility and fish health and welfare.

These changes in feed composition/quality may have significant effects on various elements of rearing and production. Reduced feed digestibility may have a negative effect upon the environment (effluent quality), and the reduced nutrient availability may have a negative impact upon feed conversion and growth performance.

Health status and disease susceptibility may also be affected, if altered feed composition is insufficient with regard to essential nutrients (particularly amino acids) and vitamins or may harm the digestive tract of the fish. This latter consideration is of particular relevance because the production of organic rainbow trout in Denmark allows the usage of only one antibiotic treatment in a full production cycle. That is, between the time the fish enter the farms at approximately 25 g mass until their slaughter. This requires attention to husbandry/production practices that improve fish welfare and prevent diseases, including case studies to investigate options for rearing systems (including the current production systems, feed and feeding) that secure sustainable production, health and welfare in organic fish production.

The substitution of fish feed with high amounts of plant ingredients may also affect flesh quality and taste, and it is important to investigate the influence of the diets containing different vegetables on eating quality. The substitution of marine feed components with components of vegetable origin will influence both the lipid and the protein composition of the fish itself. However, substitution of highly polyunsaturated marine lipids with less unsaturated lipids of vegetable origin may in fact impart a significant improvement in the oxidative stability of the fish.

Following, the objectives of the ORAQUA project is to investigate

- Availability of relevant organic produced vegetables with high protein content, including the possibilities of concentrating the protein fraction of existing protein sources with relevant amino acid profile compared to that of fish meal, a high digestibility and competitive price (taking into account organic principles)
- The effect of the organic vegetable protein sources on growth and digestibility in rainbow trout
- The influence of organic protein and –oil on eating quality
- The influence of organic vegetables on the health and welfare of farmed fish
- Optimizing the production by case studies of organic systems of production

The project is organized into 5 complementary work packages (WP). WP 1 includes project management and communication. Communication involves establishments of contacts in the agricultural - and fish feed sector and related companies/institutions with respect to optimization of knowledge about vegetable protein with high protein content/value as well as dissemination of the results and know-how obtained in the project. This will involve communications with the aquaculture industry as well as publications in the international scientific literature.

WP 2 involves protein enrichment to produce a vegetable fraction high in protein and searching for relevant new vegetable crops for organic fish feed. Based upon that organic fish feed is produced, where fishmeal is partially substituted with relevant candidate sources of Danish vegetable protein.

Following investigations of the digestibility of the diets and related effects upon fish performance (feed conversion, growth) are carried out in controlled experiments. Finally WP 2 includes modelling aspects of the feed production process.

- Interrelated with WP 2 health and welfare aspects are studied in WP 3. During the feed experiments the health and welfare in rainbow trout are evaluated. In case of increased mortality in the trouts the occurrence of pathogens are investigated and separate challenge tests are done as well. As a pilot experiment tissue samples are taken from the intestine for histological examination to investigate whether it is possible to register differences in the intestine epithelium in the fish from the different diet groups.

The case studies in WP4 includes comparison of the Danish organic farming systems, comparison of different organic test diets, management protocols including veterinarian advisory and fish health (WP 3) in selected commercial organic fish farms.

The eating quality of fish fed the different organic diets will be assessed by sensory and biochemical analyses in WP 5. This will comprise lipid analyses and objective sensory characteristics including composition of lipids.

### *Results and progress*

During the initial few months of the project the main focus area has been competitive protein sources with relevant amino acid composition in comparison to that of fish meal.

With the aim of optimizing the resources invested in the research contacts have been establish in the industry of feeding stuffs to stimulate the research and development within the field of vegetable high protein sources. By common efforts between the agricultural -, feeding stuff - and the aquaculture sector this should be concretized through communication with relevant scientific and technical resource persons from the sectors.

The concrete contacts included until now the Danish Agricultural Advisory Service, Dept. of Organic Plant Breeding (Head of Dept. Søren Nilausen, National Consultant Michael Tersbøl); Økologisk Landsforening (Plant breeding advisor Siri Pugesgård); DLG Økologi (Organic consultant/trader Henrik Kløve).

The spin off of this was a positive dialog about potential protein sources for organic fish feed like:

- Horse bean
- Lupin ("sweet)
- Pea
- Lentil
- Soya bean
- Rape

The listed protein sources are characterised by high protein yield; relative high content of digestible Lys+Met+Cys and digestible P as well as an adequate amino acid profile, and adequate starch content in horse bean and pea.

- To get started it was suggested to combine more protein sources (pea, horse bean, rape, lupin).

Based on the accessible knowledge within ingredients for organic fish feed further literature studies have been performed as well as preparation and initiation of the experimental work to shift the protein content in selected crops including selection and test of equipment, processes etc.

The following products are being considered: Pea, quinoa, lupin, horse bean, wheat and rape. The following results have so far been achieved.

- **Pea:** A pea concentrate containing 72% protein is already available in the market (Aller Aqua).
- **Horse bean:** Shelling and subsequent grinding and wind screening of horse beans have resulted in a protein content of 50-60%.
- **Rape:** The protein content of rape may be increased to 50 – 60 % (dry process) and > 90 %

protein (wet process).

- **Wheat:** By grinding and subsequently wind screening (i.e. separation of the starch and the protein fractions) a protein content of  $\geq 20\%$  has been achieved.
- **Quinoa:** Organic quinoa concentrate may be produced by a dry process, but the technology is too expensive to be commercially interesting for the time being. In a longer perspective Quinoa might be relevant due to its relatively high content of digestible Lys+Met+Cys. Quinoa would be interesting in relation to the organic rotation of crops, but might only be raised in Denmark from 2010.

During the last quarter of 2007 experiments are run to improve the protein content of the selected crops. Based on these results recipes for 3 test diets and 1 control diet are formulated and the diets manufactured. Digestibility and growth performance experiments are run from January 2008.

The following time schedule has been established following the stated milestones:

- Experimental diets for testing produced (D.2.4): (1) December 2007 (Month 12); (2) August 2008 (Month 20) and (3) August 2009 (Month 32).
- Growth experiments, D2.6 (1) Jan – maj 2008 (Month 17); (2) August – dec. 2008 (Month 24) and (3) August – dec. 2009 (Month 36)
- Digestibility experiments, D2.5 (1) Jan 2008 (Month 13); (2) August 2008 (Month 20) and (3) August 2009 (Month 32)
- Field tests, D2.6 August – december 2008 (Month 24).
- Challenge experiments *Yersinia ruckeri* (ERM Medio 2008 (Month 36)
- Quality assessments, D5.1-5.6 Primo 2009 (Month 25-42)

Information about the project and its progress have been presented for the industry and disseminated through websites.

#### *Application for continuation in 2008*

In connection to the experimental plan/time schedule given above the project partners apply for continuation by the following activities in 2008.

Based on the results of the first experimental diets (1<sup>st</sup> series) and the most recent scientific knowledge within protein enrichment/organic protein crops the experimental work will be focused on specific procedures for providing protein-rich fractions. These should be tested in protein-rich diets, with concomitant lowered inclusion of fish meal, for studies of digestibility and growth performance (2<sup>nd</sup> series) as well as providing samples for physiological analysis and for WP 3 (Health and welfare) and WP 5 (Sensory and biochemical characterisation of organic fish). However, some of the samples for WP5 may only be stored in deep freezer as the restricted budget do not include sufficient resources for sensory and biochemical characterisation from all samples from the 3 experimental series. The last and 3<sup>rd</sup> series is scheduled to 2009 (cf. WP2). The most interesting samples will be selected for the sensory and biochemical analyses.

Further, it is planned to develop a model for the production process in order to predict the performance of the final fish feed performance, based on the specific protein characteristics analysed. The model is further developed for estimating quality parameters necessary when selecting new crops. The Food Production Engineering group (FPE) at BioCentrum-The Technical University of Denmark (DTU) will be responsible for this subtask.

The described results and the research plan outlined for 2008 follows the original and approved project proposal (cf. WP1 – WP5) and following the ORAQUA group applies for continuation of the research activities in 2008.

## **A. Project summary**

Organic farming of fish is about to get established in Denmark. Five trout farms have so far received official certification of organic status. Certified organic fish feed is available but are produced at the Danish Technological Institute due to request of too low quantities (about 200 tonnes per year) to be

commercially interesting for the feed companies. There is, therefore, almost no practical experience of the challenges related to the rearing and sale of organic fish in Denmark. This project aims to contribute to the successful establishment of organic fish farming in Denmark with research upon the most critical areas in the chain that links between organic feed production, organic fish rearing, and the consumer.

The main focus is on organic fish feeds in which non-renewable fish meals are replaced with sustainable organic vegetable proteins of Danish origin. Special emphasis will be on the need for competitive vegetable protein sources with high protein content. To stimulate the research in that area available scientific and technical knowledge within the animal- and the fish feed sector are collected and synthesised with regard of improving the protein content of plant ingredients in organic fish feed. Optimized feed compositions and processing methods will be refined to maximise feed protein quality with relevant plant ingredients. The quality of the organic feed recipes will be studied in terms of their digestibility and nutrient availability. These studies, in turn, will be related to analyses of fish performance indicators such as feed conversion and growth as well as health and welfare performance. Case studies are carried out to optimize current production systems. The studies will also include field studies of a selected experimental feed from the pilot experiments as well as monitoring of general health and welfare status of the fish.

The impact of organic feed recipes upon product quality will be investigated, to ensure that organic fish are of high quality. This will comprise objective sensory and biochemical analyses of the flesh, to obtain an overall picture of their eating quality.

The results of the project will be disseminated to the aquaculture community, consumers, regulatory authorities and the scientific community through publications in the scientific, industrial and popular literature and participation in thematic meetings.

The results of the project will represent a concrete contribution to the development of Danish organic aquaculture, and so allow organic fish farming to respond more effectively to the challenges it faces.

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

WP No.	WP title	Responsible scientist	Budget DKK	Start	End	Deliverable No.
1	Management and communication	Alfred Jokumsen	923	1	48	D1.1-D1.4
2	Feed	Alfred Jokumsen	3.718	3	38	D2.1-D2.11
3	Health/Welfare	Inger Dalsgaard	717	6	38	D3.1-D3.4
4	Case study	Villy Juul Larsen	578	4	38	D4.1-D4.4
5	Quality	Henrik Hauch Nielsen	1.064	10	42	D5.1-D5.6
<b>Total</b>			<b>7.000</b>			

## B. Objectives and expected achievements

The specific objectives of the project are to investigate:

- New relevant vegetable protein sources as ingredients in organic fish feed in partial replacement of fish meal
- Availability of relevant organic produced vegetables with high protein content, including the possibilities of concentrating the protein fraction of existing protein sources with relevant amino acid profile compared to that of fish meal, a high digestibility and competitive price (taking into account organic principles)
- The effect of the organic vegetable protein sources on growth and digestibility in rainbow trout

- The influence of organic protein and –oil on eating quality
- The influence of organic vegetables on the health and welfare of farmed fish
- Production strategies by case studies of organic systems of production

The expected achievements of the project are to significantly develop and improve the Danish organic aquaculture in relation to the objectives listed above and currently to disseminate the results obtained to the aquaculture industry, consumers, regulatory authorities and the scientific community.

### C. Midterm results and progress

Due to delay in the official approval of the application (received 8 March 2007) the kick-off meeting of the project was held 20 April 2007. Accordingly, in the following the delivery dates for deliverables/milestones are extended by 3 months, but it is still expected that the project can be accomplished on schedule by 31 December 2010.

The main focus area is competitive protein sources with relevant amino acid composition in comparison to that of fish meal. Also in the industry of cultivation of plants and feed stuff processing there is a need for vegetable sources with significant higher protein content than is currently available.

Following, initiatives have been taken to establish/extend contacts in the industry of feeding stuffs to stimulate the research and development within the field of vegetable high protein sources. By common efforts between the agricultural -, feeding stuff - and the aquaculture sector this should be concretized through communication with relevant scientific and technical resource persons from the sectors.

Until now the concrete contacts include Danish Agricultural Advisory Service, Dept. of Organic Plant Breeding (Head of Dept. Søren Nilausen, National Consultant Michael Tersbøl); Økologisk Landsforening (Plant breeding advisor Siri Pugesgård); DLG Økologi (Organic consultant/trader Henrik Kløve).

The results of these contacts were a positive dialog about potential protein sources like:

- Horse bean
- Lupin ("sweet)
- Pea
- Lentil
- Soya bean
- Rape

The listed protein sources are characterised by high protein yield; relative high content of digestible Lys+Met+Cys and digestible P as well as an adequate amino acid profile, and adequate starch content in horse bean and pea.

To get started it was suggested to combine more protein sources (pea, horse bean, rape, lupin).

Based on the accessible knowledge within ingredients for organic fish feed further literature studies are being performed as well as preparation and initiation of the experimental work to shift the protein content in selected crops including selection and test of equipment, processes etc.

The following products have been considered: Pea, quinoa, lupin, horse bean, wheat and rape. The following results have so far been achieved.

- **Pea:** A pea concentrate containing 72% protein is already available in the market (Aller Aqua).
- **Horse bean:** Shelling and subsequent grinding and wind screening of horse beans have resulted in a protein content of 50-60%.
- **Rape:** The protein content of rape may be increased to 50 – 60 % (dry process) and > 90 % protein (wet process).
- **Wheat:** By grinding and subsequently wind screening (i.e. separation of the starch and the protein fractions) a protein content of  $\geq 20$  % has been achieved.

During the last quarter of 2007 experiments are run to improve the protein content of the selected

crops. Based on these results recipes for 3 test diets and 1 control diet are formulated and the diets manufactured. Digestibility and growth performance experiments are run from January 2008.

The following time schedule has been established:

- Eksperimental diets for testing produced (D.2.4): (1) December 2007 (Month 12); (2) August 2008 (Month 20) and (3) August 2009 (Month 32).
- Growth experiments, D2.6 (1) Jan – maj 2008 (Month 17); (2) August – dec. 2008 (Month 24) and (3) August – dec. 2009 (Month 36)
- Digestibility experiments, D2.5 (1) Jan 2008 (Month 13); (2) August 2008 (Month 20) og (3) August 2009 (Month 32)
- Field tests, D2.6 August – december 2008 (Month 24).
- Challenge experiments *Yersinia ruckeri* (ERM Medio 2008 (Month 36)
- Quality assessments, D5.1-5.6 Primo 2009 (Month 25-42)

Information about the project and its progress have been presented for the industry and disseminated through websites.

### C.1 Description (summary) of main results and conclusions for each year

During the initial few months of the project the main focus area has been competitive protein sources with relevant amino acid composition in comparison to that of fish meal.

By using the state of the art knowledge and by communicating with relevant scientific and technical resource persons from the agricultural -, feeding stuff - and the aquaculture sector the following potential protein sources for organic fish feed has been selected for further investigations:

- Horse bean
- Lupin ("sweet)
- Pea
- Lentil
- Soya bean
- Rape

Based on the accessible knowledge within ingredients for organic fish feed further literature studies are being performed as well as preparation and initiation of the experimental work to shift the protein content in selected crops including selection and test of equipment, processes etc.

The following results have so far been achieved.

- **Pea:** A pea concentrate containing 72% protein is already available in the market (Aller Aqua).
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- **Wheat:** By grinding and subsequently wind screening (i.e. separation of the starch and the protein fractions) a protein content of  $\geq 20$  % has been achieved.
- **Quinoa:** Organic quinoa concentrate may be produced by a dry process, but the technology is to expensive to be commercial interesting for the time being.

Information about the project and its progress have been presented for the industry and disseminated through websites.

## C.2 Fulfilment of deliverables and milestones

Due to the delay in the official approval of the application fulfilment is assumed 3 months after the original given delivery dates.

<b>Workpackage 1</b>						
<b>Deliverable No</b>	<b>Deliverable title</b>	<b>Lead scientist</b>	<b>Delivery date</b>	<b>Allocated scientific person moths</b>	<b>Type of deliverable</b>	<b>Fulfilled (ok) or deviations (d)*</b>
D1.1	Preparation of annual reports	A. Jokum-sen	Months 12,24,36, 48	7	R	OK
D1.2	Preparation of presentations for the industry	A. Jokum-sen/ All partners	Months 12, 24, 36, 48	1	C	OK
D1.3	Dissemination of results and information through websites	A. Jokum-sen/ All partners	Months 12,24,36, 48	1	O, P	OK
D1.4	Publication of project results in the literature	All partners	Month 48+	6	S, P	

<b>Workpackage 1</b>			
<b>Milestone No</b>	<b>Milestone title</b>	<b>Delivery date</b>	<b>Fulfilled (ok) or deviations (d)*</b>
M1.1	Publication of results in reports	Months 12,24,36, 48	OK
M1.2	Dissemination of results for the industry	Months 12, 24, 36, 48	OK
M1.3	Dissemination of results to organic/aquaculture websites	Months 12,24,36, 48	OK
M1.4	Publication of results in the literature	Month 48+	

<b>Workpackage 2</b>						
<b>Deliverable No</b>	<b>Deliverable title</b>	<b>Lead scientist</b>	<b>Delivery date</b>	<b>Allocated scientific person moths</b>	<b>Type of deliverable</b>	<b>Fulfilled (ok) or deviations (d)*</b>
D2.1	Procedure for production of high protein fraction of selected strains of crop	J. Kold	Month 14	5	O	
D2.2	New potential strains of crop protein have been characterised for process ability	J. Kold	Month 18	5	O	
D2.3	Standard organic recipe and new recipes available for feed experiments	P. Jes-sen	Month 6	BioMar	O	(OK)*
D2.4	Organic feeds produced	J. Kold	Month 8-16-28	2	O	(OK)*
D2.5	Digestibility of organic fish feed recipes	A. Jokum-sen	Months 8 – 38	4	R	
D2.6	Performance of trout fed organic fish feed recipes	A. Jokum-sen	Months 6 – 38	7	R	
D2.7	Delivery of trout samples for WP 3 & WP 5	A. Jokum-sen	Months 12 – 36	1	O	
D2.8	Model has been developed for production process	J. Kold	Month 18	3	R	
D2.9	Model optimised for evaluation of production procedure for new potential crops	J. Kold	Month 24	3	R	
D2.10	Annual reports about WP results and progress	A. Jo-kum-sen/All	Month 12, 24,36	4	R	OK
D2.11	Scientific article produced on modified protein sources, technological and nutritional aspects.	J. Kold	Month 30	4	S	

\* In progress

<b>Workpackage 2</b>			
<b>Milestone No</b>	<b>Milestone title</b>	<b>Delivery date</b>	<b>Fulfilled (ok) or deviations (d)*</b>
M2.1	Initial batch of organic fish feed for initial feed experiment completed	Month 8	(OK)*
M2.2	New potential crops selected for analysis	Month 18	
M2.3	Procedure for high protein fraction and selected crops completed	Month 18	
M2.4	Proteins have been characterised and processed	Month 18	
M2.5	Trial batches have been produced for evaluation	Months 8-16-28	(OK)*
M2.6	Trial batches produced for validation of models	Months 18	
M2.7	Digestibility experiments completed	Months 38	
M2.8	Performance experiments completed	Month 38	

M2.9	Fish provided to other work packages	Month 12-36	
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*\*In progress*

<b>Workpackage 3</b>						
<b>Deliverable No</b>	<b>Deliverable title</b>	<b>Lead scientist</b>	<b>Delivery date</b>	<b>Allocated scientific person moths</b>	<b>Type of deliverable</b>	<b>Fulfilled (ok) or deviations (d)*</b>
D3.1	Health and welfare data of trout fed organic fish feed recipes	I. Dalsgaard	Month 42	4	R	
D3.2	Challenge protocols for rainbow trout with <i>Yersinia ruckeri</i>	I. Dalsgaard	Month 42	2	R	
D3.3	Data on health and welfare of organic rainbow trout in case studies (cf. WP 4)	I. Dalsgaard	Month 42	2	R	
D3.4	Annual reports about WP results and progress	I. Dalsgaard	Months 12-24-36	2	R	

<b>Workpackage 3</b>			
<b>Milestone No</b>	<b>Milestone title</b>	<b>Delivery date</b>	<b>Fulfilled (ok) or deviations (d)*</b>
M3.1	Identification of health and welfare status of rainbow trout used in feed experiments	Month 42	
M3.2	Identification of disease status in organic rainbow trout in case studies	Month 42	

<b>Workpackage 4</b>						
<b>Deliverable No</b>	<b>Deliverable title</b>	<b>Lead scientist</b>	<b>Delivery date</b>	<b>Allocated scientific person moths</b>	<b>Type of deliverable</b>	<b>Fulfilled (ok) or deviations (d)*</b>
D4.1	Comparison of Danish organic production systems	V.J. Larsen	Month 42	1,5	R	
D4.2	Health and welfare in Danish organic fish farms	I. Dalsgaard	Month 42	Cf. D3.3	R	
D4.3	Comparison of two organic feed types in 2 Danish organic fish farms	V.J. Larsen/A. Jokumsen	Month 42	2	R	
D4.4	Annual reports about WP results and progress	V.J. Larsen	Months 12-24-36	2	R	

<b>Workpackage 4</b>			
<b>Milestone No</b>	<b>Milestone title</b>	<b>Delivery date</b>	<b>Fulfilled (ok) or deviations (d)*</b>
M4.1	Identification of characteristics in Danish organic production systems	Month 42	
M4.2	Identification of health and welfare in Danish organic fish farms	Month 42	
M4.3	Feed experiments with two organic feed types in 2 Danish organic fish farms completed	Month 42	

<b>Workpackage 5</b>						
<b>Deliverable No</b>	<b>Deliverable title</b>	<b>Lead scientist</b>	<b>Delivery date</b>	<b>Allocated scientific person moths</b>	<b>Type of deliverable</b>	<b>Fulfilled (ok) or deviations (d)*</b>
D5.1	Scientific report on sensory analyses	G. Hyldig	Month 42	2	R	
D5.2	Presentation of sensory data on meetings/ workshop for the industry	G. Hyldig	Month 42	1	C	
D5.3	Scientific report on lipid analysis	C. Jacobsen	Month 42	1	R	
D5.4	Presentation of lipid data on meeting/ workshop for the industry	C. Jacobsen	Month 42	1	C	
D5.5	Sensory characterisation of organic trout	G. Hyldig	Month 42	2	S	
D5.6	Annual reports about WP results and progress	H.H. Nielsen	Months 12-24-36	1	R	

<b>Workpackage 5</b>			
<b>Milestone No</b>	<b>Milestone title</b>	<b>Delivery date</b>	<b>Fulfilled (ok) or deviations (d)*</b>
M5.1	Development of sensory vocabulary finished	Months 24	
M5.2	Sensory profiling of samples completed	Month 42	
M5.3	Data analysis of sensory data completed	Month 42	
M5.4	Analysis of lipid composition and oxidative stability of samples completed	Month 42	
M5.5	Data analysis of lipid data completed	Months 42	
M5.6	Multivariate data analysis of biochemical and sensory data completed	Month 42	

The nature of the deliverables: S = publication in scientific journal with peer review; P = publication in journals without peer review; R = reports; C = presentation at meetings and congresses or O = other types of deliverables, e.g., prototypes, models, websites, etc..

#### **D. Description of deviations and subsequent adjustments of plans**

Re D2.3 – 2.6 and M2.1 and 2.5: The selection of plant protein sources and the first diet formulation are in progress and the diets are planned to be available for digestion and growth experiments in January 2008.

## **E. Project publications and other products**

### **1. Products from Organic Eprints archive**

#### **Other products (oral presentations, public meetings, field days, etc.)**

Publications prepared in connection to the implementation/reformulation of the project/budget adjustments during 2006:

Jokumsen, A. (2006): Gennembrud for økologiske fisk. Økologisk Jordbrug, 1. september

Jokumsen, A. (2006): Vidensyntese om økologisk fiskeopdræt. Nyhedsbrev fra FØJO, august 2006. [www.foejo.dk](http://www.foejo.dk).

Jokumsen, A., Larsen, V.J., Dalsgaard, I., Nielsen H.H., Jessen, P. og Kold, J.: (2006): Økologisk Fiskeopdræt. Vidensyntese om udviklingsmuligheder indenfor økologisk fiskeopdræt i Danmark. FØJO rapport nr. 21, 2006. Redaktør: A. Jokumsen. 110 sider.

## **F. Scientific education**

## **G. National and international cooperation**

The project involves key national partners within organic fish farming (Danish Aquaculture Organisation; Technological Institute – Centre of Process Innovation; The Technical University of Denmark – Danish Institute for Fisheries Research; BioMar (Fish Feed Manufacturing Company); Organic fish farmers. Further the project is carried out in close contact with the Advisory group with link to international research bodies and organisations and players within the aquaculture sector.

## **H. Critical reflection on the project**

The research activities in the project have been initiated during 2007. It is aimed to provide valid and reliable information about the critical issues for organic aquaculture and organic fish products of high eating quality. These include investigations into the extent to which fish feeds can be based upon sustainable organic vegetable products (produced in accordance with national requirements in notification no. 115 of 23/2 2004), and how to optimise the inclusion of these.

The availability and digestibility of these organic nutrients are investigated, as well as effects of the organic test diets on quality of the consumer product.

The case studies will provide knowledge about rearing systems (including the current production systems, feed and feeding) that secure sustainable production, health and welfare in organic fish production.

## 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

Year:	Original budget	Consumption 2005/2006	Expected consumption 2007	2008	2009	2010	Total
Man-months	106,5		11,5	43,25	39,25	12,5	106,5
Scientific personnel	75,5		9,5	27,25	26,25	12,5	75,5
Technical personnel	31		2	16	13		31

Year:	Original budget	Consumption 2005/2006	Expected consumption 2007	2008	2009	2010	Total
Salaries	4.734.121		493.506	1.761.426	1.702.593	639.900	4.597.425
Scientific personnel	3.719.550		431.946	1.265.490	1.278.585	639.900	3.615.921
Technical personnel	1.014.571		61.560	495.936	424.008		981.504
Other operational costs	701.000		25.000	465.000	191.000	20.000	701.000
Equipment	0		0	0	0	0	0
Others (please specify)	281.546		41.000	109.000	85.000	46.000	281.000
Direct costs	5.716.667		559.506	2.335.426	1.978.593	705.900	5.579.425
Indirect costs (20% of direct costs)	1.143.333		111.901	467.085	395.719	141.180	1.115.885
Subcontractor	140.000		20.000	60.000	60.000		140.000
Total	7.000.000		691.407	2.862.511	2.434.312	847.080	6.835.310

**Comments:** Minor deviations occur due to adjustments of the hour rate in comparison to the rates used in the application/approved budget. Therefore the "new" midterm total deviates from the approved total budget of DKK 7 mio. financed by DARCOF. Whatever following adjustments this amount will be maximum funding from DARCOF as will each of the original budgets of each partner.

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9. Signatures and stamps

Name	Institute	Date	Signature
Head of project			

## Appendix I. Detailed budget

### A. Budget for each participating institute (1.000 DKr)

Name of Institute and department:

**Danish Institute for Fisheries Research – Dep. of Marine Ecology and Aquaculture (DIFRES-HØKa-Hirtshals)**

Year:	Original budget	Consumption 2005/2006	Expected consumption 2007	2008	2009	2010	Total
Man-months	44		2				44
Scientific personnel	30		2	10	10	8	30
Technical personnel	14		0	8	6		14

Year:	Original budget	Consumption 2005/2006	Expected consumption 2007	2008	2009	2010	Total
Salaries	1.908		91	712	683	410	1.896
Scientific personnel	1.451		91	464	487	410	1.452
Technical personnel	457		0	248	196	0	444
Other operational costs	170		0	100	50	20	170
Equipment	0						
Others (travel, consult.)	123		25	50	30	18	123
Direct costs	2.201		116	862	763	448	2.189
Indirect costs (20% of direct costs)	441		23	172	153	90	438
Total	2.642		139	1.034	916	538	2.627

**Comments:**

**A. Budget for each participating institute (1.000 Dkr)**

Name of Institute and department:

**Danish Institute for Fisheries Research – Dep. of Marine Ecology and Aquaculture (DIFRES-HØKb-Frederiksberg)**

Year:	Original budget	Consumption 2005/2006	Expected consumption 2007	2008	2009	2010	Total
Man-months	10						
Scientific personnel	8		0,5	3	3	1,5	8
Technical personnel	2			1	1		2

Year:	Original budget	Consumption 2005/2006	Expected consumption 2007	2008	2009	2010	Total
Salaries	460		23	170	179	77	449
Scientific personnel	394		23	139	146	77	385
Technical personnel	66		0	31	33	0	64
Other operational costs	20		0	10	10	0	20
Equipment	0						
Others (please specify)	44		1	20	20	3	44
Direct costs	524		24	200	209	80	513
Indirect costs (20% of direct costs)	104		5	40	42	16	103
Total	628		29	240	251	96	616

**Comments:**

**A. Budget for each participating institute (1.000 DKr)**

Name of Institute and department:

**Danish Institute for Fisheries Research – Dep. of Seafood Research (DIFRES-FF)**

Year:	Original budget	Consumption 2005/2006	Expected consumption 2007	2008	2009	2010	Total
Man-months	15		0	7	7	1	15
Scientific personnel	10		0	4	5	1	10
Technical personnel	5			3	2		5

Year:	Original budget	Consumption 2005/2006	Expected consumption 2007	2008	2009	2010	Total
Salaries	646		0	279	309	51	639
Scientific personnel	485		0	186	244	51	481
Technical personnel	161		0	93	65		158
Other operational costs	280		0	180	100		280
Equipment	0		0	0	0		0
Others (please specify)	55		1	19	20	15	55
Direct costs	981		1	478	429	66	974
Indirect costs (20% of direct costs)	196		0,2	96	86	13	195
Total	1.177		1,2	574	514	79	1.169

**Comments:** The budget assumes the sensory and biochemical analyses to be performed on samples from the 3<sup>rd</sup> serie of diet experiments.

## A. Budget for each participating institute (1.000 DKr)

Name of Institute and department:

**Danish Technological Institute**

Year:	Original budget	Consumption 2005/2006	Expected consumption 2007	2008	2009	2010	Total
Man-months	33		8	13	11	1	33
Scientific personnel	23		6	9	7	1	23
Technical personnel	10		2	4	4	0	10

Year:	Original budget	Consumption 2005/2006	Expected consumption 2007	2008	2009	2010	Total
Salaries	1.498		335	542	471	51	1.399
Scientific personnel	1.168		273	418	341	51	1.083
Technical personnel	330		62	124	130		316
Other operational costs	60		25	25	10		60
Equipment	0						0
Others (please specify)	20		15		5		20
Direct costs	1.578		374	567	486	51	1.478
Indirect costs (20% of direct costs)	316		75	113	97	10	295
Subcontractor	140		20	60	60		140
Total	2.034		469	740	644	61	1.914

**Comments:**

**A. Budget for each participating institute (1.000 DKr)**

Name of Institute and department:

**The Danish Aquaculture Organisation**

Year:	Original budget	Consumption 2005/2006	Expected consumption 2007	2008	2009	2010	Total
Man-months	4,5		1	1,25	1,25	1	4,5
Scientific personnel	4,5		1	1,25	1,25	1	4,5
Technical personnel	0		0	0	0	0	0

Year:	Original budget	Consumption 2005/2006	Expected consumption 2007	2008	2009	2010	Total
Salaries	221		45	58	61	51	215
Scientific personnel	221		45	58	61	51	215
Technical personnel	0		0	0	0	0	0
Other operational costs	171		0	150	21	0	171
Equipment							
Others (please specify)	40		0	20	10	10	40
Direct costs	432		45	228	91	61	425
Indirect costs (20% of direct costs)	86		9	46	18	12	85
Total	518		54	274	110	73	511

**Comments:**

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

Name of Institute and department:

**Danish Technological Institute**

Year:	Original budget	Consumption 2005/2006	Expected consumption 2007	2008	2009	2010	Total
Man-months	5		5				5
Scientific personnel	5		5				5
Technical personnel	0						

Year:	Original budget	Consumption 2005/2006	Expected consumption 2007	2008	2009	2010	Total
Salaries	242		227				227
Scientific personnel	242		227				227
Technical personnel	0						
Other operational costs	0						
Equipment	0						
Others (please specify)	0						
Direct costs	242		227				227
Indirect costs (20% of direct costs)	48		45				48
Subcontractor	60		20	20	20		60
Total	350		293	20	20	0	333

**Comments:**


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