A randomized controlled trial of the effect of fish oil supplementation in late pregnancy and early lactation on the n-3 fatty acid content in human breast milk

The aim of this research was to investigate the effect of fish oil supplementation, in the third trimester of pregnancy and early lactation period of healthy pregnant Danish women. Forty-four pregnant women were randomly allocated to fish oil supplementation (1.3 g EPA and 0.9 g DHA per day) from week 30 of gestation (FO-group) or to a control regimen (olive oil or no oil; controls). The FO-group was randomly subdivided into women stopping fish oil supplementation at delivery [FO(pregn)], and women continuing supplementation for an additional 30 d [FO(pregn/lact)]. Thirty-six women agreed to collect milk samples at days 4, 16, and 30 postpartum. The FA composition of the milk samples was determined by GLC. At days 4, 16, and 30 in lactation, FO(pregn/lact) women (n = 12) had, respectively 2.3 (P = 0.001), 4.1 (P = 0.001), and 3.3 (P = 0.001) times higher mean contents of LCPUFA(n-3) in their breast milk compared with controls (n = 13), and 1.7 (P = 0.005), 2.8 (P = 0.001), and 2.8 (P = 0.001) times higher LCPUFA(n-3) contents, respectively, at these days compared with FO(pregn) women (n = 11). The latter group did not differ significantly from controls with regard to LCPUFA(n-3) content in the breast milk. Similar results were obtained when analyzing separately for effects on the milk content of DHA. Dietary supplementation with 2.7 g LCPUFA(n-3) per day from week 30 of gestation and onward more than tripled the LCPUFA(n-3) content in early breast milk; supplementation limited to pregnancy only was much less effective.
Free polyunsaturated fatty acids cause taste deterioration of salmon during frozen storage

Increased intensity of train oil taste, bitterness, and metal taste are the most pronounced sensory changes during frozen storage of salmon (Refsgaard, H. H. F.; Brockhoff, P. B.; Jensen, B. Sensory and Chemical Changes in Farmed Atlantic Salmon (Salmo salar) during Frozen Storage. J. Agric. Food Chem. 1998a, 46, 3473-3479). Addition of each of the unsaturated fatty acids: palmitoleic acid (16:1, n - 7), linoleic acid (C18:2, it - 6), eicosapentaenoic acid (EPA; C20:5, it - 3) and docosahexaenoic acid (DHA; C22:6, n. - 3) to fresh minced salmon changed the sensory perception and increased the intensity of train oil taste, bitterness, and metal taste. The added level of each fatty acid (similar to 1 mg/g salmon meat) was equivalent to the concentration of the fatty acids determined in salmon stored as fillet at -10 degrees C for 6 months. The effect of addition of the fatty acids on the intensity of train oil taste, bitterness and metal taste was in the order: DHA > palmitoleic acid > linoleic acid > EPA. Formation of free fatty acids was inhibited by cooking the salmon meat before storage. Furthermore, no changes in phospholipid level were observed during frozen storage. The results suggest that enzymatic hydrolysis of neutral lipids plays a major role in the sensory deterioration of salmon during frozen storage.
Protection of fish oil from oxidation by microencapsulation using freeze-drying techniques

(N-3)-Polyunsaturated fatty acids (PUFAs) reduce the risk of coronary heart disease. Cold sea water plankton and plankton-consuming fish are known sources of (n-3)-PUFAs. Enriching normal food components with fish oil is a tool for increasing the intake of (n-3)-PUFAs. Due to the high sensitivity of fish oil with respect to oxidation, it has to be protected from oxygen and light. The investigations presented demonstrate the microencapsulation of fish oil using freeze-drying techniques. Emulsions containing 10% fish oil, 10% sodium caseinate, 10% carbohydrate and 70% water were frozen using different freezing techniques and subsequently freeze-dried. Several parameters regarding formulation and process (addition of antioxidants to the fish oil, use of carbohydrates, homogenisation and freezing conditions, initial freeze-drying temperature, grinding) were varied to evaluate their influence on the oxidative stability of dried microencapsulated fish oil. The shelf life of the produced samples was determined by measuring the development of volatile oxidation products vs. storage time. It could be shown that the addition of antioxidants to fish oil was necessary to produce dried microencapsulated fish oil with an adequate shelf life. The best shelf life was achieved for the dried product which was frozen with a slow freezing rate.

General information
State: Published
Organisations: National Institute of Aquatic Resources
Authors: Heinzelmann, K. (Ekstern), Franke, K. (Ekstern), Jensen, B. (Intern), Haahr, A. (Intern)
Pages: 114-121
Publication date: 2000
Main Research Area: Technical/natural sciences

Publication information
Journal: European Journal of Lipid Science and Technology
Volume: 102
Issue number: 2
ISSN (Print): 1438-7697
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.06 SJR 0.71 SNIP 1.024
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.642 SNIP 0.881 CiteScore 1.85
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.737 SNIP 1.051 CiteScore 1.98
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.852 SNIP 1.124 CiteScore 2.16
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.873 SNIP 1.207 CiteScore 2.06
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.732 SNIP 0.945 CiteScore 1.75
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.791 SNIP 1.049
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.838 SNIP 1.077
Web of Science (2009): Indexed yes
Flavour release of aldehydes and diacetyl in oil/water systems

General information
State: Published
Organisations: Department of Biotechnology, National Institute of Aquatic Resources, Royal Veterinary and Agricultural University
Authors: Haahr, A. (Intern), Bredie, W. L. (Ekstern), Stahnke, L. H. (Intern), Jensen, B. (Intern), Refsgaard, H. (Intern)
Publication date: 1999

Host publication information
Title of host publication: Proceedings of the Food and flavour COST 96 Symposium
Main Research Area: Technical/natural sciences
Conference: Food and flavour COST 96 Symposium, Udine, 01/01/1999
Source: orbit
Source-ID: 174863
Publication: Research › Article in proceedings – Annual report year: 1999

Isolation and quantification of volatiles in fish by dynamic headspace sampling and mass spectrometry

A dynamic headspace sampling method for isolation of volatiles in fish has been developed. The sample preparation involved freezing of fish tissue in liquid nitrogen, pulverizing the tissue, and sampling of volatiles from an aqueous slurry of the fish powder. Similar volatile patterns were determined by use of this sample preparation method and for samples chewed for 10 s. Effects of sampling time, temperature, and purge flow on level of volatiles were tested. Purging at 340 mL/min for 30 min at 45 degrees C was found to be optimal. Detection Emts for a number of aldehydes were 0.2-2.7 μg/kg. Levels of volatiles are given for fresh salmon, cod, saithe, mackerel, and redfish

General information
State: Published
Organisations: Department of Biotechnology, National Institute of Aquatic Resources
Authors: Refsgaard, H. (Intern), Haahr, A. (Intern), Jensen, B. (Intern)
Pages: 1114-1118
Publication date: 1999
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Agricultural and Food Chemistry
Volume: 47
Issue number: 3
Biological variation of lipid constituents and distribution of tocopherols and astaxanthin in farmed Atlantic salmon (Salmo salar)

The contents of fat, astaxanthin, and tocopherols and the fatty acid composition of a homogeneous group of 145 farmed Atlantic salmon (Salmo salar) were determined. The analytical variation of the data was statistically-separated from the biological variation. The fat content in the muscle near the head was 15.0% with a biological standard deviation of 3.0%. The astaxanthin concentration was 5.5 mg/kg of muscle with a biological standard deviation of 1.1 mg/kg of muscle, and the canthaxanthin concentration was 200 μg/kg of muscle with a standard deviation of 47 μg/kg of muscle. The concentrations of alpha-, gamma-, and delta-tocopherols were approximately 32, 2.9, and 0.4 mg/kg of muscle, respectively, and the biological standard deviations were 4.5, 0.4, and 0.07 mg/kg (14, 14, and 20%), respectively. In another group of five salmon the distributions throughout the fillet were determined, longitudinally as well as transversally. The distribution of fat, astaxanthin, and tocopherols varied throughout the salmon. The fatty acid composition varied little between extracts from different locations of the fillet.

General information
State: Published
Organisations: Department of Biotechnology, National Institute of Aquatic Resources
Authors: Refsgaard, H. (Intern), Brockhoff, P. B. (Intern), Jensen, B. (Intern)
Pages: 808-812
Publication date: 1998
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Agricultural and Food Chemistry
Volume: 46
Issue number: 3
ISSN (Print): 0021-8561
Ratings:
BFI (2018): BFI-level 2
BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.45 SJR 1.291 SNIP 1.344
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.236 SNIP 1.253 CiteScore 3.23
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.278 SNIP 1.421 CiteScore 3.25
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.423 SNIP 1.479 CiteScore 3.44
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.43 SNIP 1.471 CiteScore 3.2
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.384 SNIP 1.446 CiteScore 3.1
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.408 SNIP 1.392
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Headspace and extraction methods for analysis of volatile and semivolatile compounds in fish: Chemical and sensory assessment of lipid-derived volatiles

General information
State: Published
Organisations: National Institute of Aquatic Resources, Department of Biotechnology
Authors: Jensen, B. (Intern), Refsgaard, H. (Intern), Olafsdottir, G. (Ekstern)
Pages: 70-91
Publication date: 1998

Host publication information
Title of host publication: Methods to Determine the Freshness of Fish in Research and Industry
Place of publication: Paris
Publisher: IIR
Main Research Area: Technical/natural sciences

Bibliographical note
Proceedings of the Final Meeting of the Concerted Action "Evaluation of Fish Freshness" AIR3CT94 2283, Nantes Conference, November 12-14, 1997
Source: orbit
Source-ID: 225973
Publication: Research › Book chapter – Annual report year: 1998

Sensory and chemical changes in farmed Atlantic salmon (Salmo salar) during frozen storage
Farmed Atlantic salmon (Salmo salar) were stored as fillets at -10 and -20 degrees C and whole at -30 degrees C. The most pronounced sensory changes were first recognized by the assessors, when the salmon samples were in the oral cavity, and were significant increases in train oil taste, metal taste, and bitter taste in the fillets. This was shown by mixed model analysis of variance and canonical variates analysis. Volatile lipid peroxidation products such as aldehydes and ketones were identified and quantified in the salmon. For most of the peroxidation products the concentration increased during storage. The content of lipid hydroperoxides and free fatty acids also increased during storage, and the changes were fastest in salmon stored at -10 degrees C. A decrease in highly unsaturated fatty acids was observed in salmon
stored at -10 and -20 degrees C. Peroxide values and the content of free fatty acids were shown by a partial least-squares analysis to be the best of the instrumental data in describing the sensory changes.
Analysis of hydroxy fatty acids from Ricinus communis and Dimorphoteca pluvialis by gas and supercritical fluid chromatography

General information
State: Published
Organisations: Department of Chemical and Biochemical Engineering, National Institute of Aquatic Resources, Technical University of Denmark
Authors: Borch-Jensen, C. (Intern), Jensen, B. (Intern), Mathiesen, K. (Ekstern), Mollerup, J. (Intern)
Pages: 277-284
Publication date: 1997
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of the American Oil Chemists Society
Volume: 74
Issue number: 3
ISSN (Print): 0003-021X
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.64 SJR 0.696 SNIP 0.905
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.682 SNIP 0.997 CiteScore 1.66
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.767 SNIP 1.043 CiteScore 1.68
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.809 SNIP 1.074 CiteScore 1.71
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.871 SNIP 1.236 CiteScore 1.81
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.833 SNIP 1.292 CiteScore 1.98
Analysis of seed oil from Ricinus communis and Dimorphoteca pluvialis by gas and supercritical fluid chromatography

General information
State: Published
Organisations: Department of Chemical and Biochemical Engineering, National Institute of Aquatic Resources
Authors: Borch-Jensen, C. (Intern), Jensen, B. (Intern), Mathiasen, K. (Ekstern), Sørensen, J. M. (Intern)
Pages: 277-284
Publication date: 1997
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of the American Oil Chemists Society
Volume: 74
ISSN (Print): 0003-021X
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.64 SJR 0.696 SNIP 0.905
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.682 SNIP 0.997 CiteScore 1.66
Ischemic stroke and n-3 fatty acid

General information
State: Published
Organisations: National Institute of Aquatic Resources
Authors: Seidelin, K. (Ekstern), Jensen, B. (Intern), Haugaard, S. (Ekstern), Reith, J. (Ekstern), Olsen, T. (Ekstern)
Pages: 405-409
Publication date: 1997
Main Research Area: Technical/natural sciences
Methods to evaluate fish freshness in research and industry

General information
State: Published
Organisations: Section for Aquatic Microbiology and Seafood Hygiene, National Institute of Aquatic Resources, Section for Aquatic Process and Product Technology
Authors: Olafsdottir, G. (Ekstern), Martinsdóttir, E. (Ekstern), Oehlenschläger, J. (Ekstern), Dalgaard, P. (Intern), Jensen, B. (Intern), Undeland, I. (Ekstern), Mackie, I. (Ekstern), Henehan, G. (Ekstern), Nielsen, J. (Intern), Nilsen, H. (Ekstern)
Pages: 258-265
Publication date: 1997
Main Research Area: Technical/natural sciences
Optimizing headspace sampling temperature and time for analysis of volatile oxidation products in fish oil

Headspace-gas chromatography (HS-GC), based on adsorption to Tenax GR(R), thermal desorption and GC, has been used for analysis of volatiles in fish oil. To optimize sampling conditions, the effect of heating the fish oil at various temperatures and times was evaluated from anisidine values (AV) and HS-CC. AV indicated sample degradations at 90 degrees C but only small alterations between 60 and 75 degrees C. HS-GC showed increasing response with temperature and time. Purging at 75 degrees C for 45 min was selected as the preferred sampling condition for oxidized fish oil.

General information
State: Published
Organisations: Department of Biotechnology, National Institute of Aquatic Resources
Authors: Rørbæk, K. (Intern), Jensen, B. (Intern)
Pages: 1607-1609
Publication date: 1997
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of the American Oil Chemists Society
Volume: 74
Issue number: 12
ISSN (Print): 0003-021X
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.64 SJR 0.696 SNIP 0.905
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.682 SNIP 0.997 CiteScore 1.66
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.767 SNIP 1.043 CiteScore 1.68
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.809 SNIP 1.074 CiteScore 1.71
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.871 SNIP 1.236 CiteScore 1.81
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.833 SNIP 1.292 CiteScore 1.98
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.763 SNIP 1.056
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.863 SNIP 1.183
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.667 SNIP 1.037
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.663 SNIP 0.891
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.658 SNIP 0.851
Web of Science (2006): Indexed yes
Erythrocyte levels compared with reported dietary intake of marine n-3 fatty acids in pregnant women

It is well established that marine n-3 fatty acids measured in erythrocyte phospholipids of non-pregnant subjects reflect the subjects' intake of these fatty acids. In 135 pregnant women in the 30th week of gestation we compared intake of marine n-3 fatty acids and energy, estimated by a combined dietary self-administered questionnaire and interview, with fatty acids measured in erythrocyte phospholipids. Daily intake (g/d) and nutrient density of marine n-3 fatty acids (mg/MJ) correlated with the n-3 fatty acid: arachidonic acid ratio (FA-ratio) with correlation coefficients of 0.48 and 0.54 respectively. In a linear regression model with three frequency questions about marine sandwiches, marine cooked meals and fish oil as explanatory variables, and the FA-ratio as dependent variable, the multiple correlation coefficient was 0.46. Conclusions from the study were (1) levels of erythrocyte fatty acids in pregnant women may be employed as a qualitative method to rank subjects according to intake of marine n-3 fatty acids; (2) with respect to the power to explain FA-ratio variability, three simple marine food frequency questions were comparable with intake of marine n-3 fatty acids assessed by an elaborate semiquantitative dietary method involving an interview.
Gestation length and birth weight in relation to intake of marine n-3 fatty acids

It has been hypothesized that marine n-3 fatty acids ingested during pregnancy prolong duration of pregnancy and increase fetal growth rate in humans. By a combined self-administered questionnaire and interview applied in the 30th week of gestation we assessed dietary intake of marine n-3 fatty acids and energy in a population-based sample of 965 pregnant Danish women; in a random 14 % subsample we also measured marine n-3 fatty acids relative to arachidonic acid (FA-ratio) in erythrocytes. Mean intake of marine n-3 fatty acids was 0.25 (95 % range 0-0.75) g We could detect no association between n-3 fatty acid intake and FA-ratio on the one hand, and gestation length, birth weight and birth length on the other. The analyses were adjusted for maternal height, pre-pregnant weight, parity and smoking. The conclusion from the study was that within the intake range of this population, marine n-3 fatty acids ingested in the weeks prior to the 30th week of pregnancy seem not to be a predictor of gestation length or fetal growth rate.
Projects:

FAO Fish Oil
The purpose of the project is to obtain preliminary data on the storage stability of a fish oil-enriched, vegetable-based product intended as a supplement to the staple diet in sub-Saharan populations. FAO Fisheries Utilization Division is in the process of setting up a project which involves supplying families in certain African regions with fish oil, rich in docosahexaenoic acid. The role of this pre-project is to follow the development of possible oxidation products during the storage at ambient temperature of the fish oil-enriched tomato-and-onion sauce. The storage stability is assessed through sensory evaluation and chemical measurements of oxidation indices.

National Institute of Aquatic Resources
Period: 01/07/1999 → 01/07/2000
Number of participants: 3
Project participant:
Jacobsen, Charlotte (Intern)
Vu, Thi Thu Trang (Intern)
Project Manager, organisational:
Jensen, Benny (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 100,000.00 Danish Kroner

Antioxidative defence
Oxidative defense, mandatory for protection of human health and for maintaining safety and freshness of foods, will be investigated in dietary invention studies in humans. Early stages of oxidation involving protein damage and formation of long-lived protein radicals will be characterized in fish and pig muscle systems which will allow detection of radical damage in tissues in more details than in humans.

Department of Biotechnology
National Institute of Aquatic Resources
Department of Systems Biology
Royal Veterinary and Agricultural University
VFD
Aarhus University
Period: 01/05/1999 → 30/04/2001
Number of participants: 6
Project participant:
Jensen, Benny (Intern)
Leif Skibsted (Ekstern)
Bittmarie Sandstrom (Ekstern)
Dragsted, Lars O (Ekstern)
Andersen, Henrik (Ekstern)
**Fish Meal Quality assessed by analysis of volatiles**

Current methods for analysis of oxidation status of the lipid component (fish oil) in fish meal do not give satisfactory results, possibly due to extraction problems. As oxidation processes result in, i.a., formation of volatile breakdown products, it is hypothesized that the determination of such volatiles may give a better indication of the oxidative deterioration of fish meal. Fish meals from various sources, processes, and antioxidant treatments were stored for 12 weeks, exposed to light and air. Amounts (arbitrary units) were determined by headspace - gas chromatography (GC), and volatiles were identified by mass spectrometry - GC. The development of volatiles displayed clear differences between meal types. The correlation of these results with the quality estimates of the trade (fish meal manufacturers) remains to be carried out.

National Institute of Aquatic Resources  
Period: 01/01/1999 → 31/12/1999  
Number of participants: 2  
Project participant:  
Vu, Thi Thu Trang (Intern)  
Project Manager, organisational:  
Jensen, Benny (Intern)

**Financing sources**  
Source: Unknown  
Name of research programme: Ukendt  
Amount: 250,000.00 Danish Kroner

**Studies of low volatility oxidation products of sensory significance**

The aim is to establish the identity and sensory significance of low volatility oxidation products in lipid-rich foods. Methods for isolation of compounds of low volatility are under development. High-vacuum distillation and supercritical extraction (SFE) have been tested for the ability to isolate lipid-derived oxidation products. Method development using SFE will be continued. Fractionation of fish muscle has been carried out by centrifugation and by HPLC of extracts. Method development along these lines is also continuing. Studies of protein oxidation in the presence of lipids are the focus in a collaboration project with Dr. Earl Stadtman at NIH (Bethesda, MD, USA).

National Institute of Aquatic Resources  
Department of Biotechnology  
Department of Systems Biology  
Period: 01/01/1998 → 31/12/2000  
Number of participants: 3  
Project participant:  
Refsgaard, Hanne (Intern)  
Holmberg, Inge (Intern)  
Project Manager, organisational:  
Jensen, Benny (Intern)

**Financing sources**  
Source: Unknown  
Name of research programme: Ukendt  
Amount: 1,900,000.00 Danish Kroner

**NUTRIFISH - Nutritional Studies on Dried Functional Ingredients Containing n-3 Polyunsaturated Fatty Acids**

1998: The project objectives are to define the lowest intake of n-3 PUFA which will exert a positive nutritional effect against biomarkers of chronic diseases in humans; to design high quality bioavailable fish oil-enriched ingredients; to incorporate these novel dried ingredients in a range of consumer food products. The tasks at FF are to provide fish oil for powder-production, to set up quality specifications for fish oil, to prepare antioxidant formulations and to test their
efficiencies, and to study formation and identity of volatile oxidation products formed in spray-dried fish oil powders during storage. Fish oil was refined and deodorized for production of microencapsulated fish oil and for a storage experiment. The fish oil was protected against oxidation by adding an antioxidant system prepared at FF. The shelf-life of commercial powders have been compared with the shelf-life of powders produced in this project. The dynamic headspace method develop at FF, applying analysis of the volatiles by gas chromatography-mass spectrometry (GC-MS), was used to evaluate sensorially significant volatiles formed by lipid oxidation. Compounds with a characteristic and easily detectable odour were selected by GC sniffing analyses. The amount of the volatiles were calculated using calibration curves, that were determined by quantitative GC-MS analysis of standards. The amounts of volatiles were found in levels of microgram volatiles / g powder (ppm).

National Institute of Aquatic Resources
Golden Vale plc
TEAGASC
Deutsches Institut für Lebensmitteltechnik
Ytkemiska Institutet
Instituto de la Grasa
Trinity College Dublin
University College Cork

University of Ulster
Period: 01/12/1995 → 01/03/1999
Number of participants: 4
Project participant:
Haahr, Anne-Mette (Intern)
Jensen, Benny (Intern)
Vu, Thi Thu Trang (Intern)
Project Manager, organisational:
Schmidtsoff, Walther (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 1,834,000.00 Danish Kroner

Analytical Chemistry
Analytical Chemistry at FF is a basic activity, aimed at maintaining the chemical-analytical know-how, which is necessary for carrying out general analytical tasks, e.g. analyses for salt, crude protein, and TVB-N. In addition, newer instrumental methods may be part of this general project area, though usually such analyses are developed within specific projects (analysis of peptides, proteins, microbial metabolites, autolytic breakdown-products). The available instrumentation include i.a. 4 HPLC-instruments (UV, DAD, ELSD, RI, fluorescence detection), 3 GC instruments (MS, PFD, FID, olfactory detection), 2 scanners for 2-D-gel electropherograms, NIR, low-resolution NMR, differential scanning calorimeter. The Analytical Quality Group follows up on developments and trends in analytical principles and in analytical quality control that may be relevant for analytical chemistry at FF. This group carries out updating of standard procedures and method descriptions for the purpose of improving quality assurance and minimizing environmental effects, and occasionally manages participation in national and international inter-laboratory tests. Safety activities have been strengthened by the employment of a safety officer. Also, within this project area are placed advisory activities towards internal and external questions on analytical problems. - A central theme of present and planned activities is quality assurance and quality control of standard analytical methods. - External cooperation in the field of chemical analysis of fish with WEFTA Working Group on Analytical Methods (WEFTA = [West] European Fish Technologists’ Association). - The basal chemistry activities, comprising approx. 1 person/year, are financed by the running costs of the department.

National Institute of Aquatic Resources
Period: 01/06/1989 → 31/12/2013
Number of participants: 7
Project participant:
Berner, Lis (Intern)
Stampe-Villadsen, Hanne Lilian (Intern)
Jørgensen, Bo Munk (Intern)
Olsen, Lone Rosenkær (Intern)
Lipid Chemistry
Lipid chemistry activities at FF are related partly to projects that are based in the fish oil and fish meal area, and partly to projects studying the formation of lipid-derived aroma and flavours. Lipid oxidation is a central topic. Lipid analytical methods maintained at FF comprise analysis of lipid content by extraction or occasionally by NIR or microwave methods. Lipid class analysis is carried out using the principle of solid phase extraction. Fatty acid composition is an important parameter in studies both of fish and of fish oil. Capillary gas chromatography, with detection by flame ionization or, occasionally, with mass spectrometric analysis is used. Oxidation parameters are analyzed traditionally (e.g. peroxide value). Polymer formation is analyzed using high performance size exclusion chromatography. Oxidative stability of edible oils, and thereby the effect of various antioxidants, is assessed using accelerated methods (Rancimat, Oxidograph). Formation of volatile products of lipid oxidation is analyzed using headspace chromatography with adsorbent trapping, thermal desorption, and gas chromatography with detection by flame ionization, mass spectrometry or olfactometry (sniffing analysis). - The basal lipid activities are financed by the related projects and by the basic running costs of the department.