



***The Fifth Open SEAFOODplus Conference***

***Copenhagen 8-10 June 2008***

***[www.seafoodplus.org](http://www.seafoodplus.org)***

**BOOK OF ABSTRACTS**



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## Secretariat information

This book of abstracts contains important information needed when attending the 5<sup>th</sup> and final SEAFOODplus Conference 8-10 June 2008 in Copenhagen.

In the **programme** you will find times for each presentation in all the sessions.

Please note that in the programme is given information about the **Reception and General Assembly** 8 June, the **SeafoodCircle dinner** on 9 June and the **Conference dinner show** 10 June.

The printed **list of participants** contains all participants having registered by 22 May. Participants joining the conference after this deadline are not listed.

The book contains the **abstracts** of all oral presentations and the posters exhibited in the foyer. For each oral presentation two slides illustrating essential information given in the presentation have been selected and printed together with the abstract, as well as a photo of the presenter.

Please observe that a **CD with the power point slides** from all the oral presentations is also provided in the back of the book. The presentations have been transformed to the pdf format. The copyright belongs to the authors.

The last pages of the book have been kept blank for you to take **notes** during the presentations or when discussing with fellow participants.

If you have any questions during the conference or need further assistance, please consult the registration/information desk.

Jette Donovan Jensen  
SEAFOODplus Secretariat manager  
DTU Aqua



# Welcome



**Professor Torger  
Børresen, DTU Aqua  
Coordinator of  
SEAFOODplus**

It is a great pleasure once again to welcome all major stakeholders within the seafood area to an exciting conference where we proudly present major results achieved in the SEAFOODplus projects.

It is a special pleasure welcoming you this year as it is the fifth and last conference in the series of annual SEAFOODplus arrangements. All 20 projects within the programme of SEAFOODplus will finish by the end of June 2008. Some projects finished after the three first years, but we still want to highlight results also from these projects, so this conference will present a comprehensive overview of all results obtained in the lifetime of SEAFOODplus.

All projects have been running according to a very strict schedule, thus making it possible to keep the work well within the timeframe planned from the very beginning. The deliverables have been produced according to schedule with very few delays. When planning the research very ambitious aims were set to bring the seafood research forward and reach goals that would be noticed within the research society. When looking at the results it is clear that the goals have been reached.

SEAFOODplus is the largest project ever supported by the EU within seafood science. In addition to producing outstanding research results it has also been requested that different scientific disciplines of importance to the seafood area should be integrated to create synergy and new development. The integration has been a challenge but the results have been rewarding. The successful integration will be documented at the conference.

In addition to the research achievements a lot of other activities have been performed like training, demonstration, dissemination and a particular emphasis on contacts to the SMEs, all of which will be highlighted at the conference. Further, a network of National Contact Points has been established. At [www.seafoodplus.org](http://www.seafoodplus.org) all the members are listed together with extensive lists of national associations and their contact addresses.

The results of the SEAFOODplus have been so successful that it is not possible to stop the activities now. Thus, the consortium partners have planned for a continuation by launching a new membership based research platform. It is a great pleasure to announce the start of this platform from 1 January 2009, when the present period of the SEAFOODplus finishes.

Welcome to a great conference and welcome to a new SEAFOODplus future!





**Programme for  
the fifth and final SEAFOODplus Conference  
8-10 June 2008  
Wallmans  
The historical Circus Building  
Copenhagen, Denmark**

**Registration and welcome reception  
Sunday 8 June 2008**

- 16:00 – 18:00 General Assembly  
18:00 – 20:00 Welcome reception and registration in the Circus Building



## Programme for the SEAFOODplus Conference Monday 9 June 2008

**8:30-9:00**      **Registration** - continued

**9:00-10:00**      **Opening talks:**  
*Ciaran Mangan, European Commission*  
*Lars Pallesen, Rector of the Technical University of Denmark*  
*Torger Børresen, coordinator of SEAFOODplus*

### **Session 1      Seafood and nutrition**

**10:00-11:15**      **Session 1: Seafood and nutrition**  
*Moderators Gertjan Schaafsma, The Netherlands and Cindy Davis, USA*

10:05              Does fish consumption modify risk of colorectal disease in humans?  
*Elizabeth Lund, Institute of Food Research, United Kingdom*

10:25              How can seafood promote health and prevent diseases in young European families?  
*Inga Thorsdottir, Landspítali-University Hospital & University of Iceland, Iceland*

10:45              Benefits of fish oil for the heart - are they explained by reduction of arrhythmia?  
*Ingeborg Brouwer, Institute of Health Sciences, The Netherlands*

11:05              Discussion

### **Market Place**

**11:20-11:45**      **Market Place and refreshments in the foyer – meet the SEAFOODplus partners**

### **Session 2      Seafood and Consumers**

**11:45-13:05**      **Session 2: Seafood and Consumers**  
*Moderator Karen Brunsø, Denmark and Richard Shepherd, United Kingdom*

11:50              Consumer attitudes and preferences for seafood - what's the trend?  
*Karen Brunsø, Aarhus School of Business, Denmark*

12:10              Improved seafood sensory quality for the consumer  
*Emilia Martinsdóttir, Matis, Iceland*

12:30              Targeting seafood information for consumer well-being  
*Wim Verbeke, Ghent University, Belgium*

12:50              Consumer's evaluation of new seafood products  
*Svein Ottar Olsen, Nofima Market, Norway*

13:10              Discussion

**13:25-14:20**      **Lunch**



## Session 3 Seafood Safety

14:20-16:15

### Session 3: Seafood Safety

*Moderators Bill Doré, Ireland and Steve Otwell, USA*

14:25

New validated rapid methods for detection of viruses in bivalve molluscs  
*Soizick le Guyader, Ifremer, France*

14:45

Viruses in shellfish - controlling the risk  
*Bill Doré, Marine Institute, Ireland*

15:05

Detection of Vibrio species in seafood by new rapid methods  
*Rachel Rangdale, CEFAS, United Kingdom*

15:25

Histamine fish poisoning – new controls for a common seafood safety issue  
*Paw Dalgaard, DTU Aqua, Denmark*

15:45

How can the shellfish industry and consumers benefit from results obtained in SEAFOODplus?  
*Doug McLeod, Scottish shellfish growers, United Kingdom*

16:00

Discussion

## Market Place

16:15-17:30

**Market Place and refreshments in the foyer – meet the SEAFOODplus partners**

## Evening event

19:00

The first Annual SeafoodCircle dinner for the Danish seafood industry  
Store Kannikestræde 19<sup>2nd</sup> floor  
Central Copenhagen  
Ask for a map at the SEAFOODplus registration desk in the Circus building



## Programme for the SEAFOODplus Conference Tuesday 10 June 2008

### Session 4 Seafood from source to consumer products

**9:00-10:35** **Session 4: Seafood from source to consumer products**  
*Moderators Joop Lutén, Norway and Mike Morrissey, USA*

- 9:05 Tasty and healthy peptides from producers to consumers  
*Gudjon Thorkelsson, Matis, Iceland*
- 9:25 Breakthrough in mild technologies for preservation of convenient seafood: from laboratory to industrial application  
*Francoise Leroi, IFREMER, France*
- 9:45 Oxidation and texture: from models to real seafood products  
*Charlotte Jacobsen, DTU Aqua, Denmark*
- 10:05 The roadmap to consumer driven functional seafood products: an international expedition  
*Mercedes Careche, Instituto del Frío, CSIC, Spain*
- 10:25 A cocktail of science, industry and culinology: SEAFOOD products plus show  
*Mike Morrissey, Oregon State University, USA*
- 10:45 Discussion

### Market Place

**11:00-11:30** **Market place and refreshments in the foyer – meet the SEAFOODplus partners**

### Session 5 Seafood from aquaculture

**11:30-13:00** **Session 5: Seafood from Aquaculture**  
*Moderators Børge Damsgård, Norway and Ole Torrissen, Norway*

- 11:35 Sequencing the fish genome for quality – the new success story of cod  
*Einar Eg Nielsen, DTU Aqua, Denmark*
- 11:55 Improving the ethical quality traits of farmed fish - identifying optimal husbandry and pre-slaughter conditions  
*Hilde Toften, Nofima Marine, Norway*
- 12:15 Linking consumer demands of environmentally friendly farming with a biological basis of ethical quality  
*Felicity Huntingford, University of Glasgow, United Kingdom*
- 12:35 The future of fish farming as seen by a SEAFOODplus partner in the feed industry  
*Niels Alsted, Biomar A/S, Denmark*
- 12:45 Discussion
- 13:00-14:00** **Lunch**



## **Session 6 Seafood and traceability**

### **14:00-15:30 Session 6: Seafood and traceability**

*Moderators Erling Larsen, Denmark and Allan Bremner, Australia*

- 14:05 The basis for data sharing in traceability - Good Traceability Practice  
*Erling Larsen, DTU Aqua, Denmark*
- 14:25 The gateway for future data collection in traceability - RFID tags and temperature measuring solutions  
*Jostein Storøy, SINTEF Fisheries and Aquaculture, Norway*
- 14:45 Validation tools for traceability - Ensuring quality and safety and preventing fraud in the seafood chain  
*Begoña Pérez-Villareal, AZTI-Tecnalia, Spain*
- 15:05 Discussion

## **Session 7 Integration within SEAFOODplus**

### **15:20-16:20 Session 7: Integration within SEAFOODplus**

*Moderators Torger Børresen, Denmark and Joop Luten, Norway*

- 15:25 Integration, training and dissemination within SEAFOODplus  
*Joop Luten, Nofima Marine, Norway*
- 15:40 ETHICOD - ethical quality of farmed cod in a full chain approach  
*Børge Damsgård, Nofima Marine, Norway*
- 15:50 ETHICOD – is it possible to 'sell' welfare to EU consumers?  
*Rian Schelvis-Smit, IMARES, The Netherlands*
- 16:10 Demonstration of health promoting effects of fish protein hydrolysates by animal testing  
*Rozenn Ravallec-Plé, University of Lille, France*

## **Session 8 Cooperation with the seafood industry and future of SEAFOODplus**

### **16:25-17:15 Session 8: Cooperation with the seafood industry and future of SEAFOODplus**

*Moderators Torger Børresen, Denmark and Begoña Perez-Villareal, Spain*

- 16:25 – 16:50 The cooperation with the seafood industry in demonstration projects  
*Begoña Perez-Villareal, AZTI-Tecnalia, Spain and industry representatives*
- 16:50 – 17:15 The future of SEAFOODplus – the SEAFOODplus research platform  
*Torger Børresen, DTU Aqua, Denmark*

## **Celebration of the grand finale of SEAFOODplus in the Circus building**

- 18:00 – 19:00: Champagne reception
- 19:00 – 20:00: The special SEAFOODplus show  
Award for the best speaker at the SEAFOODplus Conference
- 20:00 – 23:00 Gala dinner and Wallman's International Dinner show

## List of participants



## List of participants for the 5<sup>th</sup> SEAFOODplus Conference 8-10 June 2008

First name	Last name	Organisation	Country	E-mail
Allan	Bremner	Allan Bremner and Associates	AU	bremqual1@optusnet.com.au
Nancy	Fockedeey	Flanders Marine Institute (VLIZ)	BE	nancy.fockedeey@vliz.be
Ciaran	Mangan	European Commission	BE	Ciaran.Mangan@ec.europa.eu
Zuzanna	Pieniak	Ghent University	BE	zuzanna.pieniak@ugent.be
Filiep	Vanhonacker	Ghent University	BE	filiep.vanhonacker@ugent.be
Wim	Verbeke	Ghent University	BE	wim.verbeke@ugent.be
Geertrui	Vlaemynck	Ins. for Agr. and Fisheries Res.	BE	geertrui.vlaemynck@ilvo.vlaanderen.b
Swapan	Banerjee	Health Canada	CA	swapan_banerjee@hc-sc.gc.ca
Rodrigo	Gonzalez	Fundación Chile	CL	rgonzalez@fundacionchile.cl
Alberto	Ramirez	Fundación Chile	CL	aramirez@fundacionchile.cl
Oscar	Solar	Fundación Chile	CL	osolar@fundacionchile.cl
Manfred	Klinkhardt	Eurofish	DE	manfred.klinkhardt@web.de
Nina	Habermann	Friedrich Schiller Uni. Jena	DE	nina.habermann@uni-jena.de
Sabine	Mierke-Klemeyer	Max Rubner-Institute	DE	sabine.klemeyer@mri.bund.de
Jörg	Oehlenschläger	Max Rubner-Institute	DE	joerg.oehlenschlaeger@mri.bund.de
Tage	Affertsholt	3A Business Consulting	DK	ta@3abc.dk
Hasse	Vinter	AgroTech A/S	DK	hsv@agrotech.dk
Jens Erik	Zerrahn	Aller Aqua A/S	DK	bih@aller-aqua.dk
Niels	Alsted	Biomar A/S	DK	na@biomar.dk
Mette Mecklenburg	Jakobsen	Coop Danmark	DK	mette.mecklenburg@coop.dk
Jette Warrer	Knudsen	Dagbladet Børsen	DK	jette.knudsen@borsen.dk
Anne	Gravesen	Danisco	DK	anne.gravesen@danisco.com
Brian	Thomsen	Danish Aquaculture Org.	DK	Brian@danskakvakultur.dk
Frank	Minck	Danish Fishmeal and Fishoil Ass.	DK	fm@fishmeal.dk
Jens	Tellefsen	Danish Seafood Association	DK	jens@tellefsen.dk
Bente	Christensen	Det Danske Seafood Center	DK	bente@ddsc.dk
Caroline	Baron	DTU Aqua	DK	cba@aqua.dtu.dk
Torger	Børresen	DTU Aqua	DK	tb@aqua.dtu.dk
Ulrik	Cold	DTU Aqua	DK	uco@aqua.dtu.dk
Paw	Dalgaard	DTU Aqua	DK	pad@aqua.dtu.dk
Chiara	Foschi	DTU Aqua	DK	chi@aqua.dtu.dk
Stina	Frosch	DTU Aqua	DK	sfr@aqua.dtu.dk
Ditte	Green-Petersen	DTU Aqua	DK	dgr@aqua.dtu.dk
Grethe	Hyldig	DTU Aqua	DK	ghy@aqua.dtu.dk
Charlotte	Jacobsen	DTU Aqua	DK	cja@aqua.dtu.dk
Hanne	Jacobsen	DTU Aqua	DK	hja@aqua.dtu.dk
Jette Donovan	Jensen	DTU Aqua	DK	jej@aqua.dtu.dk
Louise Helene Søgaard	Jensen	DTU Aqua	DK	louise_sogaard@hotmail.com
Toke Koldborg	Jensen	DTU Aqua	DK	tkj@aqua.dtu.dk
Flemming	Jessen	DTU Aqua	DK	flj@aqua.dtu.dk
Sabeena Farvin	Koduvayur Habeebullah	DTU Aqua	DK	sfa@aqua.dtu.dk
Hugo	Ladefoged	DTU Aqua	DK	hugo@aqua.dtu.dk
Erling P.	Larsen	DTU Aqua	DK	epl@difres.dk
Jeannette Unger	Møller	DTU Aqua	DK	jmo@aqua.dtu.dk
Einar Eg	Nielsen	DTU Aqua	DK	een@aqua.dtu.dk

Jette	Nielsen	DTU Aqua	DK	jn@aqua.dtu.dk
Michael Engelbrecht	Nielsen	DTU Aqua	DK	menaqua.dtu.dk
Maria	Randrup	DTU Aqua	DK	mrr@aqua.dtu.dk
Lotte Svare	Rasmussen	DTU Aqua	DK	csr@aqua.dtu.dk
Richard Skøtt	Rasmussen	DTU Aqua	DK	rsr@aqua.dtu.dk
Rie	Sørensen	DTU Aqua	DK	rks@aqua.dtu.dk
Maike	Timm-Heinrich	DTU Aqua	DK	mat@aqua.dtu.dk
Carsten	Østerberg	DTU Aqua	DK	car@aqua.dtu.dk
Jim	Codd	Eurofish	DK	codd@aqua.dtu.dk
Marco Thorup	Frederiksen	Eurofish	DK	marco.frederiksen@eurofish.dk
Victor	Hjort	Eurofish	DK	victor.hjort@eurofish.dk
Walther Rahbek	Mortensen	Lyngsoe Systems A/S	DK	wrm@lyngsoesystems.com
Karen	Brunso	MAPP, Uni. of Aarhus	DK	kab@asb.dk
Karina Birch	Hansen	MAPP, Uni. of Aarhus	DK	kabh@asb.dk
Greta	Jakobsen	Marinova	DK	gj@danishfishprotein.dk
Inez	Johansson	Marinova	DK	ij@danishfishprotein.dk
Mette	Selchau	Min. of Food, Agr. and Fisheries	DK	mese@fvm.dk
Asmundur	Guðjónsson	Nordic Council of Ministers	DK	ag@norden.org
Hardy	Jensen	Nordjysk Fødevarer Netværk	DK	haj@agrowise.dk
Hanne	Kvist	Royal Greenland A/S	DK	hakv@royalgreenland.com
Lisbeth Due	Schönemann-Paul	Royal Greenland A/S	DK	lisc@royalgreenland.com
Thórhallur Ingi	Halldórsson	Statens Serum Institut	DK	lur@ssi.dk
Sjúrdur Fródi	Olsen	Statens Serum Institut	DK	sfo@ssi.dk
Marin	Strøm	Statens Serum Institut	DK	mrm@ssi.dk
Lars	Pallesen	Technical Uni. of Denmark	DK	rektor@adm.dtu.dk
Lene	Moth	Aalborg University Esbjerg	DK	lmoth@aaue.dk
Amaia	Lasagabaster	AZTI-Tecnalia	ES	alasa@suk.azti.es
Begona	Perez-Villarreal	AZTI-Tecnalia	ES	bperez@suk.azti.es
Jose	Gallardo	CSIC, Inst. de Inv. de Marinas	ES	gallardo@iim.csic.es
Isabel	Medina	CSIC, Inst. de Inv. de Marinas	ES	medina@iim.csic.es
Manuel	Pazos	CSIC, Inst. de Inv. de Marinas	ES	mpazos@iim.csic.es
Javier	Borderias	CSIC, Instituto del Frío	ES	jborderias@if.csic.es
Mercedes	Careche	CSIC, Instituto del Frío	ES	mcareche@if.csic.es
Isabel	Sanchez-Alonso	CSIC, Instituto del Frío	ES	isblsa@if.csic.es
Fulgencio	Saura-Calixto	CSIC, Instituto del Frío	ES	fsaura@if.csic.es
Juanjo	de la Cerda	Pescanova S.A.	ES	juanjoc@pescanova.es
Dimingo	Calvo Dopico	University of Coruna	ES	domingo@udc.es
Alina	Tudoran	University of Coruna	ES	aalina@udc.es
Gloria	Blanco	University of Oviedo	ES	gloriablanca@uniovi.es
José A.	Sánchez	University of Oviedo	ES	jafsp@uniovi.es
Susanna	Airaksinen	Finnish Game & Fisheries Res. Inst.	FI	susanna.airaksinen@rktl.fi
Hannes	Gislason	Aquaculture Res. St. of the Faroes	FO	hannes@fiskaaling.fo
Ingolf	Joensen	Aquaculture Res. St. of the Faroes	FO	ingolf@fiskaaling.fo
Janet Fríða	Johannesen	Atlanticon	FO	jj@atlanticon.fo
Olavur	Gregersen	The Bitland Enterprise	FO	og@bitland.fo
Katrin Ingolfsdóttir	Jakobsen	The Bitland Enterprise	FO	kj@bitland.fo
Steinbjørn	Dali	TracePlace	FO	sd@sporfori.fo
Charles	Delannoy	COPALIS - CTPP	FR	c.delannoy@copalis.fr
Marie-France	Pilet	ENITIAA	FR	pilet@enitiaa-nantes.fr

Jean-Pascal	Bergé	IFREMER	FR	jpberge@ifremer.fr
Lucay	Han Ching	IFREMER	FR	lhching@ifremer.fr
Laetitia	Kolypczuk	IFREMER	FR	laetitia.kolypczuk@ifremer.fr
Soizick F.	Le Guyader	IFREMER	FR	sleguyad@ifremer.fr
Françoise	Leroi	IFREMER	FR	fleroi@ifremer.fr
Agnes	Joly	JolyMer Conseil	FR	aj@jolymer.fr
Martine	Fouchereau-Peron	MNHN	FR	peron@mnhn.fr
Rozenn	Ravallec-Plé	ProBioGEM	FR	ravallecrozenn@hotmail.com
Patrick	Bourseau	Uni. of South Britany (Progebio)	FR	patrick.bourseau@univ-ubs.fr
Fabienne	Guerard	University of Western Brittany	FR	guerard@univ-brest.fr
Ronan	Gormley	Ashtown Food Research Centre	IE	ronan.gormley@teagasc.ie
John	Fagan	BIM - Irish Sea Fisheries Board	IE	fagan@bim.ie
Catherine	Halbert	Customised Food Industry Training	IE	halbert@food-training.com
Bill	Doré	Marine Institute	IE	bill.dore@marine.ie
Michael	Haverty	National Uni. of Ireland, Galway	IE	m.haverty2@nuigalway.ie
Inga	Thorsdottir	Landspítali-University Hospital	IS	ingathor@landspitali.is
Rosa	Jonsdottir	Matis	IS	rosa.jonsdottir@matis.is
Hélène L.	Lauzon	Matis	IS	helene.l.lauzon@matis.is
Emilia	Martinsdottir	Matis	IS	emilia@matis.is
Sjöfn	Sigurgísladóttir	Matis	IS	sjofn@matis.is
Gudjon	Thorkelsson	Matis	IS	gudjon.thorkelsson@matis.is
Gudrun	Ólafsdóttir	Syni Laboratory Services	IS	gudruno@syni.is
Kristberg	Kristbergsson	University of Iceland	IS	kk@hi.is
Giuliana	Parisi	University of Florence	IT	giuliana.parisi@unifi.it
Bianca Maria	Poli	University of Florence	IT	biancamaria.poli@unifi.it
Bruno	Massimiliano	University of Udine	IT	pugnatorepelagi@libero.it
Jamila	Rizgalla	Faculty of Agriculture	LY	jamilarizgalla@yahoo.com
Hester	den Ruijter	Academic Medical Center	NL	h.m.denruijter@amc.uva.nl
Nobuhiko	Domoto	Nippon Suisan(Europe)B.V.	NL	n.domoto@nissui.nl
Jurgen	Vincke	Nippon Suisan(Europe)B.V.	NL	j.vincke@nissui.nl
Johan	Verbon	Restaurant of the Future	NL	
Gertjan	Schaafsma	Schaafsma Advisory Service	NL	gertjan.schaafsma@wanadoo.nl
Susann	Bellmann	TNO	NL	susann.bellmann@tno.nl
Ingeborg	Brouwer	VU Uni., Inst. of Health Sciences	NL	ingeborg.brouwer@falw.vu.nl
Adriaan	Kole	Wageningen IMARES	NL	adriaan.kole@wur.nl
Rian	Schelvis	Wageningen IMARES	NL	rian.schelvis@wur.nl
Hans	van de Vis	Wageningen IMARES	NL	hans.vandervis@wur.nl
Ellen	Kampman	Wageningen University	NL	Ellen.Kampman@wur.nl
Gerda	Pot	Wageningen University	NL	Gerda.Pot@wur.nl
Bert	Lambooij	Wageningen UR-Animal Sci. Grp	NL	bert.lambooij@wur.nl
Ole	Torrissen	Institute of Marine Research	NO	ole.torrissen@imr.no
Lisbeth	Dahl	Nat. Inst. of Nutr. and Seafood Res.	NO	lisbeth.dahl@nifes.no
Taran	Skjerdal	National Veterinary Institute	NO	taran.skjerdal@vetinst.no
Børge	Damsgård	Nofima	NO	borge.damsgaard@nofima.no
Tor	Evensen	Nofima	NO	tor.evensen@nofima.no
Linda Anett	Hansen	Nofima	NO	linda.hansen@nofima.no
Pirjo	Honkanen	Nofima	NO	pirjo.honkanen@nofima.no
Rune	Larsen	Nofima	NO	rune.larsen@nofima.no
Joop	Luten	Nofima	NO	joop.luten@nofima.no
Svein Ottar	Olsen	Nofima	NO	sveinottar.olsen@nfh.uit.no
Gunn Berit	Olsson	Nofima	NO	gunn-berit.olsson@nofima.no
Hilde	Toften	Nofima	NO	hilde.toften@nofima.no

Tor-Jahn	Herstad	Norw. Inst. for Water Research	NO	tjh@niva.no
Turid	Rustad	Norw. Uni. of Science and Techn.	NO	turid.rustad@biotech.ntnu.no
Karin	Boxaspen	Research Council of Norway	NO	karinb@imr.no
Edmund	Brobäck	Research Council of Norway	NO	edmubro@online.no
Inger	Dalsgaard	Research Council of Norway	NO	id@aqua.dtu.dk
Rolf	Giskeødegård	Research Council of Norway	NO	rg@forskningsradet.no
Ellen	Gjøsteen	Research Council of Norway	NO	eg@forskningsradet.no
Liv	Holmefjord	Research Council of Norway	NO	liv.holmefjord@fiskeridir.no
Pål	Lader	Research Council of Norway	NO	pal.lader@sintef.no
Kjell	Maroni	Research Council of Norway	NO	kjell.maroni@fhl.no
Frode	Meland	Research Council of Norway	NO	fm@forskningsradet.no
Tom Ståle	Nordtvedt	Research Council of Norway	NO	tom.s.nordtvedt@energy.sintef.no
Elisabeth	Skjønsberg	Research Council of Norway	NO	els@forskningsradet.no
Sigurd	Stefansson	Research Council of Norway	NO	sigurd.stefansson@bio.uib.no
Svein Hallbjørn	Steien	Research Council of Norway	NO	Svein.Hallbjorn.Steien@innovasjon Norge.no
Henrik	Stenwig	Research Council of Norway	NO	henrik.stenwig@fhl.no
Revilija	Mozuraityte	SINTEF Fisheries and Aquaculture	NO	revilija.mozuraityte@sintef.no
Gunnar	Senneset	SINTEF Fisheries and Aquaculture	NO	gunnar.senneset@sintef.no
Ivar	Storrø	SINTEF Fisheries and aquaculture	NO	ivar.storro@sintef.no
Jostein	Storøy	SINTEF Fisheries and aquaculture	NO	jostein.storoy@sintef.no
Hanne	Mæhre	University of Tromsø	NO	hma002@nfh.uit.no
Anna	Pyc	Fish Industry Magazine	PL	mpr@mprfish.com
Henryk	Bialowas	Ins. of Ichthyobiol. and Aquaculture	PL	henryk.bialowas@fish.edu.pl
Maciej	Pilarczyk	Ins. of Ichthyobiol. and Aquaculture	PL	maciej.pilarczyk@fish.edu.pl
Maria Leonor	Nunes	IPIMAR	PT	mlnunes@ipimar.pt
Solveig	Buhl	Abba Seafood	SE	solveig.buhl@abaseafood.se
Mats	Lennersten	Abba Seafood	SE	mats.lennersten@abaseafood.se
Annette	Almgren	Chalmers Uni. of Technology	SE	annette.almgren@chalmers.se
Karin	Larsson	Chalmers Uni. of Technology	SE	karin.larsson@chalmers.se
Ingrid	Undeland	Chalmers Uni. of Technology	SE	undeland@chalmers.se
Marie-Louise	Wennerhag	Chalmers Uni. of Technology	SE	marie-louise.wennerhag@chalmers.se
Douglas	McLeod	Ass. of Scottish Shellfish Growers	UK	douglasmcleod@aol.com
Catherine	McLeod	Ass. of Scottish Shellfish Growers	UK	douglasmcleod@aol.com
Rachel	Rangdale	CEFAS	UK	rachel.rangdale@cefasc.co.uk
Giles	Elliott	Institute of Food Research	UK	giles.elliott@bbsrc.ac.uk
Elizabeth	Lund	Institute of Food Research	UK	liz.lund@bbsrc.ac.uk
Gosia	Majsak-Newman	Institute of Food Research	UK	gosia.newman@bbsrc.ac.uk
Tom	Wray	Seafood Processor Magazine	UK	tomseafood@yahoo.co.uk
Felicity	Huntingford	University of Glasgow	UK	f.huntingford@bio.gla.ac.uk
Sunil	Kadri	University of Glasgow	UK	s.kadri@bio.gla.ac.uk
Richard	Shepherd	University of Surrey	UK	r.shepherd@surrey.ac.uk
Steve	Lamming	Young's Seafood Ltd	UK	steve_lamming@youngbluecrest.no
Cindy	Davis	National Cancer Institute	USA	davisci@mail.nih.gov
Mike	Morrissey	Oregon State University	USA	michael.morrissey@oregonstate.edu
Steve	Otwell	University of Florida	USA	otwell@ufl.edu

## **Abstracts for the oral presentations**



## SEAFOODplus and the changing face of EU RTD

Ciaran Mangan  
*European Commission DG RTD*



This gathering has an important purpose, and that is to showcase the developments which have taken place in this flagship Integrated Project over the past four and a half years since its debut in January 2004.

It is considered a flagship project of the sixth framework programme because SEAFOODplus is the largest research project ever sponsored by the EU in the seafood sector – not only with regard to the total budget, but also with regard to the content and complexity of the research programme. It has frequently been used as a successful example of what the sixth framework programme originally set out to achieve in bringing together the "critical mass" necessary to address a specific EU objective. The objective in this case was to find ways to reduce health problems and increase well being in European consumers through increased fish consumption. This was achieved by bringing together 150 scientists from nearly 70 organisations across 16 countries to participate in 20 individual research projects, organised across 6 strategic pillars ranging from human nutrition to consumer behaviour, food safety, aquaculture and traceability along the food chain. In parallel to the research pillars the project ran a further six pillars dedicated to information flow to businesses and consumers, training, dissemination and demonstration activities. The actual impact of this 25 M€ project will be felt over the coming years as the results are tested and tried through peer review and market acceptability. With over 200 individual result based deliverables in the form of tools, trials, surveys, protocols, databases, and intellectual property along the whole food chain a very high impact is expected. Over the next two days we shall hear and learn about these developments and at the end be able to access their true significance.

The sixth framework programme is now over and we are already in the early calls of the seventh framework programme.

This new programme builds strongly on the challenges and structures of previous programmes while introducing interesting proposals and models for the future shape of EU research. Looking towards future EU programmes the cost sharing collaborative research from which SEAFOODplus was born will still be available but perhaps in a limited more targeted manner. A much greater emphasis however will be placed on the creation of a true European Research Area where Member States collaborate more thoroughly to prevent redundancy and achieve greater effectiveness and competitiveness. This can be achieved through a greater expansion of the ERANET networks, and an increased role for technology platforms, joint programming activities, and joint technology initiatives. Coupled to this, specific initiatives such as promotion of EU research infrastructures, enhancing the training and mobility structure, the creation of a European Institute of Technology, new Risk-Sharing Finance Facilities, and the increased use of structural funds for research purposes could be envisaged.

Through such cooperation we can achieve an integrated approach based on the right mix of technology, innovation, investment and regulation. Accordingly we can fulfil Europe's ambitions for growth and prosperity in an ever more competitive global economy through not only more and better research but also on how we convert the resulting knowledge into products, processes and services that others want to use and buy.

This type of cooperation is at the heart of what the SEAFOODplus project was about and reflects the importance of its success.

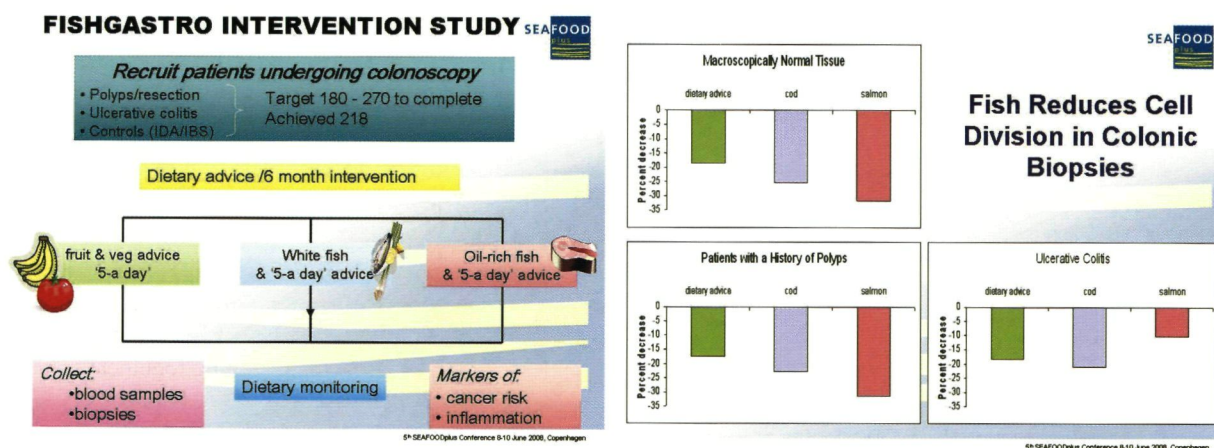
## Does fish consumption modify risk of colorectal disease in humans?

Presenting author: Elizabeth K Lund <sup>(1)</sup> co-authors: Gerda Pott <sup>(2)</sup>, Gosia Majsak-Newman <sup>(1)</sup>, Nina Habermann<sup>(3)</sup>, Linda Harvey <sup>(1)</sup>, Anouk Geelen <sup>(2)</sup>, Giles Elliott<sup>(1)</sup>, Guido Hooiveld<sup>(2)</sup> Beatrice Pool-Zobel <sup>(3)</sup> Ellen Kampman <sup>(2)</sup>

<sup>(1)</sup> Institute of Food Research, UK

<sup>(2)</sup> Wageningen University, Netherlands

<sup>(3)</sup> Friedrich Schiller University Jena, Germany



**Introduction:** Recent population based studies suggest that people who eat two or more portions of fish a week have a reduced risk of colorectal cancer. It is unclear as to whether this is due to the omega-3 fatty acid content of fish, in particular oil-rich fish; however, previous animal and cell culture studies would suggest these are protective in relation to gastrointestinal health. For example they increase cell death (apoptosis) of cancer cells and reduce cell division. Both of these parameters are indicators of reduced cancer risk, although we currently have no good predictors of disease risk. We have therefore undertaken a human intervention study (The SEAFOODplus FISHGASTRO study) to assess the impact of two types of fish, salmon and cod, on markers of gastrointestinal health, with a secondary aim to develop better markers of risk using post genomic technologies.

**Methods:** Volunteers (240), either apparently healthy or at increased risk of colorectal cancer or with inflammatory bowel disease were recruited from gastroenterology clinics in The Netherlands and UK between December 2004 and January 2008. Volunteers were randomised to one of three interventions: (a) dietary advice (DA), (b) cod (300g/week) +DA, (c) salmon (300g/week) +DA. Colon biopsies, blood and faecal samples were collected at the start and after 6 months intervention. Dietary intake was recorded.

**Results:** Volunteers showed good compliance to the fish interventions with salmon consumption significantly increasing serum fatty acid content. We will present how this then affects the levels of apoptosis and mitosis in biopsy samples, the primary end-points of the study. We have also measured the impact on DNA damage in subsets of participants in biopsies and in cultured cells exposed to faecal water. Fish consumption significantly affected levels of mRNA in colorectal biopsies for a wide range of genes with a greater impact of salmon than of cod.

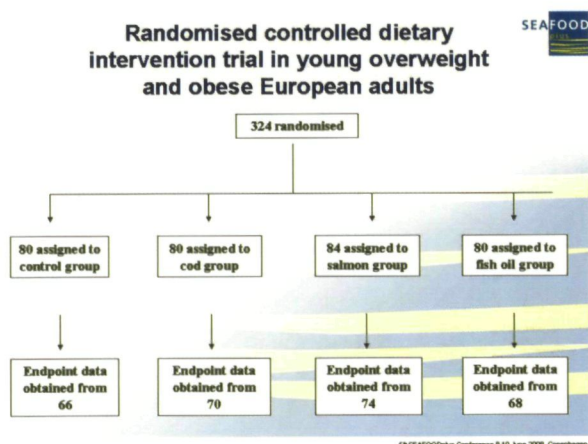
**Conclusion:** These data will allow us to better understand the mechanisms by which fish consumption may help prevent colorectal disease.

**Acknowledgements:** We thank all the clinicians involved in the study, Marine Harvest for the kind gift of the salmon and INESMA / Pescanova for the cod. We are very grateful for the advice and support obtained from NuGO (FP6-506360) and additional funding from The Food Standards Agency (UK).

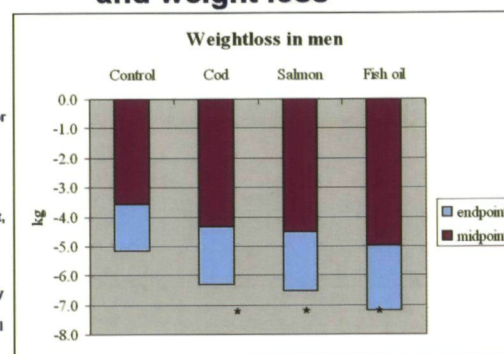
## How can seafood promote health and prevent diseases in young European families?

Inga Thorsdottir

Unit for Nutrition Research, Landspítali-University Hospital and Faculty of Food Science and Nutrition, University of Iceland



### Seafood consumption and weight loss



The aim of the YOUNG project in SEAFOODplus was to investigate the effects of seafood consumption on body composition and various health related measures in overweight and obese participants during energy restriction.

In this 8 week dietary intervention, 324 participants (20–40 years, BMI 27.5–32.5 kg/m<sup>2</sup>, from Iceland, Spain and Ireland) were randomised by computer to one of four energy-restricted diets (–30E%) of identical macronutrient composition but different seafood content: control (n = 80; no seafood; single-blinded); lean fish (n = 80; 150 g cod, three times/week); fatty fish (n = 84; 150 g salmon, three times/week); (4) fish oil (n = 80; daily docosahexaenoic/eicosapentaenoic acid capsules, no other seafood; single-blinded). Anthropometric measurements were conducted at baseline, midpoint and at endpoint of the study, blood was drawn in fasting condition at baseline and endpoint and analysed, a.o., for blood lipids, hormones and bone markers. Dietary intake was assessed using a two-day food record at baseline and during the last two weeks of the intervention, and fish consumption was measured using a FFQ.

The FFQ was suitable for ranking young adults according to their intake of fish and fish oil and could therefore be used as a tool to identify high- and low-fish consumers. Weight-loss-diets containing lean or fatty fish or fish oil resulted in ~1 kg more weight-loss in young adult men already after four weeks, a difference which remained significant after 8 weeks. Circulating triglycerides decreased significantly more by 0.09, 0.13 and 0.086 mmol/L in the groups receiving lean fish, salmon and fish oil, respectively, when compared with the control group. Endpoint insulin resistance was reduced by 16.1% in the fish-oil group compared to the control group. The cod diet was accompanied by improvements on oxidative stress markers. Neither fish nor fish oil consumption had an effect on the changes in bone markers induced by weight loss, however salmon consumption significantly increased serum 25-hydroxyvitamin D. Compliance to varying seafood consumption was good which was confirmed by changes in erythrocyte long-chain n-3 fatty acids and by the FFQ.

Regular seafood consumption, fish as main course three times a week or daily fish oil intake, can be regarded as a well accepted way to increase weight loss on a moderate energy restriction during eight weeks. Fish intake corresponding to ~65 g on average a day or a daily intake of fish oil (1.5 g n-3 fatty acids) also improves independently several health related measures during energy restriction in overweight and obese people.

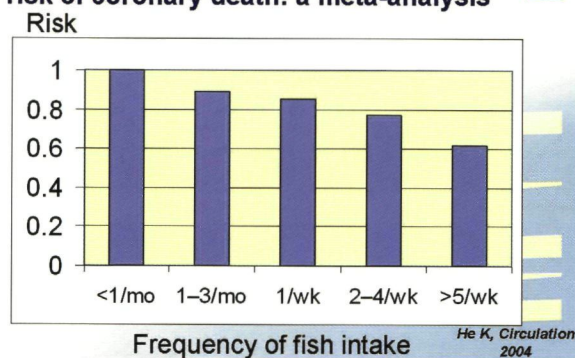
## Benefits of fish oil for the heart – are they explained by reduction of arrhythmia?

Ingeborg Brouwer

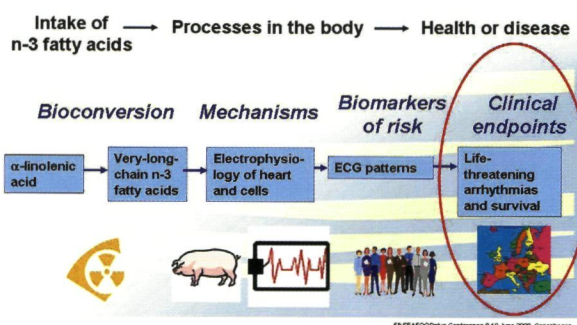
Nutrition and Health, Institute of Health Sciences, VU University Amsterdam



### Epidemiology of fish consumption and risk of coronary death: a meta-analysis



### SEAFOODplus METAHEART project



Cardiac arrhythmia is the major cause of sudden cardiac death in the Western world. Fish and fish oil are the main sources of n-3 very long-chain polyunsaturated fatty acids (n-3 PUFA), otherwise named omega-3 PUFA. These n-3 PUFA are suggested to prevent cardiac death via inhibition of cardiac arrhythmia.

Epidemiological, observational studies suggest that intake of fish is associated with less fatal coronary heart disease in several populations. These studies are fairly consistent, but people that have a high intake of fatty fish might also do other things differently. It is difficult to remove this kind of confounding completely with statistical adjustments and corrections. Therefore, trial evidence is important. However, evidence from trials is less clear than from the observational studies.

The Study on Omega-3 Fatty acids and ventricular Arrhythmia (SOFA) investigated the effect of n-3 fatty acids from fish on the incidence of recurrent ventricular arrhythmia and all-cause mortality in patients with an implantable cardioverter defibrillator (ICD). SOFA was part of the SEAFOODplus project METAHEART. The study was funded by TI Food and Nutrition, the former Wageningen Center for Food Sciences with co-funding from the EU (SEAFOODplus integrated project). SOFA is a parallel, placebo-controlled, double blind trial performed in 26 clinical centers across Europe. We randomized 546 patients with an ICD to treatment with either 2 g/d of fish oil (n= 273) or placebo (n=273), and followed them for a period of 356 days (median). Patients were eligible if they had experienced spontaneous ventricular tachycardia (VT) or ventricular fibrillation (VF) within one year before enrolment. The primary endpoint was spontaneous ventricular tachyarrhythmia episodes as recorded by the ICD, or all-cause mortality.

70% of patients in the fish oil group versus 67% in the placebo group survived free from VT or VF (p=0.33, log-rank test, intention to treat analysis). The hazard ratio for occurrence of at least one event was 0.86 (95% CI: 0.64–1.16) for patients receiving fish oil. In subgroup analyses the hazard ratio was 0.77 (0.52-1.13) for 302 patients with a sole VT at entrance and 0.76 (0.52-1.11) for patients with prior myocardial infarction (MI; n=332). Thus, SOFA does not indicate a strong protective effect of intake of n-3 fatty acids from fish oil on life-threatening ventricular arrhythmia in ICD patients. In patients who previously experienced an MI there was a non-significant trend towards a beneficial effect. Despite the SOFA study did not show a strong protective beneficial effect the overall advice to eat fish twice per week remains justifiable.

## Consumer attitudes and preferences for seafood – what’s the trend?

Presenting author: Karen Brunso<sup>(1)</sup> co-authors: Joachim Scholderer, Karina Birch Hansen<sup>(1)</sup>, Svein Ottar Olsen<sup>(2)</sup>, Wim Verbeke<sup>(3)</sup>

<sup>(1)</sup> MAPP, Aarhus School of Business, University of Aarhus, Denmark

<sup>(2)</sup> Nofima and the Norwegian College of Fishery Science, University of Tromsø

<sup>(3)</sup> Department of Agricultural Economics, Ghent University, Belgium



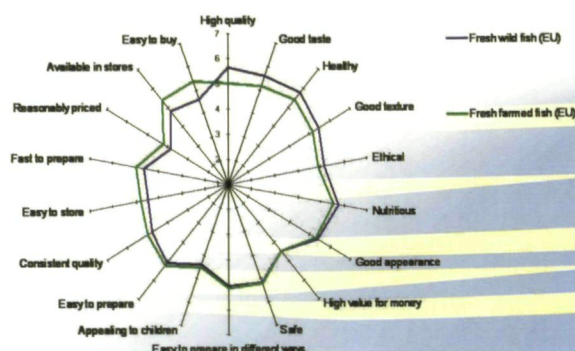
### What’s the trend?



- In general consumers want seafood products that are **tasty, healthy, convenient** and that are **‘produced’ in a desirable or acceptable way**
- Consumers do not know much about aquaculture
- But consumers want to predict quality
- So they use cues and information sources they believe in
- And consumers need easy recipes, instructions about preparation and convenience seafood to help making seafood meals a success

© SEAFOODplus Conference 8-10 June 2008, Copenhagen

### The image of seafood



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The aim of the project CONSUMERSURVEY is to investigate eating habits, attitudes and preferences towards fish and seafood as well as trace trends over time across Europe.

Consumers choose seafood products based on how they believe the product may contribute to the achievement of desired consequences and values, e.g. a nice and enjoyable family meal or a feeling of being a good cook. Information such as a label and its information about safety, traceability or sustainability may, for example, generate expectations about high eating quality – giving the consumer a feeling of luxury – or expectations about improved health, and of pleasure in life.

So far, our consumer studies have indicated that consumers hold various beliefs and perceptions about seafood and farmed and wild fish. These are not necessarily based on objective de-facto knowledge. While fish and seafood in general are perceived as healthy, nutritious and safe food products, there seems to be more confusion when the subject of wild and farmed fish is raised and findings indicate that consumer awareness and knowledge about the farmed or wild origin of the fish they buy is rather vague. As production methods gain importance to many consumers, issues of ethical production, animal treatment and welfare, organic and environment-friendly production systems as well as sustainability seem to gain more influence on seafood product choices. When consumers try to judge whether a seafood product is healthy or a production method is natural or sustainable, they base their evaluation on available quality cues they understand – colour, safety guaranties, information about origin, expert advice.

Furthermore, beyond the factors mentioned above which influence the evaluation of seafood quality, the aspect of being able to actually prepare a meal with fish is an important concern for many consumers. Many consumers experience problems and have a desire for more convenient seafood products. Still, consumers differ, some are not very interested in seafood, others are interested, but in very different ways. Such differences lead to different patterns of preference formation and food choice, and grouping of consumers into segments is an improvement over undifferentiated approaches to ‘the consumer.’ Our recent segmentation study has revealed four segments with quite different convenience orientations: (1) The Convenience segment, (2) The Critical segment, (3) The Independence segment and (4) The Traditional segment.

Finally, new results have revealed changes in some priorities over time, while others have remained the same and have also shed new light over the aspect of seafood supplements like the perception and use of Omega 3 fatty acid supplements, and into how consumers perceive seafood in contrast with other types of meat, e.g. meat, pork and poultry.

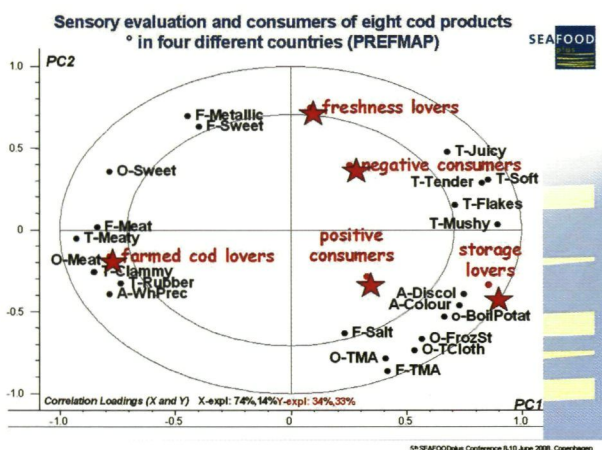
## Improved seafood sensory quality for the consumer

Presenting author: Emília Martinsdóttir <sup>(1)</sup> co-authors: Kolbrún Sveindóttir <sup>(1)</sup>, Grethe Hyldig <sup>(2)</sup>, Ditte Green-Petersen <sup>(2)</sup>, Rian Schelvis <sup>(3)</sup>

<sup>(1)</sup> MATIS (Icelandic Food Research), Iceland

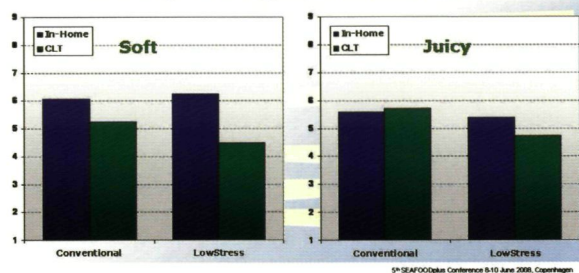
<sup>(2)</sup> National Institute of Aquatic Resources (DTU AQUA), Technical University of Denmark (DTU)

<sup>(3)</sup> Wageningen IMARES (Institute for Marine Resources & Ecosystem Studies), the Netherlands



### Ethical Slaughtering of Farmed Cod: Effects on Sensory Characteristics and Consumer Preferences

- Attribute differences
  - Consumers in a Central Location Test (CLT) (laboratory settings) found differences between the products
    - The conventional sample was more soft and juicy (see fig)
    - According to the sensory panel, the conventional sample was more tender



The main objective of SEAFOODSENSE was to develop and apply consumer oriented Seafood Sensory Quality Models that will enable the seafood industry to improve the eating quality of seafood available to consumers, will encourage increased seafood consumption. The project was led by Matís, Iceland and the other partners were DTU AQUA, Denmark and Wageningen IMARES, the Netherlands.

By simultaneous consumer test of sixteen different cod and salmon products in four countries and sensory analysis by a trained sensory panel it was found how sensory quality corresponded to consumers liking. The farmed cod products were considerably different from wild cod, with more light and even colour, meaty texture, odour and flavour and the storage time and handling also had an effect. Country differences were considerable with regard to fish consumption, attitudes and preferences of products. However, it was demonstrated that for each country, similar segments of consumers existed with different preferences, motives/barriers to seafood and demographic background.

Key decision makers determine quality at each stage in the seafood handling chain. By studying two different supply chains it was shown that there was a large variation in the way the information on sensory quality was structured and documented in each of the individual companies throughout the European fishery production chain. Almost all companies assessed the products by appearance and described general quality criteria, often related to freshness or other product specifications. For companies using defined methods it is relatively easy to describe norms and tolerances to evaluate the sensory quality on attributes. However, information on results of the sensory evaluation is not always communicated between companies in the chain. In collaboration with other SEAFOODplus projects it was studied if farmed cod produced with special animal friendly methods and conventional methods had different sensory qualities and to observe whether consumers had different likings for those groups and how different levels of information on farming practices influenced consumer liking. Sensory differences between the samples were observed, especially in texture attributes like tenderness, flakiness and meatiness. Even though some of the consumers did not differentiate between the samples ethical information had positive effect on product perception.

Using guidelines on sensory fish quality and handling for consumers showed that information and education of quality parameters, freshness evaluation and fish handling could result in more confidence in assessing quality of fish, enjoyment of fish meals and more frequent buying of fish. The results of the SEAFOODSENSE project indicated various marketing potential to increase fish consumption. Furthermore the results of the sensory evaluation performed in the different steps of the fish processing chain can be used in a seafood sensory quality model to improve the eating quality of seafood available to consumers.

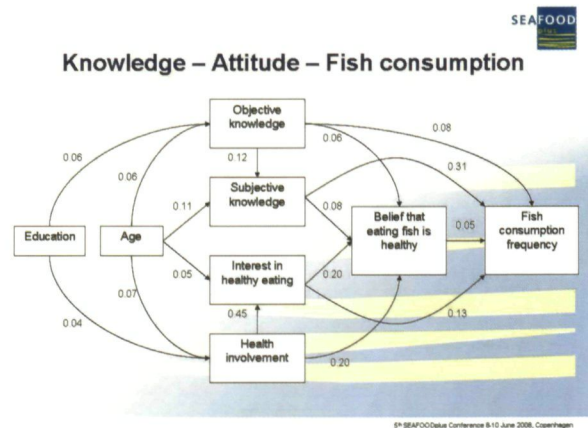
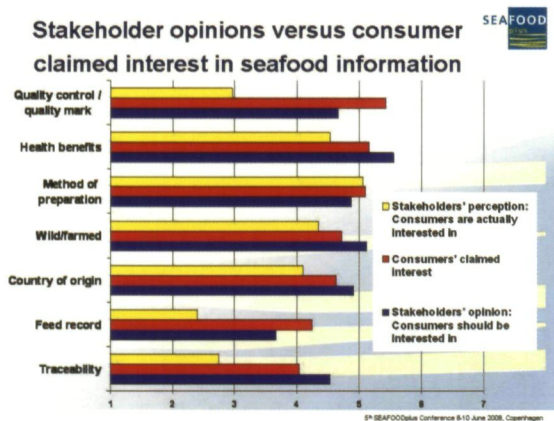
## Targeting seafood information for consumer well-being

Presenting author: Wim Verbeke <sup>(1)</sup> co-authors: Zuzanna Pieniak <sup>(1)</sup>, Karen Brunso <sup>(2)</sup>, Joachim Scholderer <sup>(2)</sup>, Svein Ottar Olsen <sup>(3)</sup>

<sup>(1)</sup> Department of Agricultural Economics, Ghent University, Belgium

<sup>(2)</sup> MAPP, Aarhus School of Business, University of Aarhus, Denmark

<sup>(3)</sup> Nofima & Norwegian College of Fishery Science, University of Tromsø, Norway



The project SEA-INFOCOM has concentrated on consumer interest in information, labelling and traceability related to seafood. The rationale for this scope is that consumers face uncertainty because information is imperfect, incomplete, inaccessible, asymmetrically distributed, non-standardised or costly to collect. Uncertainty restricts consumer well-being, and prevails specifically in situations where product differentiation is relatively low and mainly based on so-called credence characteristics, like healthiness, safety, sustainability or ethical characteristics. These areas are highly and increasingly relevant in the case of seafood in our contemporary European society, though remained largely un-investigated until the start of SEAFOODplus.

Qualitative exploratory and quantitative descriptive studies have shown that European seafood consumers displayed the highest level of trust in personal information sources about fish. These include among others doctors, dieticians, fishmonger and family or friends. Trust levels were significantly lower for mass media or commercial information sources like retailers and industry advertisements, although on average they were not alarmingly low. Expiry date, price, species name and weight were the most used information cues on seafood. Consumers were most familiar with these cues and they felt able to derive clear quality expectations from the information these cues convey. European consumers claimed a high interest in additional seafood information. The strongest interest was displayed for a safety guarantee and a quality mark for seafood. Stakeholder views on seafood information's role in the market do not consistently match with consumers' claimed interests in seafood information; e.g. consumer interest in a quality mark is largely underestimated by stakeholders. Furthermore, our findings indicate that the primary role of traceability is within the chain, rather than being a means of direct quality information to consumers, with considerable potential to guarantee seafood quality to consumers.

Three distinct market segments were identified based on consumers' use of and trust in fish information sources: Sceptics (24.0%), Enthusiasts (41.4%) and Confidants (34.6%). Those consumer segments differed with respect to use of and interest in information cues on fish labels, fish consumption behaviour, socio-demographic and attitudinal profile, which yields opportunities for targeted information provision efforts.

One of the definitions of information holds that it is anything that builds knowledge. The research activities in this project have considered both consumers' subjective and objective knowledge related to seafood. The empirical findings suggest that consumers' subjective knowledge is a better predictor for marketplace behaviour than their objective of factual knowledge.

During the course of the project, a number of additional seafood-and-information-related issues or needs have emerged: exploring more effective ways for conveying seafood dietary recommendations; investigating the potential of seafood-related nutrition and health claims; and informing consumers about environmental, ethical and sustainability issues related to seafood. These will also be discussed in the presentation.

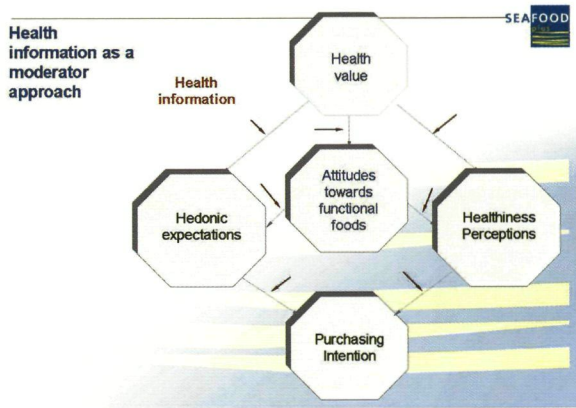
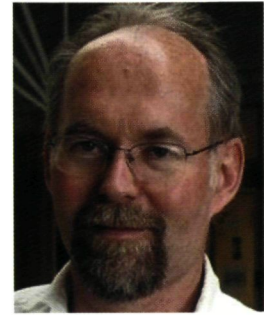
## Consumer's evaluation of new seafood products

Presenting author: Svein Ottar Olsen <sup>(1)</sup> co-authors: Alina Tudoran, Domingo C. Dopico <sup>(2)</sup>, Morten Heide and Pirjo Honkanen <sup>(3)</sup>

<sup>(1)</sup> Nofima and the Norwegian College of Fishery Science, University of Tromsø

<sup>(2)</sup> University of A Coruna, Spain

<sup>(3)</sup> Nofima Market, Norway



### EXPERIMENTAL CONDITIONS

LOCATION Madrid (Spain) 2007  
MULTIPLE SESSIONS 15-20 individuals/session/1h

Control group (n = 163)

Experimental group (n = 163)

Product with limited information

Product with full (health) information

Ingredients:  
Salmon 95%  
Water  
Soybean oil  
Soy  
Salt  
E 621  
Modified potato starch

NEW SEAFOOD PRODUCT

Nutritional information (per 100 gr):  
Protein: 18.0 g  
Carbohydrate: 5.5 g  
Lipids: 6.2 g  
Energy value: 133 kcal (560 kJ)

The same product,  
BUT different label

Ingredients:  
Salmon 95%  
Water  
Soybean oil  
Soy  
Salt  
E 621  
Modified potato starch  
JANCIARY WHEAT FIBRE

Nutritional properties (per 100 gr):  
Protein: 18.0 g  
Carbohydrate: 5.5 g  
Lipids: 6.2 g  
Energy value: 133 kcal (560 kJ)

NEW SEAFOOD PRODUCT WITH WHEAT FIBRE 2%

HEALTH BENEFITS OF WHEAT FIBRE  
The presence of dietary wheat fibre, in the product  
helps to regulate the intestinal transit  
and increases the feeling of satiety

The project CONSUMEREVALUATE has the objective of exploring and explaining consumers' preferences, evaluation and buying behavior related to convenience and tailor-made seafood products.

This presentation will first give a short overview of over published results in the first experiments of this project included at recent study of the influence of test situation on product evaluation and intention to consume a new seafood product.

The main issue of our presentation explores the role of information on individuals' evaluation of their health value, attitudes, intentions and their interrelationships in a study of new fibre-enriched seafood. A central-location test was conducted with two representative samples of consumers who evaluated a new fish product *with* and *without* information about fibre and the health benefits of fibre. The results indicate that the health-benefit information increased consumers' evaluation of their attitudes towards functional foods, but not their health value or their hedonic expectations, perceptions of healthiness or intention to purchase the fibre-enriched fish product. A conceptual model based on the value-attitude-behaviour hierarchy is discussed and tested using structural equation modelling. The model explores how the health value influences domain-specific attitudes towards functional foods, hedonic expectations and the perceptions of healthiness of the functional fish product and how these attitudes determine the intention to consume the product. The individuals' attitudes are complete mediators between their health value and their purchasing intention. Four of the seven relationships in the conceptual model are affected by the introduction of the health-benefit information.

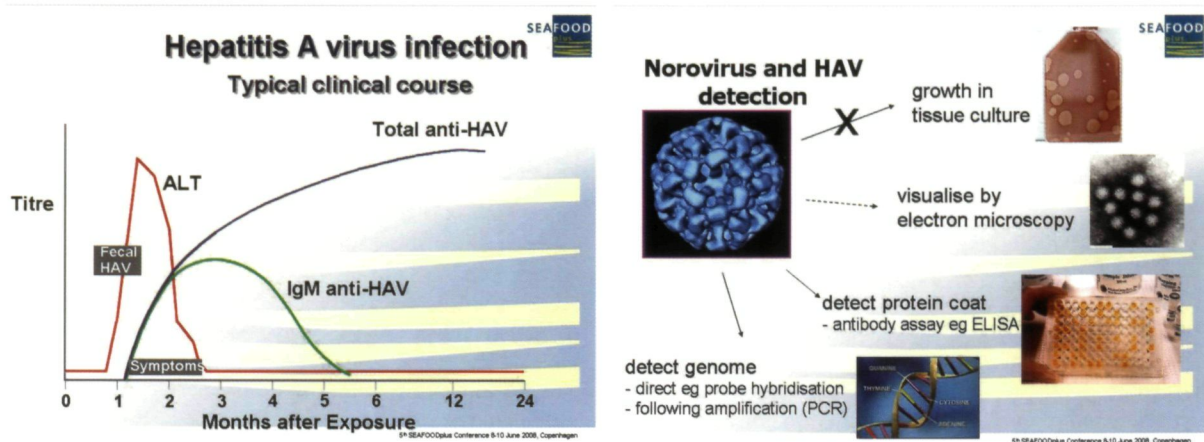
The last part of this presentation deals with some ideas for future research based on data from our field experiments.

## New validated rapid methods for detection of viruses in bivalve molluscs

Presenting author: Soizick F. Le Guyader<sup>(1)</sup> co-author: R. Pinto<sup>(2)</sup>,  
S. Parnaudeau<sup>(1)</sup>, I. Costafreda<sup>(2)</sup>, J. Schaeffer<sup>(1)</sup>, A. Bosch<sup>(2)</sup>

<sup>(1)</sup> Ifremer, Laboratoire de Microbiologie, France

<sup>(2)</sup> Enteric Virus Laboratory, University of Barcelona, Spain



Norovirus (NoV) is the most commonly identified cause of outbreaks and sporadic cases of acute gastroenteritis in human. Hepatitis A virus (HAV) infection is the leading cause of acute viral hepatitis throughout the world. Within the REFHEPA project, the development of sensitive reliable techniques for the accurate quantification of NoV and HAV in shellfish was developed as it is required to ensure the safety of these products. A dramatic improvement in diagnostic virology comes from the emergence of real-time RT-PCR, which makes uses of fluorescent probes and enables not only qualitative determination but also quantitative assays. Assays for the detection of NoV genogroups I and II must overcome the difficulties due to NoV genetic diversity. Molecular data have demonstrated relatively conserved regions at the 3' -end of ORF1 (polymerase) and the 5' -end of ORF2 (capsid) regions of NoV, being the ORF1/ORF2 junction employed as a target for real-time amplification. Real time procedures based on the amplification of a fragment of the highly conserved 5' non-coding region (5'NCR) have also been successfully developed for HAV quantitative detection in shellfish.

Specific and sensitive Taqman real-time reverse transcription- PCR assays for the detection and discrimination between the two NoV genogroups have been designed. Consensus primers and probes have been selected for both genogroups and PCR conditions have been optimized for sensitivity and specificity. Conditions then have been compared and adapted to be compatible with the real-time assay designed for HAV.

To avoid any false negative result due to inhibitors, NoV and HAV RNA internal controls have been constructed and titrated. Each sample then is analyzed for the different NoV genogroups as well HAV and also co-amplified with each internal control to evaluate the RT-PCR efficiency. Quantification may be then estimated based on the standard curve done for each genogroups.

Standard reagents, such as the MC0 Mengo virus strain and ssRNA internal controls have been employed as controls of nucleic acids extraction and RT-PCR, respectively. Quality control and quality assurance issues have been implemented though the use of standardized molecular procedures that may enable its inclusion in regulatory standards for viruses in molluscan bivalves.

Validation of the assay was performed with shellfish bioaccumulated with GI & GII NoV reference strains at several NoV concentrations. The assay was also successfully applied to naturally contaminated samples.

## Viruses in shellfish – controlling the risk

Presenting author: Bill Doré <sup>(1)</sup> co-author: Monique Pommepey <sup>(2)</sup>

<sup>(1)</sup> Marine Institute, Ireland

<sup>(2)</sup> IFREMER, France



SEAFOOD

### Risk Management Approach

Hazard identification → Risk Assess. → Risk management

- Hazard identification (sanitary survey)**
  - Identify human sources of contamination
- Risk Assessment.**
  - Relate hazard to identified risk factors (rainfall and outbreaks...)
  - Determine risk periods for viral contamination in the sites.
  - Determine environmental triggers to initiate intervention
- Risk Management.**
  - Manage risk during high-risk periods.
  - Stop harvesting, treatment, relaying

SEAFOOD

### Potential NoV Risk Management in Shellfisheries?

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**Hazard Identification**

- Sanitary surveys
- Impact

**Risk Analysis**

- Risk = Hazard + Impact
- Determine risk category for site

**Management**

- Suspend harvesting
- Increased treatment

Contamination Source		Measure
Sewage	Impact	Season
Septic Tanks	Harvest Season	Population No.
Boats	Size (sewage, boats, sludge, septic tank)	Treatment Level
Overflow	Treatment	Number
Sewage	Frequency (Overflows, sludge spreading)	Distance
	Dilution	

Risk Period	Site Risk Categorisation		
	Low	Medium	High
Summer			
October - March			
Outbreaks			
Overflows			
Outbreaks & Overflow			

Triggers	Outbreaks	Rainfall	Salinity
Epi. Surveillance			telemetry

Intervention/ Management	
Virus Monitoring	Management
Yes	Suspend harvesting
Yes	Increased treatment
??	??
No	No Action

Viral contamination of bivalve molluscan shellfish occurs at source due to faecal contamination of shellfish harvest areas. Current measures to control this risk rely on bacterial monitoring but do not fully protect consumers. Outbreaks of gastroenteritis caused by norovirus (NoV) and infectious hepatitis caused by hepatitis A virus (HAV) continue to be associated with bivalve shellfish consumption.

The objective of the REDRISK project was to identify the pollution sources and environmental conditions causing virus contamination in shellfish. The project was conducted by partners in UK, Spain & Ireland and was led by IFREMER in France. The project took a two stage approach. Firstly sanitary surveys were carried out in selected harvesting areas to identify pollution sources. Then microbiological and environmental monitoring was conducted to determine the impact on virus contamination. The project utilised, for the first time, quantitative real-time PCR procedures developed in the REFHEPA project which provided an accurate and robust tool to determine the level of viral contamination in oysters.

The results from the project demonstrated that it was possible to determine the relative risk of norovirus contamination in oysters between harvesting areas using the sanitary survey approach. During the monitoring phase of the project the three major factors influencing the extent of norovirus contamination were proximity to sewage input (dilution), season with winter representing a higher risk and the influence of overflows of untreated sewage from waste water treatment plants as result of high rainfall events. Identification of the major risk factors predetermining viral contamination is the first step towards developing improved risk management procedures in shellfisheries.

To implement risk management procedures, three principal steps are required.

#### Hazard Identification → Risk assessment → Risk management

Using the key findings from the REDRISK project it was possible to propose a risk management approach to controlling the risk in shellfisheries intermittently contaminated with viruses. A risk matrix approach was developed to determine the relative risk in harvest areas. This approach is currently being trialled and validated at a national level and provides a potential model for improved public health controls in the future.

## Detection of *Vibrio* species in seafood by new rapid methods

Presenting author: Rachel Rangdale <sup>(1)</sup> co-author's: Wagley S., Suffredini E., Croci L., Pedro S., Martinez J., Lozac S., Magnusson S., Joubrel R., Santos M., Hervio-Heath.

<sup>(1)</sup> CEFAS, UK



SEABAC- Characterisation of *Vibrio parahaemolyticus* from European shellfish and comparisons with known clinically significant strains

SEAFOOD ***V. parahaemolyticus*** SEAFOOD

An increased number of *V. parahaemolyticus* cases have been recorded since 1996 across the world

- Attributed to O3:K6 serotype first emerging in Calcutta, India
- Caused outbreaks in Japan, Bangladesh, and India
- All strains carried the *tdh* gene but not the *trh* gene
- Unique to this clone was a seven base difference in the *toxRS* operon
- This polymorphism has since been exploited to develop a group specific PCR to help identify the new O3:K6 serotype of *V. parahaemolyticus*

• ***V. parahaemolyticus* is readily detected from shellfish samples**

• **TDH/TRH is harder to detect in environment**

• **No/little similarity between known clinical strains and TDH positive environmental strains**

Characteristic bloody stool

Rice water cholera stool

Project title: Seafood: Enhanced Assessment of Bacteriological Associated Contamination (SEABAC).

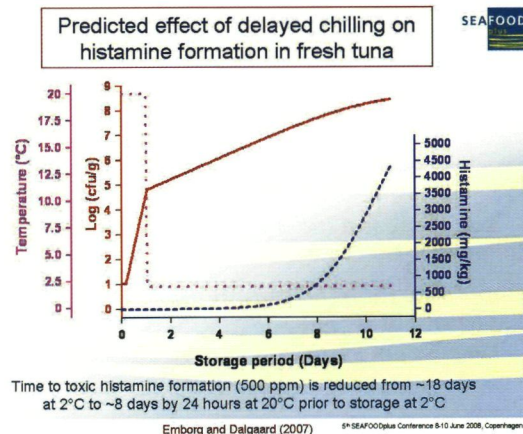
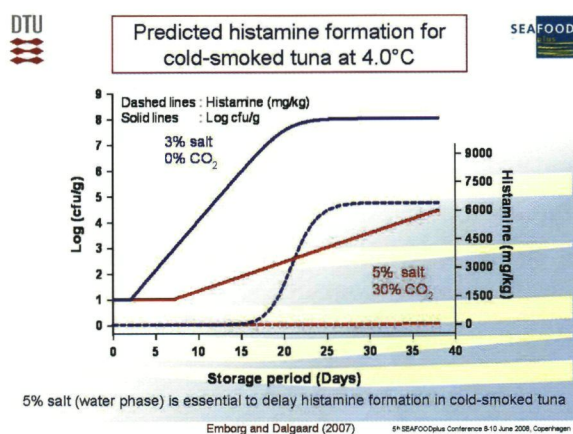
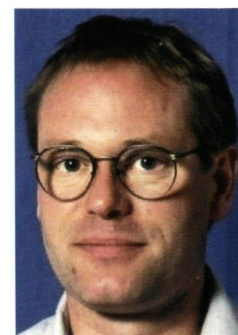
*Vibrio parahaemolyticus* is a common marine bacterium found in tropical and warmer temperate seas. Consumption of seafood contaminated with *V. parahaemolyticus* can lead to acute gastro-enteritis. Disease is caused by a minority strains that produce thermostable direct or direct related haemolysins. In the U.S. around 3,000 pa are recorded and in Asia, a pandemic serotype O3:K6 is responsible for around 40% of all seafood-associated illness.

Historically, in Europe, cases have been rare and usually related to travel to endemic regions. However, recently several outbreaks have been reported in Europe from indigenously produced seafood. In 2004, O3:K6, *V. parahaemolyticus*-associated gastroenteritis was reported in Spain. Investigation of the outbreak implicated the consumption of edible crabs (*Cancer pagurus*) that had originated in the U.K. Molecular characterisation of isolates collected from patients during this outbreak showed the emergence of the O3:K6 pandemic strain in Europe. Recently, this strain has been identified in the Northern Adriatic indicating that it may be becoming established in European waters. It has been speculated that this increased incidence may be associated with warmer sea temperatures attributed to climate change.

There are no pan-European requirements to monitor for *V. parahaemolyticus* either at in harvesting areas or ready-to-eat seafood, nor are there formal epidemiological surveillance systems. The absence of EU-wide legislative controls is largely due to the widely acknowledged lack suitable methods that allow differentiation of the pathogenic strains of the bacterium from those that are not considered a human health risk. This however, has not prevented several European countries introducing unilateral controls for imported products. In such cases the use of inappropriate test methods can potentially lead to a significant number of border rejections of imported seafood that may not constitute a public health risk. Consequently, the main aim of the SEABAC project was to establish suitable methods based upon novel molecular technologies that will enable the prevalence of pathogenic strains in European seafood to be established and as a result the real risk to seafoods consumers to be estimated.

## Histamine fish poisoning – new controls for a common seafood safety issue

Presenting author: Paw Dalgaard, co-author: Jette Emborg  
 National Institute of Aquatic Resource (DTU Aqua), Technical  
 University of Denmark (DTU)



The overall objective of the BIOCUM project was to reduce the occurrence of histamine fish poisoning. The project was the first of the SEAFOODplus projects to be completed.

The BIOCUM project documented the occurrence of histamine fish poisoning, determined the relative importance of histamine and other biogenic amines with respect to this intoxication and identified psychrotolerant (*Morganella psychrotolerans* and *Photobacterium phosphoreum*) and mesophilic (*Morganella morganii*) bacteria responsible for the formation of toxic concentrations of histamine in seafood that actually caused histamine fish poisoning. Importantly, BIOCUM determined the effect of storage conditions, including temperature (0-20°C), atmosphere and product characteristics (salt and pH) on histamine formation and developed a mathematical model to predict histamine formation in seafood depending on these parameters and the initial concentration of *Morganella psychrotolerans*. The developed predictive model can be used to determine combinations of conditions required to prevent toxic histamine formation in seafood within a given shelf-life. This is an important new approach to control histamine formation. Added salt and modified atmosphere packaging are e.g. important to control histamine formation in chilled cold-smoked tuna (left graphic above). Delayed chilling of fish after catch is a major problem in some fisheries and the new model can predict a safe shelf-life when delayed chilling occurs. A predicted time to toxic histamine formation (500 ppm) is for example reduced from ~18 days at 2°C to ~8 days with 24 h at 20°C prior to storage at 2°C (right graphic above).

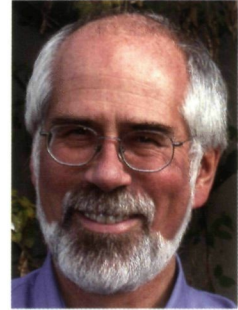
We have recently developed a new mathematical model to predict the effect of temperature (7-37°C) on growth and histamine formation by the mesophilic and strongly histamine producing bacterium *Morganella morganii*. This new model can be used together with the *Morganella psychrotolerans*-model from BIOCUM to predict histamine formation within the entire temperature range from 0°C to 37°C including both storage in ice and delayed icing of tropical fish. Predictions show that *Morganella psychrotolerans* is most important for histamine formation below ~15°C whereas *Morganella morganii* is most important above ~15°C.

Information from BIOCUM can be used together with new data, from an ongoing national research project, to control and understand histamine formation in seafood. In addition, a recently, initiated research project "Detection of strongly histamine producing and psychrotolerant bacteria in seafood" will be presented to demonstrate how results from BIOCUM is linked to future research.

The BIOCUM project has provided an important step ahead in our understanding of the factors that lead to toxic concentrations of histamine in seafood.

## How can the shellfish industry and consumers benefit from results obtained in SEAFOODplus?

Doug McLeod  
*Association of Scottish Shellfish Growers, UK*



### Risk management



- **Sampling on regular/infrequent basis is irrelevant for protection of consumer health**
- **Required to be :**
  - **continuous (Impractical); or**
  - **event related (rainfall, local outbreak of illness, agricultural activity upstream)**
- **Should be more comprehensive and risk assessment based**
  - **Output : proactive advice to growers**

5<sup>th</sup> SEAFOODplus Conference 8-10 June 2008, Copenhagen

### Improve sewage treatment plant efficiency



- **Policy must be to continue to expand capacity to reflect population increase**
- **Ensure tertiary treatment on all new plants**
- **Such efforts will reduce the impact of discharges on shellfish waters**
- **It can work!!**

5<sup>th</sup> SEAFOODplus Conference 8-10 June 2008, Copenhagen

The presentation will discuss the author's perception of industry and consumer views of scientific methods as applied to shellfish for the objective of protecting human health.

The technological and scientific contributions made by the SEAFOODplus project in the area of shellfish safety represent significant advances in this area. The development standardised methods for virus detection in shellfish is important and a prerequisite for their use to aid the control of virus risks in shellfish. Likewise the improved understanding of viral contamination in shellfish gained through the REDRISK project and recognition of potential control points is to be welcomed. These if applied appropriately could make significant improvements to the safety of European shellfish.

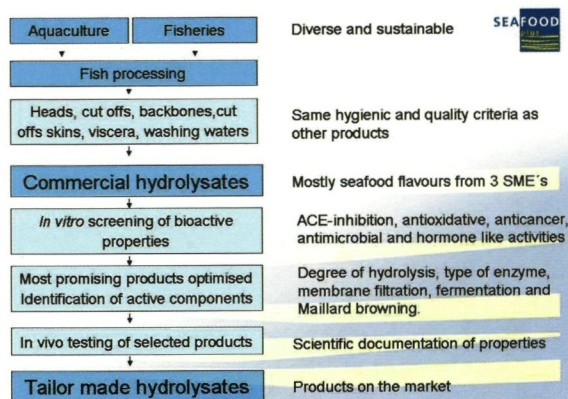
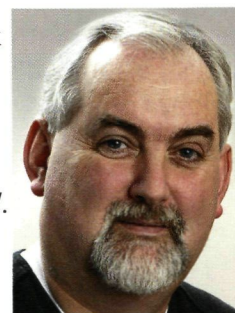
However it recognised by scientist and industry alike that there is still significant doubt over the health risk associated with low-level PCR virus positive shellfish. It is apparent that with the recent significant scientific and technical advances that have been made it is now appropriate that a wider debate on the correct use of controls to reduce the virus risk in shellfish should commence. It is critical that this debate includes the relevant stakeholders including regulators, consumers, scientists and of course industry. There are significant concerns from the sector professionals over the regulatory assessment of microbiological contamination and these will be raised.

The contribution of SEAFOODplus to developing pragmatic scientific methods and approaches will be assessed. The presentation will focus on the REDRISK project and Real Time PCR techniques, reviewing the appropriateness of these approaches to public health management in the realm of shellfish Industry concerns about the scientific focus on monitoring methodology as opposed to protection of public health through reduction in contamination of shellfish growing waters will be highlighted. The concept of the potential for inappropriate application by regulators of advances in science that result in a higher degree of constraint on the industry while failing to achieve significant progress in protecting public health will be raised. Finally, the general issue of the use of inadequate and inappropriate indicators for shellfish from remote rural coastal production areas will be examined.

## Tasty and healthy peptides from producers to consumers

Presenting author: Gudjon Thorkelsson<sup>(1)</sup>. Co-authors: Fabienne Guerard<sup>(2)</sup>, Patrick Bourseau<sup>(3)</sup>, Martine Fouchereau-Peron<sup>(4)</sup>, Rozenn Ravallec-Ple<sup>(5)</sup>, Laurent Picot<sup>(6)</sup>, Jean Pascal Berge<sup>(7)</sup>, Charles Delannoy<sup>(8)</sup>, Greta Jakobsen<sup>(9)</sup>, Irineu Batista<sup>(10)</sup>.

<sup>(1)</sup> Matis ohf, Iceland, <sup>(2)</sup> UWB, France, <sup>(3)</sup> USB, France, <sup>(4)</sup> MNHN, France, <sup>(5)</sup> ProBioGEM, Polytech', France, <sup>(6)</sup> Université de La Rochelle, France, <sup>(7)</sup> Ifremer, France, <sup>(8)</sup> Copalis, France, <sup>(9)</sup> Marinova, Denmark, <sup>(10)</sup> Ipimar, Portugal.



### ACE inhibitory effects of commercial fish protein hydrolysates

• Sample	• ACE IC50 (µg. mL-1)*
– Captopril	– 4.78.10-3
– Cod	– 75
– Plaice	– 4
– Saithe	– 200
– Salmon	– 220
– Portuguese dogfish	– 260

\* IC50 corresponds to the hydrolysate concentration (µg. mL-1) inhibiting 50% of ACE activity

The main objective of the PROPEPHEALTH project is to screen and recover new health beneficial peptides, document their health effects and to use them in tailor made products accepted by consumers. The project is lead by Matis in Iceland and other partners are from France (Université de Bretagne Occidentale, Université de Bretagne Sud, Université de Nantes, MNHN, ProBioGEM Polytech' Lille, Université de La Rochelle, Ifremer and Copalis), Denmark (Marinova) and Portugal (Ipimar).

Commercial protein hydrolysates of fish from various sources from the companies Copalis (France), Marinova (Denmark) and Primex (Iceland), have been successfully screened for various bioactive properties.

Samples of FPH were screened for angiotensin I-converting enzyme (ACE) inhibitory effects (antihypertensive effects) using *in vitro* tests. Most of them exhibited a moderate ACE inhibitory activities. The highest activity was measured for plaice hydrolysate. These results agree with previous data that fish protein hydrolysates are a good source of peptides, exerting moderate inhibitory activity on ACE.

Antioxidant activities were demonstrated in many of the fish protein hydrolysates. More active fractions of saithe could be isolated using ultrafiltration and nanofiltration. There was a linear relationship between degree of hydrolysis and antioxidative activity. It was possible to adapt laboratory results to industrial processes on basis of size exclusion chromatographic patterns. Non enzymatic browning of FPH using reducing sugars improved antioxidative properties.

The FPH were also analyzed for hormone (Gastrin, cholecystokinin (CCK) and calcitonin gene-related peptide) like activities. The highest activities were detected in Portuguese dogfish hydrolysate but activities were also detected in other samples. Fermentation of fish protein hydrolysates increased gastrin/CCK activities. Results of *in vivo* studies on satiety effects of FPH show that fermented saithe protein hydrolysates reduce food intake, body weight, glychemic index and insulin level and increase levels of CCK.

The prospects for using fish powder as food ingredient depend on whether it is possible to stabilize the residual lipids by suitable processing techniques. Measures must be taken to prevent oxidation during all processing steps including reducing access to prooxidants and oxygen, preserving endogenous antioxidants in the raw material by mild processing techniques and using added antioxidants.

The SMEs now have processes that have been developed for producing fractionated fish protein hydrolysates with tailor made properties. Some of the active ingredients have been partially identified. Scientific knowledge has been generated about the influence of the source of the raw material and process parameters on the bioactive properties of fish protein hydrolysates.

## Breakthrough in mild technologies for preservation of convenient seafood: from laboratory to industrial application

Presenting author : Françoise Leroi <sup>(1)</sup> co-authors: Inigo Martínez de Marañón <sup>(2)</sup>, Hélène Lauzon <sup>(3)</sup>, Marie-France Pilet <sup>(4)</sup> and Taran Skjerdal <sup>(5)</sup>

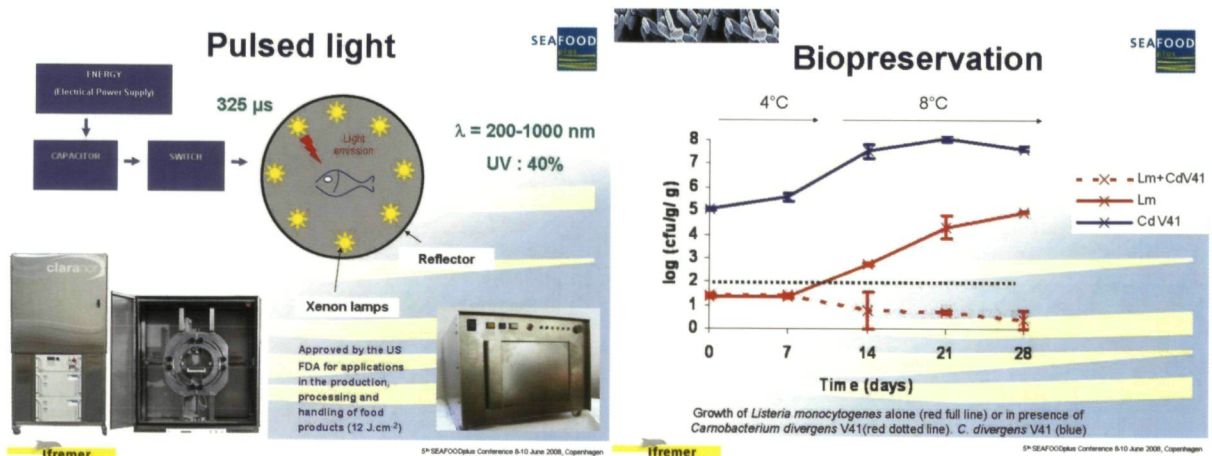
<sup>(1)</sup> Dept de Sciences et Techniques Alimentaires Marines, Ifremer, France

<sup>(2)</sup> AZTI-Tecnalia, Spain

<sup>(3)</sup> MATIS, Iceland

<sup>(4)</sup> ENITIAA, France

<sup>(5)</sup> National Veterinary Institute, Norway



Convenient seafood products such as cold-smoked fish, carpaccio, desalted cod... are highly perishable due to possible growth of pathogenic bacteria (mostly *Listeria monocytogenes*) and spoiling microorganisms. To improve quality and safety, two strategies are developed within the frame of the HURDLETECH project. The first one consists in reducing the initial bacterial count using a mild decontamination technology that does not change the nutritional and sensory characteristics: pulsed light (PL). PL is a non-thermal process that involves the use of intense and short duration pulses (300 μs) of broadband white light. Process parameters have been optimised and depend on pulse energy, distance and position of the lamps, number of pulse etc. On surface model medium or in clear liquid, one flash of 0.7 J/cm<sup>2</sup> destroys 10<sup>8</sup> cfu/g, *L. innocua* being the most resistant bacteria among a wide collection of pathogenic or spoiling marine bacteria tested. In convenient seafood products, the effect is less important and is matrix dependent (1 log for cold-smoked salmon and desalted cod, 2.5 log for surimi) but doesn't depend on the bacterial concentration. The remaining bacteria are still able to grow during storage of the product. However, the initial contamination level in commercial products is low and this decontamination rate is sufficient to significantly delay the time for *L. monocytogenes* to reach the European limit of 100/g. No adverse effect on sensory parameters or lipid oxidation has been observed. A demonstration project involving seafood producers and PL designers is currently running. In case some bacteria still survive, the second strategy consists in limiting their growth during storage. Biopreservation is a new natural technology that consists in inoculating food products with bacteria selected for their antimicrobial properties against undesirable microorganisms without presenting themselves spoiling capacities. Lactic acid bacteria are good candidates since they have a wide range of antibacterial properties (acidification, H<sub>2</sub>O<sub>2</sub> production, bacteriocin, nutrient depletion...), the GRAS status and benefit from the healthy image of dairy products. A strain of *Carnobacterium divergens* has been isolated from salmon and is active against a wide collection of *L. monocytogenes*. Inoculated in cold-smoked salmon at high level, it maintains the count of *L. monocytogenes* under the 100 Lm/g limit for more than 4 weeks of storage at 4 and 8°C. No acidification, TVBN and histamine production or changes in flavours, texture and colour are recorded. Production of this strain has been optimized and a molecular tracing method developed. This technology is now ready for a demonstration application. Furthermore, 4 new protective strains preventing convenient seafood products from spoilage have been selected and successfully tested in cold-smoked salmon and cooked/peeled shrimps. They belong to different genus and two strains constitute a new species. Using PL combined with biopreservation may be a new solution to extend shelf-life and comply with the EU legislation for *L. monocytogenes*.

## Oxidation and texture: from models to real seafood products

Charlotte Jacobsen<sup>(1)</sup>, Ingrid Undeland<sup>(2)</sup>, Ivar Storrø<sup>(3)</sup>, Turid Rustad<sup>(4)</sup>, Flemming Jessen<sup>(1)</sup>, Isabel Medina<sup>(5)</sup>

<sup>(1)</sup> National Institute of Aquatic Resources (DTU Aqua), Technical University of Denmark (DTU)

<sup>(2)</sup> Chalmers University of Technology, Sweden

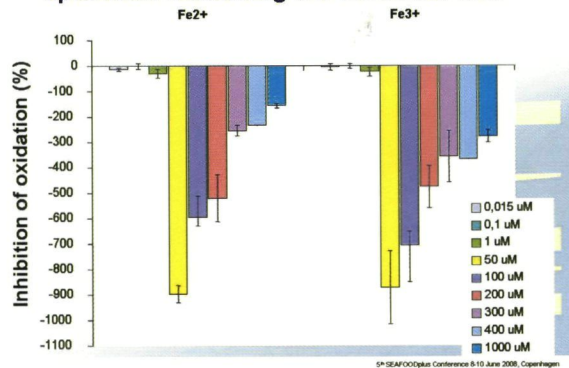
<sup>(3)</sup> SINTEF Fisheries and Aquaculture, Norway

<sup>(4)</sup> Norwegian University of Science, Norway

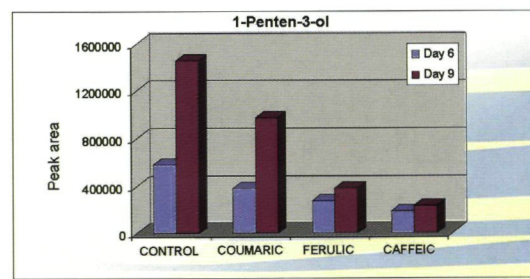
<sup>(5)</sup> Technology Consejo Superior De Investigaciones Científicas, Spain



Prooxidative effect of caffeic acid in liposomes containing low molecular iron



Antioxidative effect of natural antioxidants in chilled salmon



Caffeic acid was the most efficient antioxidant

Seafood products are healthy foods due to their high content of omega-3 lipids, antioxidants, valuable proteins and other healthy components. However, the nutritional value and sensory quality of seafood products may deteriorate during processing and storage due to oxidation processes and other *post mortem* changes in the fish muscle. The objective of the LIPIDTEXT project has been to secure and maintain high sensory quality (colour, flavour, texture parameters) and nutritional value (high level of anti-oxidants, omega-3 lipids, and low levels of potentially toxic oxidation products) of seafood based products.

To achieve this goal LIPIDTEXT has studied lipid and protein oxidation in different model systems ranging from simple oil-in-water emulsions, liposomes made with marine phospholipids, washed fish muscle, to real seafood products such as fish mince, fish fillet and omega-3 enriched fish paté.

An important aim has been to determine the effect on both protein and lipid oxidation of pro-oxidants such as copper, low molecular iron and heme iron in the different systems. Our results have shown that low molecular iron was an important oxidation catalyst in emulsions, while it seemed to play a minor role in catalysing oxidation in fish muscle systems. In contrast, heme iron was a strong oxidation catalyst in fish muscle based models. As for liposomes, oxidation could be catalysed by low molecular iron and heme iron with heme iron being a stronger catalyst than low molecular iron.

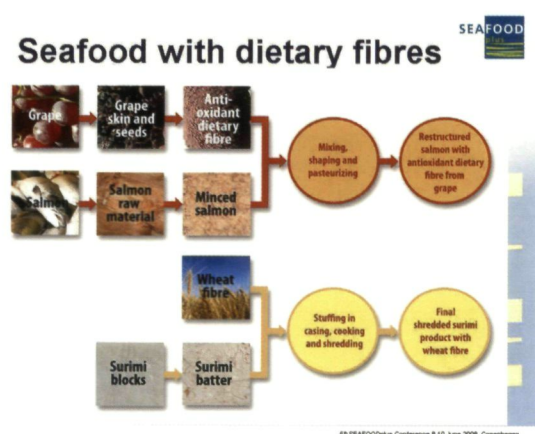
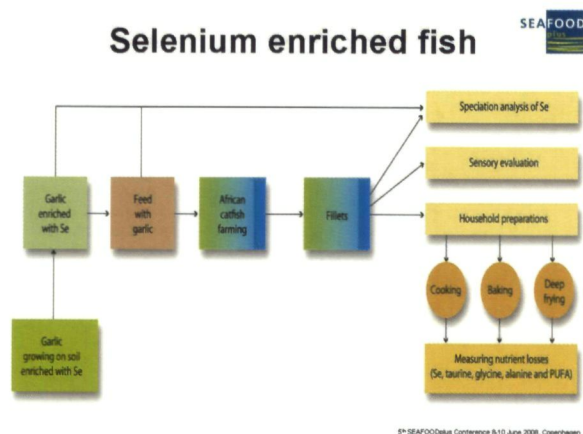
Another focus area in LIPIDTEXT has been to evaluate the effect of natural antioxidants such as caffeic acid, coumaric acid and ferulic acid on both protein and lipid oxidation. In some experiments, natural antioxidants were compared with the synthetic antioxidants EDTA or propyl gallate. Interestingly, caffeic acid was a very good inhibitor of lipid oxidation in fish muscle based systems where oxidation is catalysed by heme iron as previously mentioned. Caffeic acid's antioxidative effect was similar to that of propyl gallate in fish fillets. Caffeic acid did, however, not always inhibit protein oxidation. Caffeic acid was an efficient inhibitor of lipid oxidation in liposomes when oxidation was catalysed by heme iron, whereas it was a strong pro-oxidant when oxidation was catalysed by low molecular iron. Similarly, caffeic acid strongly promoted lipid oxidation in emulsions where low molecular iron was added as a pro-oxidant. Taken together these results suggest that the antioxidative effect of caffeic acid and other antioxidants is strongly dependant on the oxidation catalyst, i.e. on the model system and that inhibitors of lipid oxidation may not necessarily also inhibit protein oxidation.

## The roadmap to consumer driven functional seafood products: an international expedition

Presenting author: Mercedes Careche <sup>(1)</sup>, co-authors:  
CONSUMERPRODUCTS <sup>(2)</sup>

<sup>(1)</sup> *Instituto del Frío (CSIC), Spain*

<sup>(2)</sup> *See below*



The objective of the CONSUMERPRODUCTS project is to develop, in a consumer-oriented approach, innovative functional seafood products from both capture species and farmed fish, containing health-promoting compounds. Some of these compounds have been incorporated as ingredients to restructured and fillet based products, where as for others such as organo-selenium from garlic, dietary modulation of fish has been the procedure.

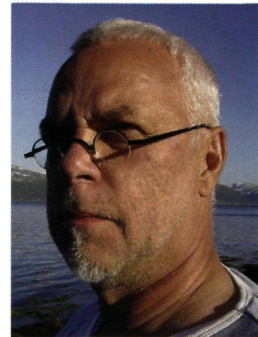
During this four and a half years expedition, a team of European scientists have been working together on this task from their different disciplines, covering areas from social sciences to product development, analytical chemistry or nutrition. At some stages, industrial partners have been taken on board, and we have also counted with the collaboration of partners from consumer science and nutrition projects within SEAFOODplus. The presentation will outline the roadmap and main achievements of this experience.

It will contain a short description of the consumer studies directed towards this development covering the whole product development process. Some consequences and interactions of these studies with other sub-tasks will be mentioned. Secondly, the main results in the block of activities directed towards the enrichment of fish in organo selenium compounds will be presented, such as the production of enriched feed, enriched fish, study of selenium species accumulated, bioaccessibility of selenium, and retention of selenium and other beneficial components upon processing or cooking. Another part of the activities focuses on the development of restructured and fillet based seafood products, including preparation of ingredients, the study of the technological feasibility of their inclusion into the products, matrix/fibre interactions, and the bioaccessibility of the matrix components. Product concepts have translated into pre-products which have been tested by consumers. Some near final products have been designed and prepared to a 'near final' stage, which could be taken up by an industry and further developed until their final form. The process is being done in an iterative mode integrating, and sometimes adapting the designed work depending on the latest results on the consumer studies.

<sup>(2)</sup> List of co-authors (key persons): J. Borderías, P. Carmona, F. Saura (CSIC); J. Luten (Nofima); A. Kole, E. Schram (IMARES); O. Scholten (PRI); R. Havenaar (TNO); R. Gormley (Teagasc); J. Oehlenschläger (Max Rubner-Institut); E. Elvevoll (UiT); M.L. Nunes (INIAP); C. Cámara (UCM); and the contribution of D. Calvo-Dopico (UC, CONSUMEREVALUATE), E. Lund (IFR, FISHGASTRO), and J. L. Hurtado (AA).

## A cocktail of science, industry and culinology: SEAFOOD products plus show

Joop Lutén  
*Nofima Marine, Norway*



### Success factors product development (Cooper 1999)



- solid up-front homework
- **dedication to consumer-voice**
- product advantage from consumer point of view
- sharp, stable and early product definition,
- high quality launch strategy
- a well executed stage gate process
- **accountable cross functional teams**
- an international orientation

### Expertises in SEAFOODplus product development area



- Consumer science
- Sensory science
- Seafood product quality
- Seafood technology
- Culinology
- Nutrition
- Industrial experience

Various activities in the RTD pillar 4 in SEAFOODplus 'Seafood from source to consumer product' has led to new concepts for seafood products using integrated approaches to reach the targets. The possibilities for restructured fish products enriched with fibre have been mapped and investigated in cooperation between seafood technologists and a SME associated to SEAFOODplus.

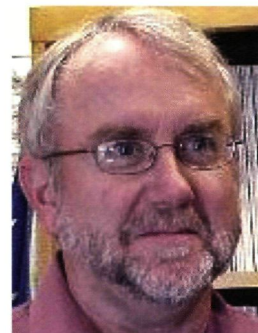
A consumer oriented approach has been followed applied to identify potential consumer segments for new seafood products. The winning idea from a seafood design competition is further developed to a seafood concept for the identified consumer segments according the stage gate principle by a multidisciplinary team (technology, consumer science, sensory science, culinology etc ).

This Stage gate team goes through the different stages of product development consisting of a set of activities (pre-determined, parallel, cross functional). Each stage is followed by a gate where a decision is made to go to the next stage or not.

The learning experiences in both processes will be shared with the audience during an interactive performance of some of the key players involved.

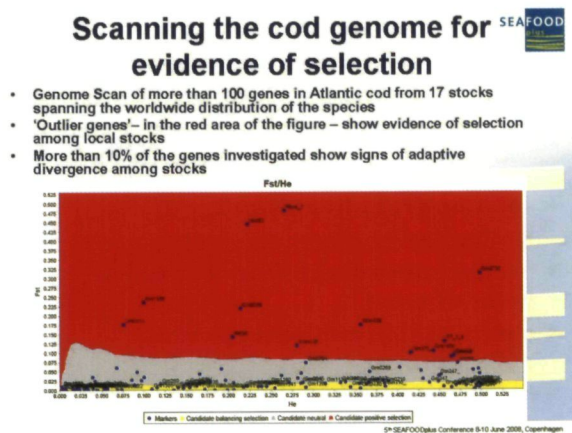
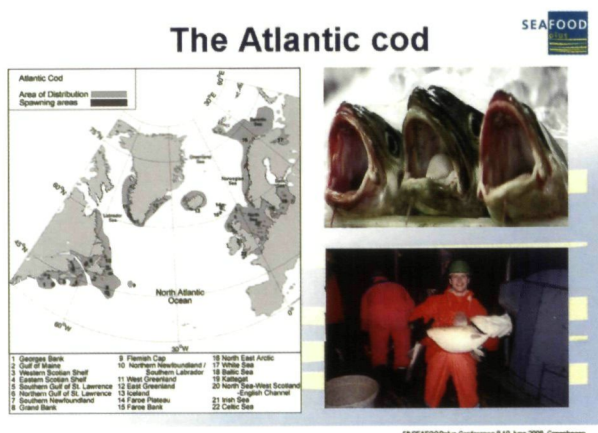
Mike Morrissey, Oregon State University, USA, and SEAFOODplus External Advisor Board member for the RTD Pillar 4 will be your guide in this show.

He will interview a seafood product developer, a consumer scientist, an industrial partner of health beneficial seafood components and a chef.



## Sequencing the fish genome for quality – the new success story of cod

Presenting author: Einar Eg Nielsen, co-author: Jakob Hemmer-Hansen  
 National Institute for Aquatic Resources (DTU Aqua), Technical University of Denmark (DTU)



The Atlantic cod is by many considered 'the new salmon' in aquaculture. A lot of effort in many countries is currently aimed at producing market size cod of good quality for human consumption. To improve production traits and quality, breeding programmes have been established. However, relatively little emphasis is given to the origin of fish for the initial establishment of 'broodstocks'. This is despite the fact that the Atlantic cod is known to be separated into a number of genetically isolated wild stocks, which displays trait differences shaped by their genetic adaptation to the local environment (e.g. temperature and salinity). Accordingly, different stocks can potentially possess different traits beneficial for aquaculture.

Investigating trait differences among fish from numerous stocks simultaneously under controlled environmental conditions is, however, a formidable task. Alternatively, a 'genome scan' is a newly developed and fast method for generating insights into genetically based adaptive trait variation among stocks. Here a high number of genes are screened to identify those displaying divergent patterns of variation in different stocks, thus likely reflecting differences in adaptive traits.

Within the project BIOQUAL we investigated genetic variation among wild cod from more than 15 cod stocks spanning the worldwide distribution of the species. We studied variation in more than 100 genes of which many were candidate genes for 'quality', both in a narrow and a broad sense, i.e. in genes directly linked to flesh quality but also genes important for the well being and productivity of the fish.

We found a surprisingly high number of genes with divergent patterns of variation among populations, likely to reflect adaptive trait variation. Accordingly, broodstock selection from a single stock is highly unlikely to be representative of the trait variation desired in aquaculture. Furthermore, different broodstocks particularly suited for specific environmental conditions could be selected. Finally, the candidate genes identified here can form the foundation for selection programmes targeting specific traits of interest to ensure improved future quality of farmed cod.

## Improving the ethical quality traits of farmed fish - identifying optimal husbandry and pre-slaughter conditions

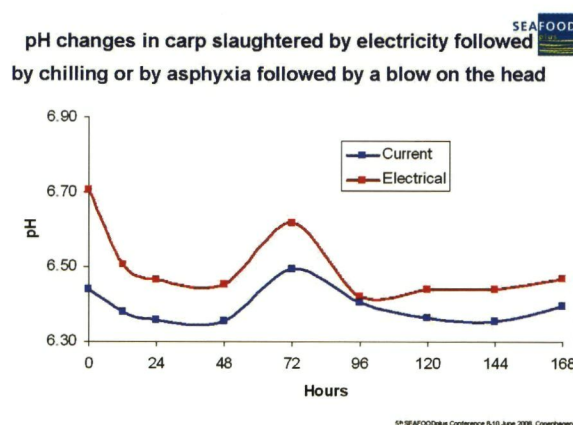
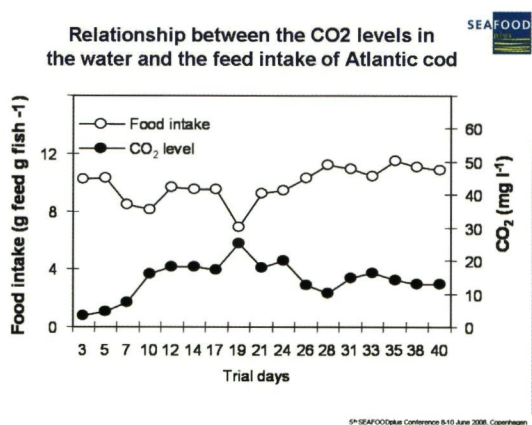
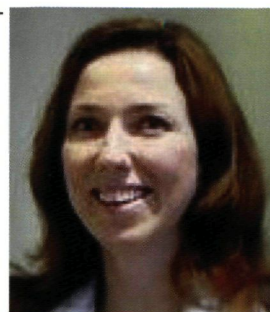
Presenting author: Hilde Toften<sup>1</sup>; Co-author's: Børge Damsgård<sup>1</sup>, Øyvind Aas-Hansen<sup>1</sup>, Linda Hansen<sup>1</sup>, Hans van de Vis<sup>2</sup>, Maciej Pilarczyk<sup>3</sup>, Bert Lambooij<sup>4</sup>

<sup>1</sup> Nofima, Norway

<sup>2</sup> IMARES, The Netherlands

<sup>3</sup> Institute of Ichthyobiology and Aquaculture, Polish Academy of Sciences

<sup>4</sup> Animal Sciences Group, Wageningen University and Research Centre, The Netherlands



Fish welfare and ethical questions about husbandry and pre-slaughter practices have been increasingly important as a quality trait of farmed fish. However, the relationships between these practices and the quality traits are poorly understood. One of the main objectives in the project ETHIQUAL in SEAFOODplus has been to examine how husbandry practices and pre-slaughter conditions contribute to the flesh quality and ethical quality of finfish seafood. The goal has been to find a good balance between the current trend towards intensive rearing and the increasing consumer demand for healthy, high quality seafood, produced in an ethical sustainable way.

In this presentation, we are going to show some examples of husbandry practices that potentially can compromise the welfare and influence the flesh and ethical quality of farmed fish by using data collected under the SEAFOODplus programme. We will focus on intensive rearing conditions and poor water quality in production of Atlantic cod (*Gadus mohua*) and pre-slaughtering conditions and slaughter methods for turbot (*Psetta maxima*) and carp (*Cyprinus carpio*).

The cod studies revealed a poorer welfare in groups kept in water qualities associated with intensive rearing conditions such as sub-optimal carbon dioxide and oxygen levels. Indications of reduced welfare status were for example higher mortalities, impaired feed intake and growth, and higher incidences of nephrocalcinosis, haemorrhages, gas bubbles and fin damages.

The slaughtering studies with turbot showed that the current industrial method (transport followed by live chilling) does not affect the freshness of the product, compared to an experimental method (instantaneous electrical stunning applied directly to turbot in a holding tank followed by chilling). Visual inspection also revealed no product differences between the two methods. Electrical stunning did not result in carcass downgrading, and this implies that electrical stunning is an applicable method for farmed turbot.

In the carp study, the industrial method (asphyxia followed by a manually applied blow to the head) was compared with electrical stunning and chilling. Based on analysis of EEGs, behavioural observations, and colour and pH of fillets, electrical stunning and chilling was evaluated to be the most "humane" slaughter method of the two. Analysis of product quality parameters revealed that the flesh of carps killed by the experimental method had significantly higher pH values during the entire storage period, compared to the batch slaughtered by the industrial method. Contrary to our expectations, the experimental slaughter method did not result in a persistently lower lightness and increased redness of the fillets.

## Linking consumer demands for environmentally friendly farming with a biological basis of ethical quality

Presenting author: Felicity Huntingford<sup>(1)</sup>, co-authors: Marie-Laure Bégout<sup>(2)</sup>, Sandie Millot<sup>(2)</sup>, Sunil Kadri<sup>(1)</sup>, Maciek Pilarczyk<sup>(3)</sup>, Simon MacKenzie<sup>(4)</sup>

<sup>(1)</sup> DEEB, FBS, University of Glasgow, UK

<sup>(2)</sup> IFREMER, France

<sup>(3)</sup> Polish Academy of Sciences, Poland

<sup>(4)</sup> Facultat de Biociències Universitat Autònoma de Barcelona, Spain

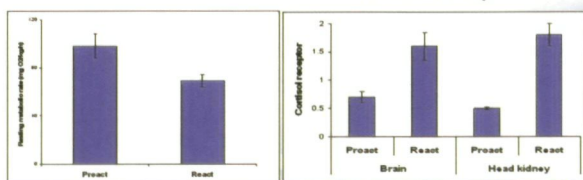


### Coping strategies in carp



Variable metabolic physiology measured for proactive and reactive carp

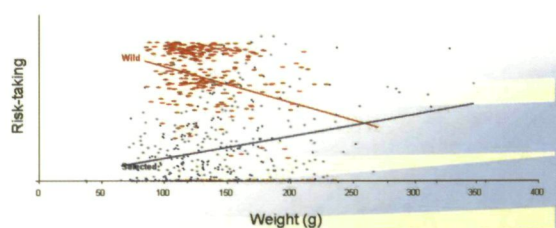
Variable gene expression measured for proactive and reactive carp in brain and kidney



Distinct patterns of response to environmental challenge

SEAFOODplus Conference 8-10 June 2008, Copenhagen

### Coping strategy and performance in seabass



- Positive association between risk-taking phenotype and growth in seabass selected for fast growth.
- Negative association in seabass of wild origin.
- Different coping strategies flourish in different environments?

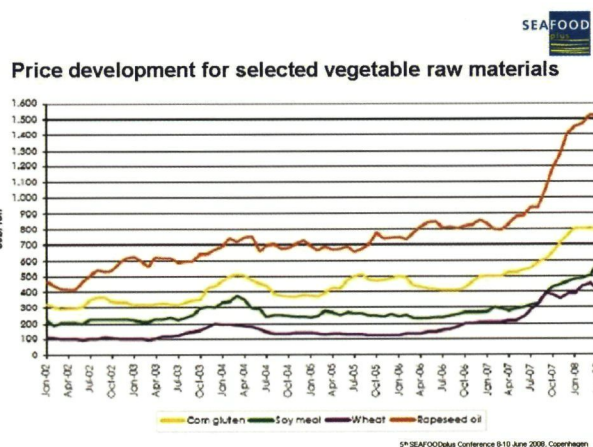
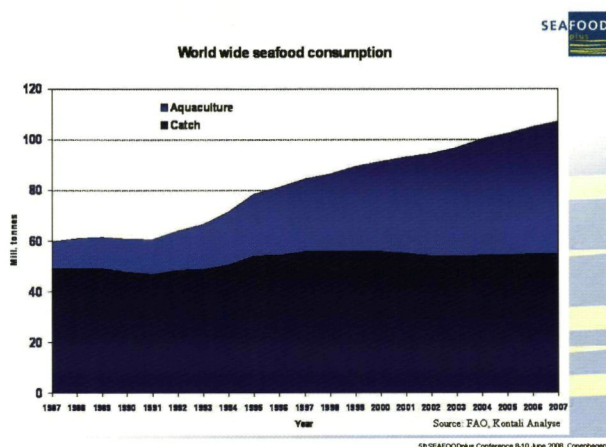
SEAFOODplus Conference 8-10 June 2008, Copenhagen

'Environmentally friendly' in its broadest sense includes the requirement for ethical quality and there is increasing public concern that farmed fish should experience good welfare. There are a number of obvious requirements for ethical quality, such as the availability of suitable food and sufficient space, that are dependent on species and life history stage. However, within a species and life history stage, all animals are not interchangeable in terms of their requirements for ethical quality, reflecting the existence of striking and consistent differences in how individuals respond to challenge ('coping strategies'). Typically, *proactive* individuals show an active, adrenaline-based response to challenge, take risk in the face of potential danger and have a high resting metabolic rate. In contrast, *reactive* individuals show a passive, cortisol-based response to challenge, avoid risk and have a low resting metabolic rate. Different coping strategies exist and persist in nature because individual showing them do well under different selection regimes, with proactive individual flourishing when resources are abundant and predictable and reactive individuals doing well when resources are sparse and unpredictable. Such a spectrum of behavioural and physiological variation has been reported for many vertebrate groups, including fish.

In this talk, we will characterise different coping strategies using data from common carp collected in the ETHIQUAL project in SEAFOODplus. These data range in level from behaviour, through metabolic physiology and endocrinology to gene expression in the brain. Proactive and reactive carp show different patterns of growth when exposed to typical husbandry stressors. The effects of inadvertent domestication or selection can illuminate the evolutionary biology of coping strategies. The competitive environment is very different in intensive husbandry conditions and in the wild and the former is likely to favour proactive animals and the latter, reactive ones. Data on seabass collected in the ETHIQUAL project demonstrate striking variability in risk-taking (predictive of coping strategy) among both wild fish and fish from a strain selected for fast growth. Interestingly, the association between risk-taking and size is diametrically opposite in the two stocks, with a negative relationship in wild fish and a positive relationship in the selected strain. This result indicates that the circumstances that favour fast growth (a component of production and welfare in aquaculture) depend on the coping strategy of the fish concerned, probably as the combined result of context-dependent differences in the ability to acquire food and of different patterns of energy utilisation. The message that, within a species, some individuals have been 'designed' by natural selection to flourish in circumstances somewhat similar to those found on well-run, productive fish farms could be important for public perception of the welfare of farmed fish.

## The future of fish farming as seen by a SEAFOODplus partner in the feed industry

Niels Alsted  
Biomar A/S, Denmark



The future of farming is bright.

Fish farming is the only way to fulfil the continuously increasing demand of fish for human consumption world wide.

Wild stocks are exploited and in several case overexploited and will not be able to fulfil future demand for seafood.

The future of fish farming depends on several factors. Important basic elements are available sites and suitable water resources (fresh, brackish or sea water), healthy fish, available feed (ingredients) and consumer acceptance.

Diet formulation is based upon several criteria's: (1) Nutritional requirement for each species, (2) technical criteria for production, (3) handling (transport, storing etc) and (4) available raw material.


The recent huge fluctuations in raw material prices have increased the demand for technical and nutritional knowledge in order to have a flexible formulation based upon low cost formulation. Technical knowledge includes knowledge about food safety issues, palatability, process ability, anti nutritional factors. In addition to these factors sustainability of raw materials, social responsibility, and CO2 emission are factors which will affect the future of fish farming.

SEAFOODplus has been a very valuable contributor in order to establish knowledge within several of these areas. Within the BIOQUAL project, BioMar have specifically gained new knowledge regarding the importance of water soluble marine proteins in diets for trout and salmon. Based on these studies BioMar continued the investigations and will be able to utilise this commercially.

## The basis for data sharing in traceability – Good Traceability Practice

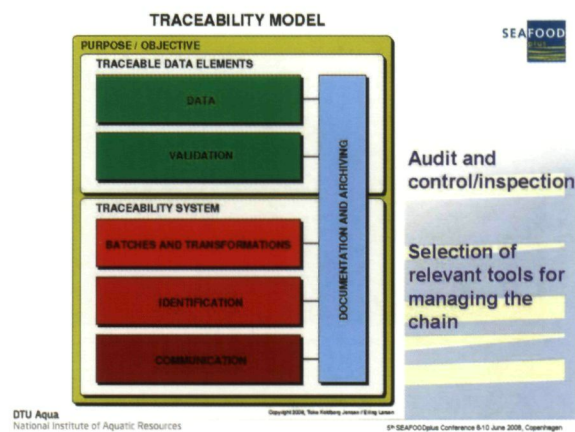
Presenting author: Erling P. Larsen, co-author: Toke Koldborg Jensen  
National Institute of Aquatic Resources (DTU Aqua), Technical University of Denmark (DTU)



**Seafood chains analysed -**   
the basis for METHOD's Traceability Model

- **Aquaculture**
  - Salmonides: The chain of Atlantic salmon from Norway to Spain
  - Other aquaculture species: Wild caught tunas, kept in cages until reaching marked size
- **Wild caught fish**
  - Pelagic fish species: Tunas, anchovies and herring, deepwater prawn
  - Demersal fish species – European and imported: Merlucciidae – the hake family

DTU Aqua National Institute of Aquatic Resources 5<sup>th</sup> SEAFOODplus Conference 8-10 June 2008, Copenhagen



The SEAFOODplus project METHODS has focused on the necessary further development of methodologies for improving traceability in the seafood sector. The main achievements fall in the following categories:

- Vocabulary
- GIS server / MapService
- Literature study
- Development of guidelines for good traceability practice

**Vocabulary.** The basis for all communication is a common language that can be used in an easy and unambiguous way. In METHODS further development of the vocabulary that is used in the sector has been made to guarantee that e.g. the name of the fish species is correct. This work has resulted in a comprehensive vocabulary which has been implemented in a number of data files. These files are of great value for software developers when designing traceability software for the seafood industry. The METHOD project has continuously looked for other data element developed in the SEAFOODplus projects to define these elements and implement them in the vocabulary.

**GIS server/MapService.** Data files, however important they are for establishing common standards, are not suited for presentation of traceable information to end users. There is a need for a graphic interface. The MapService has been developed in METHODS in order to translate nautical positions given as data coordinates to easily understandable maps.

**Literature study.** A literature study of traceability is combined with the experience achieved today in the fish sector and a comparison with the development in other branches has been carried out. This study has been serving as reference list in several chapters in books and for making reports and submitted scientific papers. The amount of literature on traceability is not big, but it is an important task to collect all the relevant results.

**Development of guidelines for good traceability practice.** The main result of METHODS is to use all the gathered information and research results in the development of guidelines for good traceability practice. This work builds on analysis of basic traceability aspects, as well as analyses of various real-world chains from the seafood industry in Europe (slide 1). A part of the work has resulted in the development of a new generic traceability model which identifies different aspects of traceability. These aspects are: purpose, data, validation, batch handling and transformations, identification, communication, and documentation and archiving. By using the model, we are able to identify the general traceability requirements, as well as sector specific requirements and implementation details (slide 2).

## The gateway for future data collection in traceability – RFID tags and temperature measuring solutions

Presenting author: Jostein Storøy, co-authors: Gunnar Senneset, Eskil Forås  
SINTEF Fisheries and Aquaculture, Norway



### Tags on steel containers and in Styrofoam boxes



### Experiences from testing of electronic data capture technology

- Standards for has been established for exchange of ID numbers
- Standards for exchange of memory information (temperature records) is being established
- Only a few RFID suppliers use these standards
- Readability rates has become more stable (98-100%)
- Readability range has increased (documented  $\leq 20m$ )
- Battery capacity is good (3-5 years)
- Prices are still high on active tags (ca 100 € or more)

SEAFOODplus is a large EU integrated research project, with the overall objective defined as:

*To reduce health problems and to increase well-being among European consumers by applying the benefits obtained through consumption of health promoting and safe seafood products of high eating quality.*

This includes integrating the information flow from primary producer to the other links in the chain by using new technologies regarding global batch identification, data capture, storage and transmission. Among the research partners in this task are SINTEF, DTU Aqua, NOFIMA and AZTI. An increasing number of implementations of RFID technology show that companies from various industries see the possibilities for improving business processes. At the same time technology for RF based sensors, sensor networks, advanced multi-modal sensing and real-time location systems (RTLS) is evolving rapidly.

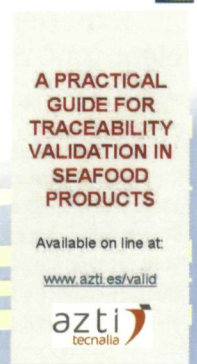
Together with the Norwegian Innova RFID project, and othert national projects, we have testes various solutions for automatic data capture technology during the last 4.5 years, and our research has contributed to ease the implementation of new tehcnical solutions in the industry. Tests have been carried out with multiple RFID technology systems in various environments:

- Active and passive RFID technology
- Meat and fish products
- Fresh and frozen products
- Different load carriers (steel, plastic, Styrofoam, etc.)
- Stationary and mowing load carriers
- RF based temperature sensors

In the beginning of the project read rates for available RFID tags were poor. However, in the last 2 years technology has improved a lot and read rates are now close to 100%. In addition; both readability range and batery capacity has improved. Hence applicability for such equipment have increased a lot lately. This presentation shows results from technical tests carried out by the involved institutes, together with an overview of current technology status and applications. RFID technology is still developing and there are unsolved technical challenges related to the use of RFID tags in the fisheries sector. Finally, we will give some recommendations for good data capture practice in the fishery sector.

## Validation tools for traceability – ensuring quality and safety and preventing fraud in the seafood chain

Presenting autor: Begoña Pérez-Villarreal, co-authors: Miguel Angel Pardo, Ibán Sagardia, Borja Alberdi, Carlos Bald  
AZTI-Tecnalia, Spain



azti tecnalia

Validation of fish species identification based on DNA methodologies

SEAFOOD

### Sequencing (FINS) as Gold Standard Validation method

- The most robust technique
- Reference materials are needed:

**Tool DNA database**

- 53 species & 727 sequences to compare results
- Dynamic & public system: [www.azti.es/dna\\_database](http://www.azti.es/dna_database)

**Tool Plasmidic standards**

- Certified DNA standards to standardise and calibrate
- Applied for patent: PCT No. ES2007/000777

The general objective of the project VALID is to define a validation model for obtaining seafood traceability along the whole chain that could be considered as a guide and reference by all the agents involved in the fishery chain as well as by the control authorities. Several traceability tools have been developed to attain this objective:

### A Practical Guide for the Validation of Traceability in the Seafood Chain:

A guide specifically directed for the seafood sector has been published as a web page (<http://www.azti.es/valid/>). The guide contains the map of indicators of efficiency and reliability of the traceable information for each link of the fishery chain. It gives references to the official methods when approved and to the alternative methods when available. The guide presents a summary for each of the validation tools that have been studied within the VALID project. The summary discusses the state of the art for each methodology and gives some interesting information about the existing reference methods and other techniques at developmental stage as well as links of interest to get further information or for assessment. The final aim of the guide is to allow verifying that all the critical information is tracked and the reliability of this information validated, becoming a tool for the traceability validation in a specific link on the chain or for the whole chain.

### Validation of fish identification methodologies based on DNA analysis:

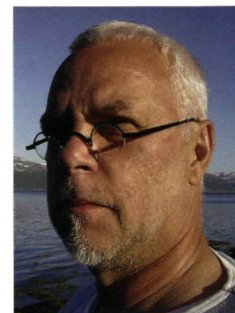
In order to assure authentication methodologies and specifically DNA based techniques, quantifiable reference materials as validation tools in the form of plasmids have been developed. A pool of **plasmidic standards** have been prepared to be used as reference materials by specialised laboratories and fraud agencies in their DNA techniques for fish authentication. This development has been submitted for a patent application. An Interlaboratory Ring Test has been organised involving 12 research centres and institutions having genetic fish identification services offering authentication analysis to fish industry. At the same time, a **dynamic DNA database** including more than 700 DNA sequences from 53 commercial fish species has been made accessible free by internet [http://www.azti.es/DNA\\_database/](http://www.azti.es/DNA_database/).

### Validation of 2 complete seafood commercialisation chains:

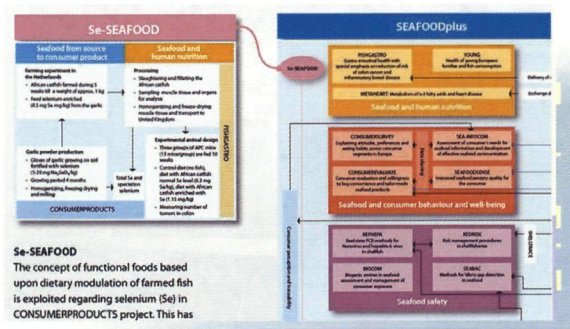
A practical exercise on real commercial chains has taken place, in order to validate quality specifications, preventing fraud and ensuring correct data management and information flow. South African hake and Pacific tuna imported to Europe have been the chosen chains. A cooperation with another EU project has taken place in the trails by incorporating innovative flexible tag datalogger with integrated sensors developed in the IP-GOODFOOD.

## Integration, training and dissemination within SEAFOODplus

Joop Lutén  
Nofima Marine, Norway



### Integration within SEAFOODplus



### SEAFOODplus participates in dissemination network for FP6 food projects



The objective of SEAFOODplus is to make it possible to reduce health problems, to prevent major diseases and to increase well-being among European consumers by using the opportunity to apply the benefits obtained through consumption of health promoting and safe seafood products of high eating quality.

In order to address this objective six research areas are addressed each with its specific R&D projects: (1) Seafood and human nutrition, (2) Seafood and consumer behaviour and well-being, (3) Seafood safety, (4) Seafood from source to consumer product, (5) Seafood from aquaculture and (6) Traceability to ensure consumer confidence. One of the tasks in SEAFOODplus is to stimulate integration of R&D activities between projects of the different areas.

As part of the **training** programme about 50 scientists have participated in exchange visits between project partners in the same project, between different projects in the same R&D area and between projects in different R&D areas.

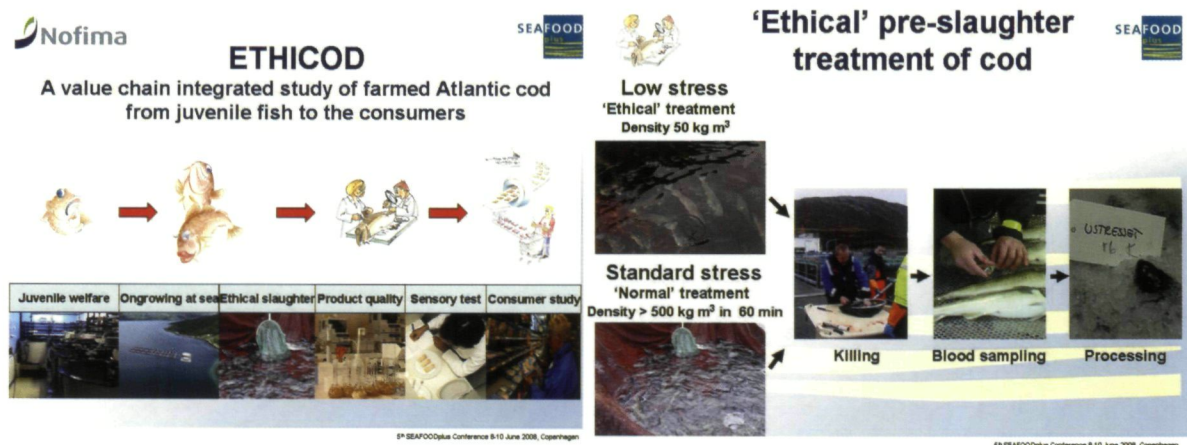
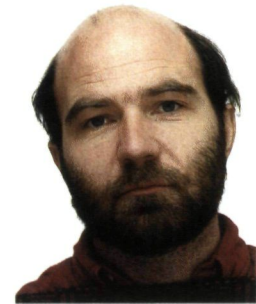
One of the important success criteria for scientific projects is the number of peer-reviewed **scientific publications**. In the period 2005-2007 the total number of registered scientific publication is 75. Other dissemination activities include articles in media, internet communication and participation in the network **COMMNET** for FP6 food projects. Four PhD students have defended their thesis based upon results from SEAFOODplus projects.

Three new **integrated R&D initiatives** were taken in SEAFOODplus: (1) ETHICOD, (2) Se-SEAFOOD and (3) FPH-animal. The concept and the outcome of ETHICOD will be highlighted in two other separate presentations during the final SEAFOODplus conference. The concept of functional foods based upon dietary modulation of farmed fish is exploited regarding selenium (Se) in the CONSUMERPRODUCTS project from the R&D area 'Seafood from source to consumer'. This has led to the Se-SEAFOOD experiment where African catfish is farmed using feed containing anti-carcinogenic organo-Se enriched garlic. The health beneficial properties of the Se enriched African catfish is now tested in *in-vivo* experiment carried by a partner in FISHGASTRO from the R&D area 'Seafood and human nutrition'.

The *in-vitro* testing of several fish protein hydrolysates (FPH) in PROPEPHEALTH has led to the selection of a few FPH with promising anti-hypertensive, calciotropic and secretagogues activities. Due to the flexibility of 18 months planning periods in SEAFOODplus it was possible to design two animal experiments to test the efficacy of the FPH. The design of both studies is based upon discussion between partners from the the PROPEPHEALTH project and the R&D area 'Seafood and human nutrition'. One *in vivo* study shows that FPH from saithe can reduce food intake, body weight, glychemic index and insulin level and increase levels of CCK. One *in-vivo* study about hypertensive activities from FPH is on-going.

## ETHICOD – ethical quality of farmed cod in a full value chain approach

Presenting author: Børge Damsgård, co-author: Hilde Toften, Øyvind Aas-Hansen, Kjell Midling  
Nofima Marine, Norway



The main objective of the project ETHIQUAL is to examine how husbandry practices, aquaculture systems and pre-slaughter conditions contribute to the flesh quality and ethical quality of finfish seafood.

This objective in ETHIQUAL has been met with a range of studies, including different farm species and scientific question. In addition, the ETHICOD approach aimed to integrate many of these issues into a full value chain approach in one fish species. The approach covered the biological mechanisms (RTD pillar 5), the fish quality aspects (RTD pillar 4) and the consumer perspective (RTD pillar 2). This full scale value chain experiment tracked individual tagged Atlantic cod (*Gadus morhua*) from juveniles to slaughter, and to the consumer.

In general, the relationships between 'ethical' husbandry and muscle quality are complex, and the consumer perception may be affected of both flesh quality and perceived quality traits, based upon the product information. A combined study of biological mechanisms and public perception may thus contribute to understand the relative importance of ethical traits in farmed fish.

In the biological part of ETHICOD, the first part focuses on water quality and fish density in juvenile cod production. The study revealed a poorer welfare in intensive reared groups with high densities which were not compensated with higher water flow. The reduction in welfare status led to nephrocalcinosis and 20-30% growth reduction.

The second part during the on-grow period in sea cages terminated after 1.5 years at an average fish size of 1.5 kg. The sub-optimal rearing in juveniles was not compensated and the optimal reared juveniles were 10% larger at slaughter than the more intensive groups, revealing long term effects of poor welfare status in juvenile fish.

A standard pre-slaughter protocol were compared with a more 'ethical' protocol. Compared to e.g. salmonids, the Atlantic cod were less affected by pre-slaughter treatment, and changes in e.g. plasma cortisol and lactate indicated that welfare was little affected. After slaughter, the fish was processed in a fish industrial plant, and the filets were distributed to a flesh quality study, a sensory study in a trained panel, and to an in-home consumer survey.

## Is it possible to 'sell' welfare to EU consumers?

Presenting author: Rian Schelvis<sup>(1)</sup>, co-authors: Emília Martinsdóttir<sup>(2)</sup>, Kolbrún Sveindóttir<sup>(2)</sup>, Wim Verbeke<sup>(3)</sup>, Svein Ottar Olson<sup>(4)</sup>, Pirjo Hokanen<sup>(4)</sup>, Adriaan Kole<sup>(5)</sup>

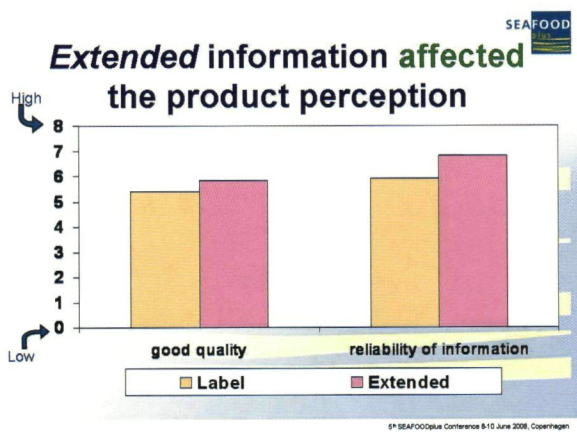
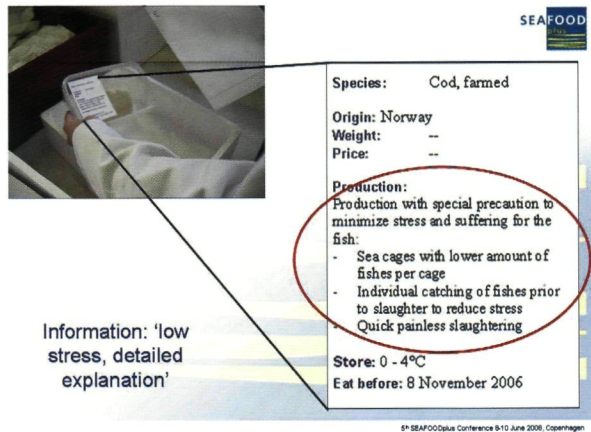
<sup>(1)</sup> Wageningen IMARES, the Netherlands

<sup>(2)</sup> MATÍS, Iceland

<sup>(3)</sup> Ghent University, Belgium

<sup>(4)</sup> Nofima, Norway

<sup>(5)</sup> Wageningen University, The Netherlands



In the ETHICOD project, we address ethical concerns, asking if good fish welfare lead to better quality of farmed fish. The project includes full scale value chain experiments with Atlantic farmed cod following the development of the fish all the way from small juveniles to slaughter and up to the consumer's fork.

The objectives of this project were:

- To measure the effect of consumers' knowledge about welfare information on the consumers' product perception.
- To measure the effect of consumers' use of and trust in welfare information on the consumers' product perception.

Results will be presented from the consumer in-home tests performed in Iceland and the Netherlands

Previously we presented the results of sensory differences between farmed cod produced following standard pre-slaughter practises versus low-stress pre-slaughter practises, the effect of ethical information and individual factors on consumer preferences for farmed cod and People's attitudes towards fish farming, farming practices and information about farming practices.

In an in-home situation  $n = 156$  subjects from Iceland and  $n = 202$  subjects from The Netherlands tested once a week the 4-6 samples with various sets of information. The consumers filled out a 'product test' questionnaire and a 'general' questionnaire.

The results show that the consumers hardly use information on welfare when they buy seafood but if they search for information about welfare, they firstly look on the product label.

Consumers think that Government and fish farmers have the equal responsibility to take care of the welfare of the fish. When the source of the information about welfare is mentioned on the label of the tested cod, either governmental or producers organisation, the reliability of the governmental source is higher. The consumers think that although the fish farmers are the experts they also have more interest in hiding the truth about welfare issues. The more reliable the information is perceived, the higher the buying intention of the product labelled as such.

The more detailed the information provided, the more relevant, important and reliable this information was perceived and resulted in higher self reported knowledge of the system. At the same time this resulted in higher quality perception of the product.

## Demonstration of health promoting effects of fish protein hydrolysates by animal testing

Presenting author : Rozenn Ravallec-Ple <sup>(1)</sup>, co-authors : D. Vercaigne-Marko <sup>(1)</sup>, Charles Delannoy <sup>(2)</sup>, Greta Jakobsen <sup>(3)</sup>, Inez Johansson <sup>(3)</sup>, Martine Fouchereau-Peron <sup>(4)</sup>, Didier Guillochon <sup>(1)</sup>

<sup>(1)</sup> ProBioGEM, France

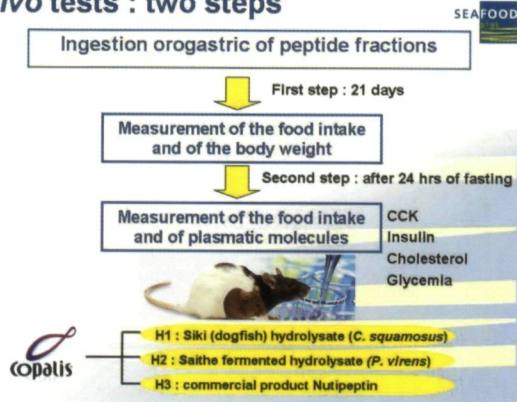
<sup>(2)</sup> Copalis (CTPP), France

<sup>(3)</sup> Marinova, Denmark

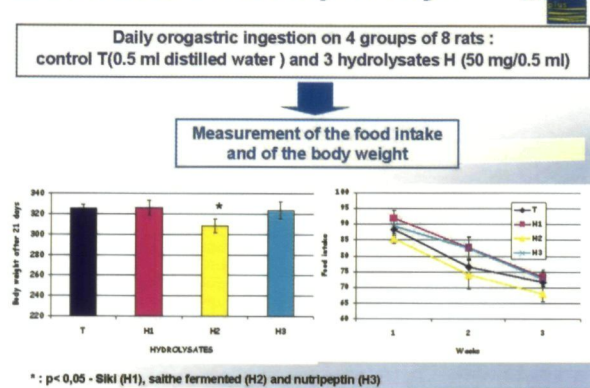
<sup>(4)</sup> Marine Biology Station- MNHN Concarneau, France



### In vivo tests : two steps



### In vivo tests : first step 21 days



In the PROPEPHEALTH project, the goal of the researchers was to scan the byproducts produced during seafood processing with modern, improved isolation techniques in order to discover 'new' substances that might be of health value, and which of them that are 'bioactive' and may be useful in the production of functional seafood products. To go further on our biological test, we required the knowledge of researcher from Pillar 1, in particular the team of Dr Elizabeth Lund (FISHGASTRO) from the Institute of Food Research (UK). This presentation is the result of this successful integration.

In order to explore the possibility of obtaining biologically active peptides from marine processing by-products we searched for the presence of peptide hormones in fish hydrolysates. This study was focused on the cholecystokinins (CCK) family which are small peptides controlling the intestinal mobility and the secretion of digestive enzymes. The CCK also proves to be one of the paramount factors of the control of satiety. It was shown that an increased production of CCK involved a state of satiety allowing the control of the food intake of obese patients.

The biological content of hydrolysates from industrial origins was studied *in vivo* by orogastric ingestion on 32 male Wistar rats (270 g). The food intake and the body weight were followed for three weeks and the amount of plasmatic cholecystokinins, cholesterol, insulin and glucose level were measured. Six different hydrolysates (H1, H2, H3, H4, H5 and H6) were daily tested (150 mg/kg).

After the *in vivo* trial, a significant difference was observed between the body weight of the group feed with H2 in comparison with the control (ED) but also with rats stuffed with the other hydrolysates. The food intake was also lower with H2, as well as the glucose level in the blood after the last feeding. The different molecules amount in plasma consolidated these results.

These really interesting results will be completed in direct collaboration with the SME'S at the end of SEAFOODplus. This future work will focus on the characterisation (*in vitro*) and the purification of the active hydrolysate by RP-HPLC and MS/MS. From an upgrading point of view, an industrial scale fraction exhibiting an activity comparable with CCK would be of great interest in several domains such as feed or nutraceutic.

## The cooperation with the seafood industry in demonstration projects

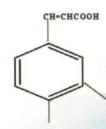
Begoña Pérez-Villarreal  
AZTI-Tecnalia, Spain



5<sup>th</sup> SEAFOODplus Conference 8-10 June 2008, Copenhagen

### Natural antioxidant extracts enriched in caffeic acid for seafood products

- Coordination by CSIC, Instituto de Investigaciones Marinas



- Industrial partners:  
Euromed S.L.N.E., Bioglane S.L.N.E., Pescanova, S.A.

5<sup>th</sup> SEAFOODplus Conference 8-10 June 2008, Copenhagen

As a result of the two demonstration calls made in 2006 and 2007, four demo projects have been launched:

#### 'Pulsed light technology to improve safety and shelf life of lightly preserved fish products and/or convenience seafood products' Coordinated by AZTI-Tecnalia

Pulsed light (PL) technology is a novel process consisting of high power pulses of a broadband light emission with a considerable amount of light in the short-wave UV spectrum. This process has been shown to be effective in inactivating spoilage and pathogenic microorganisms isolated from seafood products (SEAFOODplus project: HURDLETECH). The main objective of this demonstration project was to point out the suitability of PL technology (2 SMEs manufacturing PL semi-industrial systems involved) to reduce the surface contamination of seafood products (lightly preserved fish products and/or convenience seafood products) processed by 2 SMEs. This decrease in surface microbial counts could be reached by (1) direct PL treatment of the surface of seafood products and (2) decontamination of processing surfaces, devices, packages and/or environments (water,...) which would reduce the risk of surface microbial spoilage resulting from a surface cross-contamination of the seafood product during the processing chain. The main benefits for the seafood industries involved would be a shelf life extension and/or improvements on microbial safety of target seafood products.

#### 'Natural Antioxidant Extracts enriched in Caffeic Acid for Seafood Products' Coordinated by Instituto de Investigaciones Marinas-CSIC

The main objective of this demonstration project is to evaluate and demonstrate the antioxidative effect of plant extracts enriched in caffeic acid in frozen fish. The project also includes extraction, purification and analysis of a natural phenolic extract enriched in caffeic acid aimed to be used as food additive.

#### 'TraceShell – A useful tool for the Bivalve sector' Coordinated by DTU-Aqua

This project will demonstrate in European countries producing bivalves that the TraceShell standard (constructed within the SEAFOODplus Traceability pillar) can be used for tracking and tracing bivalves and will be an advantage for the shellfish sector in Europe.

#### 'Fish restructured products with commercial dietary fibres' Coordinated by Instituto del Frío-CSIC

The objective of this project is to prove that the inclusion of wheat dietary fibre, together with other commercial dietary fibres leads to sensory acceptable restructured products made of fish muscle, that fulfil the requirement of 'source of dietary fibre' and/or 'high content of fibre', according to the EC legislation.

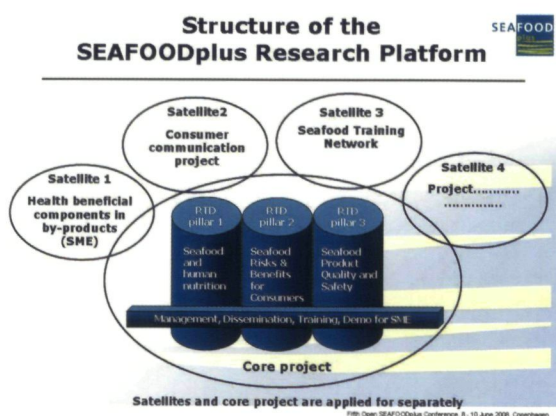
## The future of SEAFOODplus – the SEAFOODplus Research Platform

Presenting author: Torger Børresen<sup>(1)</sup> co-authors: Joop Luten<sup>(2)</sup>, Mercedes Careche<sup>(3)</sup>

<sup>(1)</sup> National Institute for Aquatic Resources-DTU Aqua, Denmark

<sup>(2)</sup> Nofima Marine, Norway

<sup>(3)</sup> Institute del Frio, CSIC, Spain



### The Mission

- To begin, stimulate and encourage international integrated multidisciplinary seafood research covering the whole production chain from aquaculture and fisheries for consumers' health and well-being
  - To influence the European research agenda with focus on seafood research related to human health, consumer perception and well-being, product quality, product development, safety and aquaculture as source for seafood
  - To bring forward and promote the project ideas from the scientific community via the channels at the scientific level of the European Commission in addition to existing Technology Platforms
- File: Open SEAFOODplus Conference, 8-10 June 2008, Copenhagen

The EU supported Integrated Project SEAFOODplus has been a great success. SEAFOODplus has delivered several research results being breakthroughs in the areas of (1) seafood and health, (2) consumers and seafood, (3) seafood safety, (4) seafood quality and product development and (5) aquaculture. The management structure developed for the 20 projects has been blueprint for many other integrated projects. This structure has contributed to the integration of many different scientific disciplines of relevance to the seafood area. SEAFOODplus has become a brand label for highly qualified seafood research managed in a professional way.

These achievements have been highly acknowledged, and many requests have been received for a continued operation of SEAFOODplus. It has thus been decided that the **SEAFOODplus Research Platform** will be developed as a new collaborative concept after the closing date of the present SEAFOODplus project period, which is by the end of 2008. The new research platform will thus start its operation 1 January 2009.

The new SEAFOODplus Research Platform will be operated on a membership basis, welcoming research institutions, universities, industry and other stakeholders wishing to support the further development of the seafood area and promotion of seafood to the benefit of human health and well-being.

The vision of the SEAFOODplus research platform is (1) To be the preferred research platform for major stakeholders in all aspects of the seafood science, industry, policy makers and financing bodies in Europe, particularly addressing research supported by the European Union. (2) To work for continued and effective integration of the best research environments in academia and industry with the aim of having European seafood research to be recognised as the world leaders in seafood science.

This vision will be realised by the mission adopted where **international integrated multidisciplinary** research will be stimulated and encouraged. Every opportunity will be explored to influence the European research agenda with focus on seafood research. Project ideas from the members of the research platform will be brought forward and promoted for funding wherever possible. Research priorities will be communicated via channels at the scientific level of the European Commission and to existing Technology Platforms in relevant areas.

The research platform will be operated by a management structure based on principles applied in the present SEAFOODplus organisation, where project leaders in charge of new projects, called satellite projects, fostered by the research platform will have a seat in the management committee, which will be the central Council for the research platform. Further, a small management team will take care of the day to day management, and all stakeholders will have a seat in the general assembly, being the governing body of the SEAFOODplus Research Platform.

## Abstracts for the posters



## Integration within SEAFOODplus

Joop Luten

*Nofima Marine, Tromsø, Norway*

One of the tasks in SEAFOODplus is to stimulate integration of R&D activities between projects of the different areas. As part of the training programme about 50 scientists have participated in exchange visits between project partners in the same project, between different projects in the same R&D area and between projects in different R&D areas.

Three new integrated R&D initiatives were taken in SEAFOODplus: (1) ETHICOD, (2) Se-SEAFOOD and (3) FPH-animal.

The concept of functional foods based upon dietary modulation of farmed fish is exploited regarding selenium (Se) in CONSUMERPRODUCTS project from R&D area 'Seafood from source to consumer'. This has led to the Se-SEAFOOD experiment where African catfish is farmed using feed containing anti-carcinogenic organo-Se enriched garlic. The health beneficial properties of the Se enriched African catfish is now tested in *in-vivo* experiment carried by a partner in FISHGASTRO from R&D area 'Seafood and human nutrition'.

The *in-vitro* testing of several fish protein hydrolysates (FPH) in PROPEPHEALTH has led to the selection of a few FPH with promising anti-hypertensive, calcitropic and secretagogues activities. Due to the flexibility of 18 months planning periods in SEAFOODplus it was possible to design two animal experiments to test the efficacy of the FPH. The design of both studies is based upon discussion between partners from the PROPEPHEALTH project and R&D area 'Seafood and human nutrition'. One *in vivo* study shows that FPH from saithe can reduce food intake, body weight, glychemic index and insulin level and increase levels of CCK. One *in-vivo* study about hypertensive activities from FPH is on-going.

## Functional ready-meals with fish

Marina Braidá, Ronan Gormley

*Corresponding author: Ronan Gormley, Ashtown Food Research Centre (Teagasc), Dublin, Ireland*

Ready-meals are excellent carriers for functional (healthy) ingredients. Trials were conducted at Ashtown Food Research Centre on the formulation and testing of gluten-free salmon lasagne with nutraceuticals, and also on a *sous vide* processed ready-meal of the same formulation but containing gluten-free pasta pieces instead of lasagne sheets.

The lasagne contained salmon sauce (50% salmon pieces), Béchamel sauce, gluten-free pasta sheets (Dr Schär, Italy) and mozzarella cheese. Nutraceutical targets (per 400g lasagne, or per 146g Béchamel sauce) were: apple pectin (7g), Beneo HP (5g), taurine (1.5g) and Aquamin Soluble (120mg). Apple pectin (Obipektin-uly, Switzerland) reduces serum cholesterol; Beneo HP (ORAFTI, Belgium) is an oligosaccharide, a dietary fibre and a prebiotic; taurine is beneficial for cardiovascular health; Aquamin Soluble (Marigot, Ltd, Cork) is a highly available algal calcium. The nutraceuticals were added to the Béchamel sauce, both individually and together. Each inclusion lightened sauce colour except for pectin which had a yellowing effect. Beneo HP thinned the sauce while Aquamin Soluble caused slight thickening. Pectin also caused thickening, especially at the 5% inclusion level. The rheological data for the all-inclusions sauce were similar to those for the sauce with the 2.5% pectin inclusion level. The lasagne was blast frozen (-35°C); stored at -20°C for 24h; tempered at 4°C; stored at 2-4°C, and then tested (physicochemical, sensory, microbiological) on days 1, 5 and 8 post-chill. Paired comparison and acceptability taste tests [6-cm scale: 0 (unacceptable); 6 (very acceptable); 20 tasters] between the all-inclusions gluten-free salmon lasagne and a commercial gluten-containing salmon lasagne showed a preference ratio of 5/15 and a score of 2.59 vs 3.59 in favour of the latter. This was attributed to differences in spice content rather than to the Béchamel sauce with the inclusions.

The *sous vide* gluten-free pasta product with salmon and nutraceuticals was processed ( $P_{90} = 10\text{min}$ ) in a Barriquand Steriflow cooker; blast frozen (-35°C; 2h); stored -20°C for 4 weeks; tempered at 4°C; stored at 2-4°C for 30d. Tests on days 1, 15 and 30 showed no pathogens and good sensory acceptability.

## Sensory quality of seafood

Ditte Green-Petersen and Grethe Hyldig

*Corresponding author: Ditte Green-Petersen, DTU Aqua, Technical University of Denmark*

When discussing quality of seafood it is important to remember the sensory quality. The sensory quality of a seafood product has a significant influence on how satisfied consumers are with a product and thereby also on products success on the market. It is therefore of great importance for the seafood processing industry that the sensory quality of their products can fulfil the demands of the consumers. To ensure this the use of sensory evaluations is of major importance. However sensory evaluation is not always used in an optimal way in the seafood industry. The poster describes how sensory evaluation can be used and implemented in the different steps of the seafood processing chain from when the seafood is caught or slaughtered and until consumption of the seafood. Furthermore the poster illustrates how the results of the sensory evaluation performed in the different steps of the fish processing chain can be used in a seafood sensory quality model.

The implementation of sensory quality control in the seafood production chain contains some different stages. First decisions have to be made about where to perform sensory evaluations in the processing chain, called quality control points. Secondly standards defining the sensory quality in the different quality control points have to be developed. This will include decisions about what to do if a product does not fulfil the requirement of the standard. After having developed standards, sensory testing methods need to be developed, or chosen from already existing methods. Finally the methods have to be implemented in the daily production.

## Fish market segmentation based on consumers' motives, barriers and risk perception in Belgium

Filiep Vanhonacker, Zuzanna Pieniak, Wim Verbeke

*Corresponding author: Filiep Vanhonacker, Department of Agricultural Economics, Ghent University, Belgium*

Following scientific findings and current health recommendations, fish consumption should be stimulated from a public health perspective. In order to meet this goal, it is necessary to distinguish consumer segments based on issues which have a significant impact on fish consumption either as a driver or as a barrier, and which offer at the same time market opportunities with respect to possible communication and information provision, and to product development and/or product focus in future marketing efforts.

In this vein, we performed a cluster analysis using a cross-sectional consumer dataset collected within the SEAFOODplus project in November 2004 with 852 Belgian respondents, based on three categories of variables: 'motives for eating fish', 'barriers in terms of difficulties faced with fish meal preparation and fish quality evaluation' and 'barriers in terms of perceived health risks from fish consumption'.

The analysis distinguished between three consumer segments. *Uncertain* fish consumers (30.6%) indicate strong motives and a low risk perception, but experience some barriers to increase their fish consumption. *Fish Lovers* (36.4%) do not perceive any risk from eating fish and express strong motives and low barriers. Finally, *Concerned* fish consumers (33.0%) perceive few barriers, and they score relatively moderate on fish consumption motives, but express some doubts with respect to potential risks from eating fish. Tackling the barriers and/or reinforcing the motives, together with the exploration of between segment differences in behaviour, attitude, interest in information, life-style orientation in relation with fish consumption and socio-demographics involves the possibility to derive and formulate some opportunities to stimulate fish consumption within each segment through targeted marketing strategies and product orientation.

## Information and health-related beliefs as determinants of fish consumption

Zuzanna Pieniak, Wim Verbeke, Karen Brunsø

Corresponding author: Zuzanna Pieniak, Department of Agricultural Economics, Ghent University, Belgium

The overall objective of this research was to improve the understanding of information and health-related beliefs as determinants of European consumers' fish consumption. Important levels of analysis were cross-cultural variations in Europe, consumers' needs for fish information, attitudes and preferences in relation to fish, and the link of these aspects to perceived health, well-being and involvement with health from a consumer point of view. This work was performed within the SEAFOODplus project 2.3 SEA-INFOCOM and was structured using a conceptual framework based on three stages of the classical consumer decision-making process: information search, evaluation of alternatives and behaviour itself. Both qualitative exploratory (focus group discussions) and quantitative conclusive (pan-European consumer survey) studies were conducted, with secondary and primary data input.

This study provides cross-culturally validated measures of use of and trust in information sources, use of and interest in information cues, knowledge, behaviour, health beliefs, health involvement and risk perception in relation to fish across consumer samples taken from Belgium, the Netherlands, Spain, Denmark and Poland. Consumers' health-related beliefs were found to be important factors influencing fish consumption. This result entails opportunity for public health authorities in creating more effective communication – with specific reference to the potential health benefits from consuming fish. Furthermore, the importance of subjective knowledge as determinant of fish consumption, was emphasised. Improving consumers' subjective knowledge is more likely to cause an increase in their fish consumption as compared to strategies aiming at increasing consumers' objective or factual knowledge about fish. Additionally, labels were found to have considerable potential as market effective sources of information. Consumers were most familiar with basic, mandatory information cues, and strongest interested in safety guarantee and a quality mark for seafood. Finally, three distinct clusters based on use of and trust in fish information sources were identified: Sceptic (24.0%), Enthusiast (41.4%) and Confident (34.6%).

## Acute administration of fish oil inhibits triggered activity in patients with end-stage heart failure

Hester M. Den Ruijter, Arie O. Verkerk, Géza Berecki, Diane Bakker, Antonius Baartscheer, Cees A. Schumacher, Nicolaas de Jonge, Ruben Coronel.

Corresponding author: Academic Medical Center, The Netherlands

**Background:** An increased intake of fish oil reduces sudden death in patients with a myocardial infarction. This suggests that fish oil reduces arrhythmias in these patients. Patients with a myocardial infarction often develop heart failure, and arrhythmias are frequently due to triggered activity. In heart failure, triggered activity is caused by an imbalanced intracellular  $Ca^{2+}$  handling of the cardiomyocytes that leads to delayed and early afterdepolarizations (DADs and EADs), and triggered action potentials. We therefore hypothesize that superfusion with fish oil reduces triggered activity in isolated myocytes from patients with end-stage heart failure by normalizing intracellular  $Ca^{2+}$  handling.

**Methods:** Cardiomyocytes were isolated by enzymatic dissociation from 4 patients with end-stage heart failure (NYHA class IV). Membrane potentials (patch-clamp technique) and intracellular  $Ca^{2+}$  (indo-1 fluorescence) were recorded 5 minutes after superfusion with fish oil fatty acid eicosapentaenoic acid (EPA; 20  $\mu$ M) or control fatty acid oleic acid (OA; 20  $\mu$ M-control). Subsequently, the incidence of triggered activity was tested with rapid pacing (1-2 Hz) in the presence of 1  $\mu$ M noradrenalin.

**Results:** Fish oil fatty acid EPA, but not control fatty acid OA caused a  $\approx$ 30% decrease in intracellular  $Ca^{2+}$  (all,  $p < 0.05$ ). In the presence of OA, rapid pacing resulted in  $1.3 \pm 0.79$  ( $n=11$ ) triggered action potentials and  $1.0 \pm 0.28$  ( $n=11$ ) DADs. In addition, EADs were observed in 73% of the OA-superfused myocytes ( $n=11$ ). In the presence of EPA, the number of triggered action potentials was  $0.2 \pm 0.16$  ( $n=12$ ,  $p=n.s.$ ) and the number of DADs was reduced to  $0.3 \pm 0.11$  ( $n=12$ ,  $p < 0.05$ ). In addition, the occurrence of EADs was reduced to 17% in EPA-superfused myocytes ( $n=12$ ,  $p < 0.05$ ). Intracellular  $Ca^{2+}$  measurements showed that the number of  $Ca^{2+}$ -aftertransients were also reduced in EPA-superfused myocytes, although this did not reach statistical significance (OA:  $2.2 \pm 1.32$ ,  $n=10$  and EPA:  $0.3 \pm 0.15$ ,  $n=11$ ).

**Conclusion:** Fish oil reduces triggered activity in isolated cardiomyocytes of patients with end-stage heart failure by lowering the intracellular  $Ca^{2+}$ . This study provides a new mechanism by which fish oil may reduce sudden death in patients with heart failure.

## Bioactive and functional fish protein hydrolysates

Inez Johansson, Greta Jakobsen

*Corresponding author: Inez Johansson, Marinova, Højmark, Denmark*

Marinova has for commercial purpose produced different extract and hydrolysates from fish and shellfish for the last 20 years. All products are produced for human consumption, and Marinova has a great expertise within the area. The products are used as flavour enhancing, emulsifier, antioxidant, freeze stabilizer and protein enrichment in different fish related products. The products are often costumer specific products developed in co-operation with the costumer.

Parallel to the general development of peptides with bioactive properties from milk and soya Marinova has worked on development of peptides from fish with similar properties. This work is for instance made in the PROPEPHEALTH within the SEAFOODplus project Pillar 4. In the project the work is mainly focused on two hydrolysates: MariPep C® og MariPep P®, produced respectively from specific parts from cod and plaice. Both hydrolysates exert good antioxidative activity in-vitro. Within the project is established good documentation for the reproducibility of MariPep C® og MariPep P®, which is a very important factor. MariPep C® and MariPep P® show moderate ACE inhibition in-vitro, which suggests, they might have the ability to lower blood pressure in-vivo.

Marinova is also involved in the project Marifunc, where the focus is on the use of fish, nutrients and other bioactive substances isolated from fish as ingredients in functional foods.

As the latest Marinova participates in the project PEPFISH financed by The Danish Council for Strategic Research. The project covers utilisation of bioactive peptides from fish processing – upgrading the value of secondary products.

Marinova offers costumer specific development of functional hydrolysates and peptides if not part of existing product assortment and participation in research project as supplier of hydrolysates and peptides from fish. For development purpose Marinova has facilities as laboratory, pilot plant and production plant.

## Fish consumption and gastro-intestinal inflammation in the FISHGASTRO study

Gerda Pot, Anouk Geelen, Gosia Majsak- Newman, Linda Harvey, Gertjan Schaafsma, Ger Rijkers, Elizabeth Lund, and Ellen Kampman

*Corresponding author: Gerda Pot, Department of Human Nutrition, Wageningen University, Wageningen, the Netherlands*

**Background:** Several observational studies have indicated that fish consumption is inversely associated with colorectal adenomas and progression of ulcerative colitis (UC), both risk factors for colorectal cancer. N-3 fatty acids in oily fish may favourably influence inflammatory processes involved in colorectal carcinogenesis by stimulating anti-inflammatory and inhibiting pro-inflammatory cytokine production. However, results of previous studies have been inconsistent and often did not include a wide range of inflammatory markers.

**Aim:** To determine the effects of interventions with fatty or lean fish on a range of faecal inflammatory markers.

**Subjects and methods:** The study is a randomised, parallel, multi-centre six months intervention trial. In total, 242 volunteers were randomly allocated to receive one of three interventions: oil-rich fish (salmon), lean fish (cod), or no extra fish. Faecal samples were collected in a subset of patients (n=74) before and after intervention. Pro-inflammatory cytokines, interleukin (IL)-1alpha, IL-1beta, IL-6 and TNFalpha, and anti-inflammatory cytokines IL-4, IL-10, and IL-13, were assessed by a multiplex immunoassay. Also, the chemokines macrophage migration inhibitory factor (MIF), monocyte chemoattractant protein-1 (MCP-1), macrophage inflammatory protein-1-alpha (MIP-1alpha), 'regulated upon activation, normal T-cell expressed and secreted' (RANTES), eotaxin, and IL-8 were assessed by a multiplex immunoassay.

**Results:** No differences were found in the responses on intervention between the three treatment groups in any of the cytokines, or chemokines measured in faecal water.

**Conclusion:** This six-month intervention with either fatty or lean fish, does not affect inflammatory markers measured in faecal water. Since many values were below the detection limit, it can be argued that these volunteers were too healthy to see any effect. Further analyses will include calprotectin in faeces as marker of mucosal inflammatory activity, cytokines and chemokines in mucosal biopsies, and systemic C-reactive protein as general inflammatory marker.

## The mechanism of iron induced peroxidation of PUFAs in liposomes

Revilija Mozuraityte, Turid Rustad and Ivar Storrø

*Corresponding author: Ivar Storrø, SINTEF, Fisheries and Aquaculture, Trondheim, Norway*

This work discusses the mechanism of iron induced lipid oxidation in marine phospholipids liposomes. This was investigated by studying the effect of both  $\text{Fe}^{2+}$  and  $\text{Fe}^{3+}$  on peroxidation and the circulation between these ions. Oxygen consumption was used as a method to study lipid oxidation at pH 5.5 and 30°C.

The relationship between consumed oxygen and amount of peroxides (PV) and thiobarbituric reactive substances (TBARS) formed, indicated that both  $\text{Fe}^{2+}$  and  $\text{Fe}^{3+}$  catalysed lipid oxidation. When  $\text{Fe}^{2+}$  was added to liposomes at a concentration of approx. 10  $\mu\text{M}$ , an initial drop in dissolved oxygen (oxygen uptake rate  $>258\mu\text{M}/\text{min}$ ), followed by a slower linear oxygen uptake (oxygen uptake rate 4-6 $\mu\text{M}/\text{min}$ ), was observed. Addition of  $\text{Fe}^{3+}$  induced only the linear oxygen uptake. The initial fast drop in dissolved oxygen was due to oxidation of  $\text{Fe}^{2+}$  to  $\text{Fe}^{3+}$  by lipid peroxides (rate of 79  $\mu\text{M Fe}^{2+}/\text{min}$ ). No oxidation of  $\text{Fe}^{2+}$  was observed in oxygen saturated buffer at pH 5.5, proving that  $\text{Fe}^{2+}$  was oxidized by the added lipids.  $\text{Fe}^{3+}$  is reduced by peroxides to  $\text{Fe}^{2+}$  at a slow rate (0.25 $\mu\text{M}$  of  $\text{Fe}^{3+}/\text{min}$  at 30°C) in a pseudo-first order reaction. When equilibrium between  $\text{Fe}^{2+}$  and  $\text{Fe}^{3+}$  was achieved, the linear oxygen uptake was observed and  $\text{Fe}^{3+}$  became the rate limiting factor in the circulation between  $\text{Fe}^{3+}$  and  $\text{Fe}^{2+}$ . Both alkoxy and peroxy radicals are presumably formed by breakdown of peroxides by  $\text{Fe}^{2+}$  and  $\text{Fe}^{3+}$ . These radicals react with fatty acids giving a lipid radical reacting with oxygen. Under these assumptions two moles of peroxides are used for circulation of one mole of iron producing two radicals. One mole of lipid radicals react with oxygen and consume approximately 10 moles of oxygen producing 10 moles of peroxides, giving a net production of 8 moles of peroxide per mole iron circulated.

## Characterisation of $\text{Fe}^{2+}$ as prooxidant in oxidation of phospholipids

Revilija Mozuraityte, Turid Rustad and Ivar Storrø

*Corresponding author: Ivar Storrø, SINTEF, Fisheries and Aquaculture, Trondheim, Norway*

When studying lipid oxidation, antioxidants are often the main focus, while effects of pro-oxidants are often overlooked. Increased knowledge of the action of prooxidants could help to find better ways to protect food from lipid oxidation. The objective of this work is to study the pro-oxidant activity of  $\text{Fe}^{2+}$  in oxidation of phospholipids. The effect of temperature, lipid concentration in the form of liposomes, pH,  $\text{Fe}^{2+}$  concentration, salt type and ionic strength was analyzed.

The consumption of dissolved oxygen in a closed vessel by liposomes was used as a measure for the rate of lipid oxidation. The concentration of dissolved oxygen was measured continuously by a polarographic oxygen electrode. Phospholipids, extracted from cod roe using acetone precipitation method, were used for liposome preparation. Liposomes in 5mM MES buffer were made by sonication.

No change in oxygen consumption was measured in buffer (control) sample after addition of  $\text{Fe}^{2+}$ . When adding  $\text{Fe}^{2+}$  to a liposome/buffer solution, a fast decrease followed by a slower linear decrease in dissolved oxygen concentration is observed. The rate of oxygen consumption in liposomes was proportional to the added iron concentration and to the concentration of lipids. The oxygen consumption rate was independent of oxygen concentration (200 to 5 $\mu\text{M}$ ). The oxygen consumption rate was dependent on pH with maximum observed between pH 4 and 5. The oxygen consumption rate followed Arrhenius kinetics in the investigated temperature range 20°-40°C and the variation in activation energy might be due to variations in the composition of the raw materials used in the experiments and different susceptibility to oxidation. The addition of salt (final concentration 0.04 – 0.08 M) decreased the oxygen consumption rate. The oxygen uptake rate was described mathematically. The influence of temperature,  $\text{Fe}^{2+}$ , pH and lipid concentrations were included in the formula.

## **New seafood prototype enriched with coloured dietary fibre**

Javier Borderías, Isabel Sánchez-Alonso, María José Jiménez and Mercedes Careche

*Corresponding author: Isabel Sánchez-Alonso, Instituto del Frío (CSIC), Department of Science and Technology of Meat and Meat Products and Fish and Fishery Products, Madrid, Spain*

In the frame of CONSUMERPRODUCTS it has been demonstrated - in addition to the positive physiological effects of dietary fibres (DF) - how technologically interesting it can be to use them in restructured muscle formulations, that will be frozen or pasteurized. Consumer studies have shown a positive opinion of the consumers on the appearance and overall organoleptic attributes of both preliminary mince and gel products prototypes enriched with DF. The addition of DF generated positive expectations by the consumers, whereas a colour, usually rendered by antioxidant DFs (ADF) sometimes could be a problem depending on the type of product. The results taken together have significantly led to a knowledge that can be applied to many product concepts based on restructured seafood.

Thus, we developed a range of seafood product prototypes based on a new product idea generated in our research group: a 'jelly roll' or 'gypsy's arm'. This type of products are very interesting for the development of innovative seafood products enriched with coloured ADF e.g. from seaweed or grapes, previously studied by the authors. One of these prototypes comprises a cover of surimi-based gel enriched with WDF stuffed with a mixture of mince fish and freeze-dried seaweed (*Ulva rigida*). This seaweed renders a light green colour. The seafood jelly roll prototype contains DFs in a sufficient amount to be labelled as a source of DF (Directive EC 1924/2006).

This prototype was tested by 46 consumers recruited from CSIC. They evaluated the cover, the filling, and the whole product prior and after tasting. Results show that, prior to tasting, consumers evaluated very positively the whole product. After tasting the overall impression of the prototype was better for the whole product than for the two parts evaluated separately.

It has been shown that it is possible to make restructured coloured products with a good image and sensory acceptability, thus overcoming the main barrier for the application of some very interesting ADFs studied within CONSUMERPRODUCTS. This prototype is ready for industrial transfer.

**The product will be presented and offered for tasting at the Market Place of the Fifth SEAFOODplus Open Conference.**

## **Influence of smoking on the content of beneficial components in selenium-enriched African Catfish (*Clarias gariepinus*) fillets designed as 'functional food'**

Sabine Mierke-Klemeyer, Jörg Oehlenschläger, Narcisa Bandarra, Edward Schram and Joop Luten

*Corresponding author: Sabine Mierke-Klemeyer, Max Rubner-Institute, Federal Research Institute for Nutrition and Food, Department of Safety and Quality of Milk and Fish Products, Hamburg, Germany*

Fish contains many health beneficial components such as vitamins, minerals and n-3 polyunsaturated fatty acids (PUFAs) which make it unique for human nutrition. n-3 PUFAs of marine origin are associated with a reduced risk of coronary heart disease (CHD). Selenium incorporated in enzymes and selenoproteins are involved in cell antioxidant systems.

Professional processing and/or heat treatment of fish muscle generally leads to losses of water soluble components or other components present in the cytosol due to a potential destruction of the cell walls. It was therefore an interesting aspect of the development of tailor-made functional seafood products to see (1) if and to what extent the nutritional health benefits of the functional components could be retained during processing and (2) can this also be achieved for the beneficial components naturally occurring in these products. We therefore compared the content of the beneficial components in raw fillets with the content of the smoked fillets; also considering the weight loss and compositional changes during processing and calculating the retention. In this study the influence of professional hot and cold smoking process on the content of Se and polyunsaturated fatty acids in Se-enriched African Catfish fillets was investigated.

The retention calculated for selenium was about 100% leading to the conclusion that Se seemed to be incorporated in peptides, which were not leaching out in any noticeable extent.

For the polyunsaturated fatty acids under investigation it could be stated that the data obtained in smoked catfish fillets allow concluding that the type of smoking process (cold or hot) had no relevant effect in the final PUFA n-3 content. The total of EPA and DHA/100g was higher in both smoked samples comparing to raw catfish samples due to the water loss.

## Understanding the fish matrix-dietary fiber interactions in restructured seafood

Ignacio Sánchez-González, Pedro Carmona, Pilar Moreno, Arantxa Rodríguez-Casado, Mercedes Careche

*Corresponding author: Mercedes Careche, Instituto del Frio (CSIC), Madrid, Spain*

It has been demonstrated the interest of wheat dietary fibre (WDF) as ingredient for the formulation of seafood restructured products. In order to use these formulations for products with nutritional claims, the percentage of dietary fibre has to be between 3 to 6%. In the upper range, there are several technological parameters related to gel elasticity and strength, and water retention, which change upon addition of this fibre. In order to study the causes of the above effects the study of the interactions between the matrix constituents and WDF is needed. The objective of this work was the rheological and spectroscopic study of the formulations consisting of gels with 0, 3, and 6% of WDF Vitacel® WF200.

The main results reveal the following: the rheological changes caused by the WDF on the gel are a balance of its filler effect and the heterogeneity of the gel network caused by fibre addition. The heterogeneity can stem from the high water holding capacity of the fibre, which could cause dehydration of the proteins. This was confirmed by FT-Raman spectroscopy. It was shown that  $\beta$ -sheets formation resulted upon addition of 6% WDF. On the basis of the spectral features of the WDF  $\nu$ CH band as a function of humidity and its relative intensity within the sample matrix, it was concluded that water transfer from protein to WDF can occur in *surimi* gels. The said WDF hydration can be interpreted in the sense that this fibre either takes water that is delivered from the gel protein upon heat-mediated formation of  $\beta$ -sheets and/or or acts as active dehydrating agent. The H/D exchange kinetics of the gels with WDF are slower than those of samples without fibre. This can be interpreted in terms of either stronger fibre-water hydrogen bonding or smaller interstitial water domains. The spectral results of the  $\nu$ OH band suggest that the former mechanism corresponds to the true situation, LT-SEM supporting the above conclusion. Interestingly, these results constitute molecular data to be considered when designing fish restructured food with these fibre ingredients.

## Study on addition of dietary fibre in restructured fish products: PhD thesis

Isabel Sánchez-Alonso and Javier Borderías

*Corresponding author: Isabel Sánchez-Alonso. Instituto del Frio (CSIC, Department of Science and Technology of Meat and Meat Products and Fish and Fishery Products, Madrid, Spain*

The main object of this PhD-thesis was the study of the technological aspects of incorporation of dietary fibre (DF) into minced fish muscle (MFM) and surimi-based gels – used as bases for restructured products – kept in frozen storage. Two types of DF were considered: (1) a highly-insoluble wheat DF and (2) two antioxidant DF concentrates from wine industry by-products (red pomace-GADF and white pomace-WGDF).

It can be concluded that when 3% or 6% WDF is added to Alaska pollack or giant squid surimi gels, the appearance of the gels changes very little, but there is a slight loss of water binding capacity and a decline in mechanical characteristics like gel strength and cohesiveness. The colour of MFM (hake or horse mackerel) is lightened by addition of WDF. The water in products with added WDF is more strongly bound, which is important to avoid yield losses from thawing or cooking; and more importantly, it means that battered products made with this muscle are less likely to lose shape or burst when deep-fried. MFM with added WDF is softer and less cohesive, which may be an advantage for some end products. Sensory analysis suggests that 3% is a better concentration for addition of this WDF to MFM.

Minced horse mackerel muscle with added 2% or 4% GADF or WGDF has an acceptable appearance, tending to be slightly more reddish in the first case and browner in the second. Addition of either DF concentrates helps to enhance binding of both added and native water, so that in addition to improving thawing and cooking yield, it makes the fish juicier in the mouth. MFM with added DF concentrates are less hard and less cohesive. The most acceptable sample in sensory terms is the one containing 2% GADF or WGDF. Both DF concentrates significantly inhibit lipid oxidation in minced horse mackerel muscle over six months of frozen storage; nevertheless WGDF is more effective than GADF. Vacuum packing of samples with 2% GADF significantly enhances antioxidant efficacy. The extractable polyphenols content in DF concentrates is the chief factor determining the efficacy of the WGDF and probably of the GADF too.

## AFLP's markers for authentication and traceability of the most important sparids species for the Spanish market

José A. Sánchez, Jorge A. Piñera, Emilia Vázquez, Gloria Blanco

Corresponding author: José A. Sánchez. Universidad de Oviedo, Dpto. Biología Funcional. IUBA.

Laboratorio de Genética Acuicola. C. Julián Clavería s/n. 33071 Oviedo. Asturias, Spain.

Tracing food from origin to consumption through the processing and distribution chain is actually an important concern of food industries. In fish food production, species substitution is one of the most common fraud, particularly for vacuum-packed fish, smoked fish, fillets, flours, eggs or frozen products which are not recognizable on their morphological characteristics. In this way, molecular markers have been used to species identification and authenticity testing. AFLP is a fingerprinting method PCR-based which provides hundreds of informative genetic markers with no previous knowledge of the species genomes. AFLP technique was here used as tool for authentication of the seven most important sparid species in Spanish market. Several sparids are being exploited by both fisheries and aquaculture industries. Gilthead seabream (*Sparus aurata*) and seabass (*Dicentrarchus labrax*) have a high production in culture, whereas others as blackspot seabream (*Pagellus bogaraveo*) and common dentex (*Dentex dentex*) are widely captured off Spanish coasts. In this study, a total number of 101 individuals belonging to 7 species were analyzed through 4 possible primer combinations. 522 bands were detected on the size range 50-500 bp. Comparisons on Dice similarity coefficients shown unambiguous assignment of every individual to their correct species. Furthermore, species-specific band patterns were found from the preliminary screening of a single primer combination. Likewise, a specie-specific monomorphic band was found for seabass, which could be a future candidate to SCAR development.

## Plasmidic standards to validate fish species identification methodologies based on the DNA technology

Miguel Angel Pardo

AZTI-Tecnalía, Txatxarramendi ugarteá z/g, E-48395 Sukarrieta, Bizkai, Spain

**Objective:** During the last years several fish species identification methodologies based on DNA technology were developed to fulfil the European Union regulations (EC No 104/2000) which indicate the necessity of labelling the seafood products with the scientific name to assure the traceability system through the whole chain. Most of these methodologies are based on the amplification by PCR of a specific DNA fragment from the whole genome. To date, the validation of the DNA methodologies have been performed using a DNA template previously extracted from some well characterised fish samples but this type of techniques introduces a variation parameter during the DNA extraction step. To solve this handicap, plasmidic standards have been developed inside project VALID within SEAFOODplus integrated programme. These standards have the same characteristics and composition which ensure the standardization of measurements and procedures, and thus allowing the comparison of results obtained in different laboratories. Moreover, a precisely quantified PCR standard provides valuable information about true positive/negative results, the optimum PCR parameter and the estimation of the initial amount of DNA template.

**Methodologies:** Amplification of the complete mitochondrial cytochrome *b* gene from different fish species were developed in a Mastercycler Personal from Eppendorf. The amplicons were purified with the GFX-PCR-DNA and Gel Band Purification Kit (Amersham Biosciences AB, Buckinghamshire, UK). DNA sequencing was carried out directly on the purified fragments with a 3700 DNA Analyzer ABI PRISM, using the ABI Prism BigDye Terminator Cycle Sequencing Ready Reaction Kit, version 3.0 (Applied Biosystems, Foster City, USA). The complete mitochondrial cytochrome *b* gene of 1200 bp was cloned into pMOSBlue following the specifications of the pMOSBlue vector cloning kit (Amersham Biosciences). The insert size was resolved by electrophoresis and the sequence of the insert was obtained by sequencing using the T7 and U19 primers.

**Results:** An innovative set of primers were designed in order to amplify successfully the complete mitochondrial cytochrome *b* gene from different fish species of gadoids, tunas, hakes and anchovies. The complete gene of fish species was also effectively cloned into pMOSBlue vector. A set of cell bank was established and maintained at -80°C. A plasmid propagation protocol at the desired scale was optimized in order to obtain enough quantity for each plasmid. Thus, every plasmid can be shipped in the desired solution and at the required concentration together with the corresponding quality certifications. The specifications of the quality certificate include: the purity (spectrophotometry at 260 nm), the absence of RNA and genomic DNA, the plasmid identity by sequencing and the plasmid homogeneity by densitometry in agarose gels.

## Functional properties of a new marine ingredient: study in model matrixes

Nicolas Decourcelle, Delphine Laroque, Gaëlle Dauer, Céline Berger, Eric Vouland, Claude Inisan, Fabienne Guerard

Corresponding author: Fabienne Guerard, University of Bretagne Occidentale, Laboratory "ANTiOX", Pôle Universitaire PJ Helias, F-29000 Quimper France

New food ingredients are needed to improve the stability of the microheterogeneous compositions of foams and emulsions. Furthermore, consumers require that such new ingredients be produced from natural sources. The use of sugar-protein conjugates deals with this attempt. They come from natural sources (proteins and sugars) and they also show different surface-active properties in comparison to native proteins. In this context, this study focuses on the tensio-active and organoleptic properties of a marine by-product hydrolysate (PH), and its sugar-conjugate (GPH). The latter was obtained by heating PH in the presence of a reducing sugar. In comparison to PH, it was shown that GPH had : (i) the same surface-tension values ( $44.8 \text{ mN/m} \pm 0.3$ ), (ii) a slight different behaviour as a function of pH, (iii) better foaming capacity, and (iv) lower emulsion stability. It was hypothesized that PH had a sufficient presence of free hydrophobic amino-acid residues to be easily and/or rapidly adsorbed to the oil/water interface in emulsions. From this, the lower emulsion stability shown by GPH was explained by a reduction in the proportion of free hydrophobic amino-acid residues due to chemical reactions between sugar and PH. This would also explain the better foaming capacity of GPH. The decrease in the free hydrophobic amino-acid content would increase the hydrosolubility of GPH, which thus probably improved the hydrodynamic properties of the foam's film. Finally, in GPH, the native fish flavour of PH disappeared but a chicory flavour was detected. Perspectives of this work are to compare the molecular compositions of PH and GPH, and to check the absence of cytotoxicity associated with GPH.

## Abundance and distribution of halophilic *Vibrio* species in molluscan shellfish harvested in Canada: Impact on food safety and consumer health

Swapan K. Banerjee and Jeffrey M. Farber

Corresponding author: Swapan K. Banerjee Bureau of Microbial Hazards, Food Directorate, Health Canada, 251 promenade Sir Frederick Banting Driveway, Ottawa, ON, K1A 0K9. CANADA

**Aim:** To monitor the presence and abundance of pathogenic *Vibrio* species in molluscs harvested in Canada and construct a database of *Vibrio* species inhabiting the eutrophic regions of the ecosystem.

**Methods:** Molluscan shellfish were harvested from sites in the coastal waters of British Columbia (B.C.), the Gaspé Peninsula and two sites in Nova Scotia (N.S.) between May and October, 2006 - 2007. Molluscs were shucked in laboratories near the harvest sites, or packed live with aeration and moisture, and shipped overnight under refrigeration to the analytical laboratory in Ottawa. Biochemical (standard diagnostic kits, including API-20E) and molecular (Polymerase Chain Reaction) assays were used to identify and characterize the presumptive isolates of *Vibrio* spp.

**Results:** Molluscan samples from the Pacific coast were more frequently positive for *Vibrio* species as compared to those from the Atlantic coast. *V. alginolyticus* (Va) was the predominant species followed by *V. parahaemolyticus* (Vp); 94% and 63% of west coast (Pacific) samples were positive for Va and Vp, respectively, while east coast (Atlantic) samples yielded 82% Va and 48% Vp during the study period. Levels of Vp in molluscan tissue were higher in the east coast samples than in bivalves from the west coast. Pathogenic Vp strains, positive for thermostable direct haemolysin (*tdh*), were isolated from oysters harvested in B.C. (2 sites) and N.S. (one site) in 2007. In addition to Vp and Va, *V. vulnificus* was detected in oysters from Eel Lake in N.S.

**Discussion and conclusion:** The ecology of halophilic *Vibrio* species identified in molluscs harvested in Canada probably displays the composition of *Vibrio* species in the Canadian estuaries. Colonization by the less harmful Va may help to prevent the harmful *Vibrio* species, such as Vp, from being the dominant microflora on bivalve molluscs, and thus may reduce the risk of illness(es) in consumers of raw and undercooked shellfish.

## Quality of fish and fisheries products, research at ILVO, Belgium

Katrien Broekaert, Geertrui Vlaemynck, Marc Heyndrickx, Koen Parmentier, Kris Cooreman, Lieve Herman.

*Corresponding author: Geertrui Vlaemynck, Institute of Agricultural and Fisheries Research (ILVO), Brusselssesteenweg 370, 9090 Melle, Belgium.*

At ILVO-Technology and Food, research is performed for the improvement of microbiological and chemical quality of food products including fish and fishery products. At ILVO-Fisheries, research on fisheries biology, aquaculture and restocking, technical fisheries, and the quality of the marine habitat and its biological resources is carried out. Some research to be typically highlighted:

### **Quality of fish and fishery products:**

**QIM:** High quality fishery products are a must. The QIM method, based on sensory parameters, offers an objective and fast measure for the quality. In several projects of ILVO, optimization of techniques and handling is investigated based on QIM scores.

**Microbiota and freshness/shelf-life:** searches concerning specific spoilage organisms (SSO) and different pathogens via conventional as well as molecular techniques (real time PCR, DGGE, typing, sequencing, ...) are carried out. The dynamics and characterisation of the microbiota of fish and fishery products throughout the chain of conservation and processing and the significance of various storage/processing parameters is studied.

The production through metabolic activity of various substances such as biogenic amines is also under study. Routine simultaneous chemical analysis of several representatives of this family is done while a molecular study of the genes for biogenic amine production will be carried out. These and various other quality aspects are under study for e.g. common shrimps (*Crangon crangon*), herring, ray and aquaculture products.

**Contaminant analysis:** Analysis of antibiotic residues (via LC-MS), PCBs, PAHs and chlorinated pesticides are carried out on fish and fishery products, biota and sediment, indicating the ecosystem health status, and revealing alert situations.

**Authenticity** is investigated by means of DNA sequences of mitochondrial markers and microsatellites.

**Aquaculture:** Fish breeding can be an alternative for decreasing quota and fish stocks. That can be achieved either in aquaculture (e.g. sole, turbot), open sea farming (e.g. at windmill parks on sand benches) or mariculture (e.g. the mussel breeding on buoys in open sea). Research on various aspects is carried out.

## Eurofish International Organisation

Victor Hjort and Behnan Thomas

*Eurofish, H.C. Andersens Blvd 44-46, 1553 Copenhagen, Denmark*

Eurofish is an international organisation based in Copenhagen with currently 12 member countries (Albania, Bulgaria, Croatia, Denmark, Estonia, Italy, Latvia, Lithuania, Norway, Romania, Spain, Turkey). The organisation was established to assist the development of fisheries and aquaculture in Central and Eastern Europe. It was set up as a project financed by the Danish government and executed by the FAO in 1996. In 2001 the project became an international organisation with five member countries. Since then it has expanded to the current twelve. The broad mandate of the organisation is to provide information and advice on the European fisheries and aquaculture sectors. This takes the form of publications such as the Eurofish Magazine, trade and market reports, as well as training, workshops and the organisation of conferences. While the focus of our efforts has been the countries of Central and Eastern Europe we also work with our western European members to give them information or catalyse trade linkages between them and the Central and Eastern European countries. More information on Eurofish is available from our website [www.eurofish.dk](http://www.eurofish.dk).

Eurofish has played a significant role in the dissemination of information about SEAFOODplus to the general public. Since the project's inception the Eurofish Magazine has reported on all the RTD and ITD pillars that constitute SEAFOODplus, it has also carried regular information on the SEAFOODplus conferences and the results that are presented there. In addition Eurofish sends out a regular newsletter to the approximately 750 people around the world who have signed up to receive more information about the research activities being carried out under SEAFOODplus. For the last two years Eurofish and SEAFOODplus have also had a joint stand at the European Seafood Exposition in Brussels.

## **MmmmmSeafood, Nordic seafood product concepts for young adults and families with young children**

Joop Luten

*Corresponding author: Joop Luten, Nofima Marine, Tromsø, Norway*



Limited preserving means resulted in (dried,salted,fermented) traditional Nordic seafood which does not have the attractive image for young consumers. Even though seafood consumption is high there is a decline in seafood consumption by younger people and young families. An increase in seafood consumption by developing new Nordic seafood product concepts might contribute to healthiness. An analysis of the attitudes of consumer groups to seafood products will provide better understanding of their needs to develop strategies against the decreasing trend in seafood consumption. Trends show that there is a need for seafood products with a focus on healthiness, convenience and enjoyment (flavour, texture, appearance). However product development is risky.

The overall objective of the MmmmmSeafood project is to strengthen the Nordic seafood sector by a consumer oriented development of new fresh seafood product **concepts** for young adults and families with young children in order to stimulate the consumption of healthy high quality seafood at home and in at out-of-home situations as well to develop and test a targeted communication strategy for increasing seafood consumption by young adults and young families. Proven methods (stage gate culinology approach) will be applied to develop new Nordic seafood product concepts.

MmmmmSeafood project is granted by the Nordic Innovation Centre. Details of the activities in the project with various partners from three Nordic countries (Norway, Denmark and Iceland) will be presented. MmmmmSeafood partners are: Nofima (Norway), Culinary Institute (Norway), Norwegian Seafood Export Council (Norway), Tank Design (Norway), MAPP (Denmark), Matis (Iceland), Fylgifiskar (Iceland), Public Health Institute (Iceland) and the municipality of Reykjavik (Iceland).

## Notes











**SEAFOODplus Coordinator Torger Børresen**

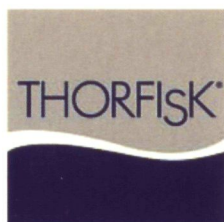
[tb@aqua.dtu.dk](mailto:tb@aqua.dtu.dk)

**SEAFOODplus Secretariat Manager Jette Donovan Jensen**

[jej@aqua.dtu.dk](mailto:jej@aqua.dtu.dk)



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