59th Pacific Fisheries Technologists

Annual Meeting

February 3-6, 2008

Hotel Whitcomb
San Francisco, California USA

http://seafood.ucdavis.edu/pft2008

President's Greetings

Pamela Tom
2007-2008 PFT President

On behalf of the Pacific Fisheries Technologists, I am delighted to welcome you to the 59th annual Pacific Fisheries Technologists international conference in San Francisco, California at the Hotel Whitcomb during February 3-6, 2008.

In planning the 2008 conference, PFT presenters were able (for the first time) to upload their abstracts onto the internet. Over 100 abstracts were received. This year's conference will host 106 (60 oral and 46 poster) presentations.

PFT presenters spanning numerous U.S. States and coming from all over the world (including Australia, Belgium, Canada, China, Ghana, Korea, Mexico, Norway, Taiwan, Thailand, Turkey, and UK) have pre-registered. This is a record attendance for international seafood scientists.

This year's program addresses key issues in the seafood industry including: the keynote address by Joyce Nettleton. Ph.D., R.D. on the benefits and risks of eating seafood followed by national perspectives on mercury; species identification; education and outreach, food safety; environmental management; marketing; processing and engineering; protein research; by-product utilization, chemistry; regulatory update; and inspection and audits. Furthermore we will have two days of poster sessions covering seafood: safety; chemistry; by-products; protein; processing; and education.

I would especially like to thank the dedication and hard work of our volunteer leaders in planning and implementing this year's PFT conference: **Subramaniam "Sathi" Sathivel** - Technical Program Chair; **Jae Park** - Treasurer and **Sue Hansell** – Conference Registrar And Administrative Assistant; **Don Kramer** - Student Paper Competition Chair; **Liz Brown** – Student Travel Award Chair; **Hart Schwarzenbach** – sponsorship chair; **George Berkompas** – advisor; **Michael Morrissey** – Keeper of the Checkbook; **Joe Frazier** – Hospitality Chair; members of the PFT Executive and Planning Committees; Session Moderators and our generous sponsors and donors. A special thanks also to PFT volunteers who are helping with arrangements during the conference: **Lucina Lampila, Jane Townsend, Laurie Wong, Yildiz Karaibrahimoglu, Connie Rezendes, Steve Gabrysh, Richard Kellems and OSU Graduate Students.**

PFT is a non-profit organization that is highly dependent on volunteer leadership and commitment. Officers are voted in annually to correspond with the new host state or country. The PFT conference is progressing northward with Oregon as the next host. If you would like to assist with the planning or sponsoring of next year's meeting, please let me know and I will be pleased to connect you with our new leaders.

PFT Organizing Committee

Pamela Tom
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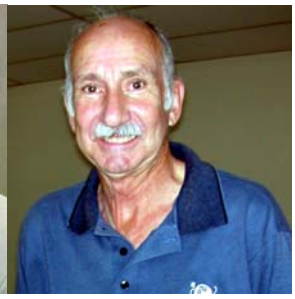

George Berkompas
Advisor

Michael Morrissey
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Sue Hansell
Administrative Assistant

Joyce Nettleton, DSc

Keynote Address: Is the Devil in the Deep Blue Sea? Benefits and Risks of Eating Seafood

Dr. Nettleton is a specialist in seafood nutrition and science communications who has an independent consulting practice, ScienceVoice Consulting, in Denver, CO.

Nettleton is well known for her work in seafood nutrition and omega-3 fatty acids since the publication of her first book, *Seafood Nutrition*, in 1985. Her third book, *Omega-3 Fatty Acids and Health*, was published in 1995. Nettleton has published scientific articles on seafood composition, omega-3 fatty acids and type 2 diabetes, and mercury in seafood. She is currently editor of two science-based electronic newsletters specializing in polyunsaturated fatty acids, the *PUFA Newsletter* for health professionals and *Fats of Life* for consumers. Both are freely accessible at www.fatsoflife.com. Nettleton is a frequent guest speaker on omega-3 fatty acids and health and is often quoted in the news media about the health benefits of seafood.

Nettleton holds a doctorate in nutrition science from the Harvard School of Public Health and a Masters in International Nutrition from Cornell. In 1999, she was elected Fellow of the American Association for the Advancement of Science.

Bruce Ferree

Dinner Speaker: How to Argue with an Auditor and Still Pass

He is currently employed as the Quality Manager at California Natural Products in Lathrop, CA.

A quarter century ago Bruce began his career after graduating from Colorado State University. He became a quality control supervisor at Longmont Foods in Longmont, CO. A short time later, Bruce and his new family, wife Christeen and daughter Corri, relocated to New Hampshire where he worked in a meat processing plant. They returned to Tracy, CA where Bruce became quality control manager for Leprino Foods. A lucky 13 years later, he joined TFIS and traveled the world as a food safety and quality systems auditor, trainer and consultant; realizing a life long goal of visiting all fifty US states. Bruce is an active volunteer leader with the Institute of Food Technologists and he serves at the local and national levels of IFT. He will discuss some of those travel adventures he had while working as a food safety guy.

PACIFIC FISHERIES TECHNOLOGISTS

2008 CONFERENCE

A Special Thanks

to our generous sponsors

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Alaska – Don Kramer, University of Alaska, Sea Grant - Marine Advisory Program
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California - Yildiz Karaibrahimoglu, Consultant
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Immediate Past Officers:

Past President - Josafat Marina Ezquerra Brauer, Universidad de Sonora
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Past Technical Program Chair - José Luis Cárdenas López, Universidad de Sonora

2008 PFT Planning Committee

Thank you for your support!

- Kate Abraham, Canadian Fishing Company
- George Berkompas, NOAA Fisheries -Seafood Inspection Program
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- Wayne Heikilla, Western Fishboat Owners Association
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- Jae Park, Oregon State University - Seafood Research Lab
- Juan Carlos Ramírez Suárez, CIAD, Mexico
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- John Ossmann, Silgan Containers Corporation
- Subramaniam Sathivel, Louisiana State University
- Jane Townsend, California Fisheries and Seafood Institute
- Pamela Tom, University of California - Sea Grant Extension Program
- Laurie Wong, Consultant

2008 PFT Exhibitors

Anresco Laboratories is a broad spectrum analytical and consulting laboratory specializing in the application of scientific and statistical principles to the problems of manufacturers, insurance companies, importers, marine surveyors, attorneys, and government agencies. We handle all testing required by the FDA for the Automatic Detention of import products, including seafood testing, filth, color & microbiological testing in foods & cosmetics, Nutrition Facts labeling, and leak testing for gloves & condoms. We also offer expert witness and consulting services in food science, HACCP planning, FDA & USDA regulations, and chemical & corrosion engineering. Established in 1943, we are located in San Francisco, CA with regional offices in Los Angeles, CA, New York and Florida. Our staff is fluent in Spanish, Chinese (Mandarin & Cantonese), Vietnamese and Russian.
Contact: Cynthia Kushi, Anresco Laboratories, 1370 Van Dyke Ave., San Francisco, CA 94124 Phone: (800) 359-0920 E-mail: cynthia@anresco.com
http://www.anresco.com/

California Sea Grant sponsors research, education and outreach activities to generate and share knowledge and solve problems related to coastal, marine and aquatic resources. It is a statewide, multi-university program administered by the University of California and based at Scripps Institution of Oceanography at the University of California, San Diego. It is the largest of 31 Sea Grant programs in the National Sea Grant College Program network and is part of the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce.
Contact: Steve Gabrysh, University of California, San Diego, California Sea Grant 9500 Gilman Drive, # 0232, La Jolla, CA 92093-0232 Phone: (858) 534-4446 E-mail: sgabrysh@ucsd.edu http://www-csgc.ucsd.edu/

Infratab Freshtime™ labels are RFID UHF EPC Class 1 Gen2-compatible labels that actively monitor the condition of tagged perishables. The labels not only monitor temperature but also integrate time and temperature. The result is a "live" assessment of how much shelf life or transport life was used and is left. Infratab is the inventor and maker of Shelf Life Smart Tags for seafood (RFID EPC Global).
Contact: Stanton Kaye, Infratab, Inc., 4347 Raytheon Road Oxnard, CA 93033 Phone: (805) 986-8880 E-mail: info@Infratab.com http://www.infratab.com/

The National Oceanic and Atmospheric Administration (NOAA) oversees fisheries management in the United States, and through the 1946 Agricultural Marketing Act, provides a voluntary inspection service to the industry. The NOAA Seafood Inspection Program offers a variety of professional inspection services, which assure compliance with all applicable food regulations. In addition, product quality evaluation, grading and certification services on a product lot basis are also provided. Benefits include the ability to apply official marks, such as the U.S. Grade A, Processed Under Federal Inspection (PUFI) and Lot Inspection.

The services provided by NOAA include the following:

- Establishment Sanitation Inspection
- Process and Product Inspection
- Product Grading
- Product Lot Inspection
- Laboratory Analyses
- Training
- Consultation

These services can be provided nationwide, in U.S. territories, and in foreign countries. All types of establishments such as vessels, processing plants, and retail facilities may receive these services. All edible product forms ranging from whole fish to formulated products, as well as fish meal products used for animal foods, are eligible for inspection and certification. The official government forms and certificates issued by USDC inspectors are legal documents recognized in any U.S. court.
Contact: Eric W. Staiger, Western Inspection, USDC/NOAA/NMFS Seafood Inspection Program, 7600 Sand Point Way NE, Bldg. 32, Seattle, WA 98115 Phone: (206) 526-4259 E-mail: eric.staiger@noaa.gov http://seafood.nmfs.noaa.gov/

SAI Global/EFSIS is a third party inspection and certification service offering certifications for several international standards including the BRC Global Food Safety and Storage and Distribution Standards, ISO 9001 and 22000, the IFS Food Safety and Storage and Distribution Standards, HACCP, Woolworths Trade Partners, Organic and EUREGAP. SAI Global is independently certified against various international standards including EN45004, EN45011 and EN45012. SAI Global/EFSIS is headquartered in the United Kingdom and has representatives or offices in the US, Thailand, Germany, France, Spain, Sweden, Hungary and the Czech Republic.
Contact: John Clemence, SAI/Global/EFSIS, 10604 Forest Ave S, Seattle, WA 98178, 206-772-2817 E- mail: cansalmon@aol.com

The Seafood Products Association (SPA) is an industry resource for technical and regulatory consultation. Formerly the Northwest Laboratory of the Grocery Manufacturers Association/Food Products Association (GMA/FPA), and the National Food Processors Association (NFPA), the SPA has provided member services, primarily to the seafood industry, for over 80 years.

General Membership provides assistance with and consultation for:

- regulatory inspections
- labeling
- food safety
- recognized process authority to develop and validate processes and evaluate process deviations
- developing and reviewing HACCP Plan
- product testing for nutritional, chemical, or microbiological characteristics
- consumer complaint exhibit testing
- shelf life studies
- packaging
- advocacy for science-based interpretation of regulatory and audit requirements
- training

Associate Membership provides

- a forum for collaborative issue management related to domestic and international regulatory requirements
- opportunities to network with customers and industry colleagues at Association functions
- access to additional information resources to enhance knowledge of technical issues and needs of customers.
- access to publications and training materials that are relevant to your business interests.

Contact: Kenny Lum, Seafood Products Association, 1600 South Jackson Street, Seattle, WA 98144 Phone: (206) 323-3540 E-mail: klum@spa-food.org http://www.spa-food.org

US Food and Drug Administration. FDA consumer materials on seafood safety (including FDA/EPA mercury advisory in several languages), labeling (including allergens), general nutrition (e.g., Dietary Guidelines in several languages), and industry-related handouts will be available at the PFT meeting.
Contact: Janet McDonald, US Food and Drug Administration, FDA/San Francisco District 1431 Harbor Bay Parkway, Alameda, CA 94502 E-mail: janet.mcdonald@fda.hhs.gov http://www.fda.gov

PFT MEETING AT-A-GLANCE
Hotel Whitcomb, 1231 Market St., San Francisco, CA USA
Web: http://seafood.ucdavis.edu/pft2008

Pre-PFT Meeting Events – Open To Public

SUNDAY, February 3, 2008 – Lombard Room

1:00 p.m. –	2:00 p.m.	Pacific HACCP Advisory Panel, K. Lum, Chair
2:00 p.m. –	3:00 p.m.	Alaska Seafood Processors Advisory Council, R. Klein, Chair

PACIFIC FISHERIES TECHNOLOGISTS PROGRAM
Tentative

SUNDAY, February 3, 2008

3:00 p.m. –	7:00 p.m.	Registration and Check In - Foyer
3:18 p.m. –	8:30 p.m.	Mixer (Light Refreshments) and Super Bowl - Ghirardelli
8:30 p.m. –	9:15 p.m.	PFT Executive Board Meeting – Room 745
9:15 p.m. –	Midnight	Cards and Social Hour - Room 745

MONDAY, February 4, 2008 – Ballroom (unless noted)

7:00 a.m. –	8:00 a.m.	Continental Breakfast
7:00 a.m. –	4:30 p.m.	PFT Registration and Check In - Foyer
7:15 a.m. –	7:55 a.m.	Poster Moderators Available - Mezzanine
8:00 a.m. –	8:15 a.m.	Welcome and Opening Remarks
8:15 a.m. –	8:40 a.m.	Keynote Address
8:40 a.m. –	10:00 a.m.	National Perspectives on Mercury Session
10:00 a.m. –	10:30 a.m.	Coffee Break - Mezzanine
10:30 a.m. –	11:45 a.m.	Did You Get What You Ordered? - Species Identification Session
11:45 a.m. –	1:00 p.m.	Luncheon - Mezzanine
1:00 p.m. –	1:45 p.m.	Education and Outreach Session
1:45 p.m. –	3:30 p.m.	Seafood Safety Research Session
3:30 p.m. –	4:30 p.m.	Refreshment Break and Poster Session - Mezzanine • Seafood Safety Research • Seafood Chemistry • Seafood By-products and Seafood Protein

6:00 p.m. – 7:30 p.m.	PFT President's Seafood Reception hosted by the California Fisheries & Seafood Institute at Fisherman's Wharf - Pier 45 Seafood (On Pier 45, Shed B, Unit 11) (Transportation on your own) – PFT Name Tag Required
9:15 p.m. – Midnight	Cards and Social Hour – Room 745

<u>TUESDAY, February 5, 2008</u> - Ballroom (unless noted)

7:00 a.m. – 8:00 a.m.	Continental Breakfast
7:00 a.m. – 4:30 p.m.	PFT Registration and Check In - Foyer
7:15 a.m. - 7:55 a.m.	Poster Moderators Available - Mezzanine
8:00 a.m. – 9:15 a.m.	Environmental Management Session
9:15 a.m. – 10:00 a.m.	Seafood Marketing Session
9:45 a.m. – 10:15 a.m.	Coffee Break - Mezzanine
10:15 a.m. – 11:45 a.m.	Seafood Processing and Engineering Session
11:45 a.m. – 12:50 p.m.	Luncheon - Mezzanine
12:50 p.m. - 1:15 p.m.	PFT General Business Meeting
1:15 p.m. – 2:15 p.m.	Seafood Protein Session
2:15 p.m. – 3:30 p.m.	Seafood By-product Utilization Session
3:30 p.m. – 3:45 p.m.	Refreshment Break - Mezzanine
3:45 p.m. – 5:00 p.m.	Seafood Chemistry Session
5:00 p.m. - 5:30 p.m.	Break
5:30 p.m. – 6:30 p.m.	Poster Session - Mezzanine • Seafood Processing and Marketing
5:30 pm – 7:00 p.m.	Cocktail Hour - Mezzanine
7:00 p.m. – 9:00 p.m.	Banquet
9:15 p.m. – Midnight	Cards and Social Hour – Room 745

<u>WEDNESDAY, February 6, 2008</u> - Ballroom (unless noted)

7:00 a.m. – 8:00 a.m.	Continental Breakfast
7:00 a.m. – 11:00 a.m.	PFT Registration and Check In - Foyer
8:00 a.m. – 9:15 a.m.	Current Seafood Regulatory Issues Session
9:15 a.m. – 11:45 a.m.	Seafood Inspection and Audit Session
9:30 a.m. – 9:45 a.m.	Coffee Break
11:45 a.m. – 12:00 noon	Concluding Remarks
12:00 p.m.	Adjourn

Post-PFT Meeting Events

(Separate Registration Required)

WEDNESDAY, February 6, 2008

1:00 p.m. – 4:30 p.m.	HACCP Segment 2 Course and HACCP Review Session San Francisco Federal Building, 90 Seventh Street, Room B040 East Auditorium (basement) -- about 1-1/2 blocks walk from Hotel Whitcomb Government issued identification required. See: http://seafood.ucdavis.edu/haccp/training/ca.htm

THURSDAY, February 7, 2008

9:30 a.m. – 5:00 p.m.	BRC Global Standard Food – Issue 5 (Global Food Safety Standard), Hotel Whitcomb See: http://seafood.ucdavis.edu/pft2008/brc.htm
8:30 a.m. – 12:15 p.m.	HACCP Segment 2 Course (Continued) San Francisco Federal Building, 90 Seventh Street, Room B020 East Auditorium (basement).

PACIFIC FISHERIES TECHNOLOGISTS PROGRAM
Tentative

SUNDAY, February 3, 2008

3:00 p.m. – 7:00 p.m.	Registration and Check In – Foyer
3:18 p.m. – 8:30 p.m.	Mixer (Light Refreshments) and Super Bowl - Ghirardelli
8:30 p.m. – 9:15 p.m.	Executive Board Meeting – Room 745
9:15 p.m. – Midnight	Cards and Social Hour – Room 745

MONDAY, February 4, 2008

7:00 a.m. – 8:00 a.m.	Continental Breakfast - Ballroom
7:00 a.m. – 4:30 p.m.	Registration and Check In – Foyer
7:15 a.m. – 7:55 a.m.	Poster Moderators Available – Mezzanine
8:00 a.m. – 8:15 a.m.	**Welcome and Opening Remarks - PFT 2008 President -** PAMELA TOM
8:15 a.m. – 8:40 a.m.	**Keynote Address** Is the Devil in the Deep Blue Sea? Benefits and Risks of Eating Seafood – JOYCE NETTLETON
8:40 a.m. – 10:00 a.m.	**National Perspectives on Mercury** **Session Moderator:** RANDY RICE
8:40 a.m. – 8:55 a.m.	Mercury Risk Assessment – PHIL SPILLER*
8:55 a.m. – 9:10 a.m.	Dietary Selenium in Prevention and Treatment of Mercury Toxicity – NICHOLAS V.C. RALSTON*
9:10 a.m. – 9:25 a.m.	Selenium and Mercury Molar Ratios of Pelagic Fish in the Central North Pacific near Hawaii - JOHN KANEKO*
9: 25 a.m. – 9:35 a.m.	Where are We Headed with Mercury? – RANDY RICE
9:35 a.m. – 10:00 a.m.	Mercury Panel Discussion with Audience
10:00 a.m. – 10:30 a.m.	Coffee Break
10:30 a.m. – 12:00 p.m.	**Did You Get What You Ordered? – Species Identification** **Session Moderator:** BRUCE FAIREY

10:30 a.m. – 10:45 a.m.	Update on the Seafood List, FDA's Policy for Determining if a Name is an Acceptable Market Name, and Reported Species Substitution Cases – SPRING RANDOLPH*
10:45 a.m. – 11:00 a.m.	Species Identification Programs for the Seafood Industry - SELESTER BENNETT*
11:00 a.m. – 11:15 a.m.	Rapid Identification of Imported Asian Catfish After Cooking - YUN-HWA P. HSIEH*
11:15 a.m. – 11:30 a.m.	Genetic Identification and Traceability in Pacific Salmon: Implications for Management and Marketing - MICHAEL MORRISSEY
11: 30 a.m. – 11:45 a.m.	Species Authentication of Raw and Commercial Salmon Products using PCR-RFLP - ROSALEE RASMUSSEN*
11:45 a.m. – 1:00 p.m.	**Lunch (Ticketed Event) - Mezzanine**
1:00 p.m. – 1:45 p.m.	**Education and Outreach** **Session Moderator:** LIZ BROWN
1:00 p.m. – 1:15 p.m.	A New Internet Training Course on Current Good Manufacturing Practices (GMPs) - KEN GALL*
1:15 p.m. – 1:30 p.m.	Top Ten Seafood Myths and Misconceptions – LUCINA LAMPILA
1:30 p.m. – 1:45 p.m.	Consumer Response to New Technologies – CHRISTINE BRUHN
1:45 p.m. – 3:30 p.m.	**Seafood Safety Research** **Session Moderators:** YI-CHENG SU and SCOTT SMILEY
1:45 p.m. – 2:00 p.m.	Field-Based Monitoring for Marine Biotoxins: Tools for Volunteers and Fisheries – GREGG LANGLOIS *
2:00 p.m. – 2:15 p.m.	Effects of Frozen Storage on Reducing *Vibrio parahaemolyticus* in Pacific Oysters - YI-CHENG SU*

2:15 p.m. – 2:30 p.m.	Degradation of Histamine by Extremely Halophilic Archaea Isolated from Salt-fermented Fishery Products - WANAPORN TAPINGKAE*
2:30 p.m. – 2:45 p.m.	Effects of Electrolyzed Oxidizing Water Treatments on Reducing Histamine-producing Bacteria and Histamine Formation in Fish - SUREERAT PHUVASATE*
2:45 p.m. – 3:00 p.m.	Improving Food Safety in Seafood Products Through Pathogen Growth Suppression - LEE GALLIGAN
3:00 p.m. – 3:15 p.m.	Investigating Some Quality Parameters of Several Traditional Fish Products in Relation to Food Safety - SEVIM KÖSE*
3:15 p.m. – 3:30 p.m.	Intestinal Tract as the Origin for Ethanol Production During Pink Salmon Spoilage - ALEXANDRA OLIVEIRA*
3:30 p.m. – 4:00 p.m.	**Refreshment Break - Mezzanine**
3:30 p.m. – 4:30 p.m.	**Poster Session - Mezzanine** **Session Moderators:** A. M. M. NURUL ALAM and ANGEE HUNT

Section - Seafood Safety Research

1. Histamine Level and Species Identification of Billfish Meats Implicated in Two Food-Borne Poisonings - YUNG-HSIANG TSAI*
2. Reduction of *Vibrio parahaemolyticus* in Pacific Oysters During Refrigerated Seawater Circulating Process - QIANRU YANG*
3. PCB Analysis of Carp (*Cyprinus carpio*) Harvested from Utah Lake - SHANNON ROSELL*
4. *Vibrio parahaemolyticus* in Oyster: It's Accumulation from Culture Water and Changes of Population During Storage - XIAOSHENG SHEN*
5. A Simple Method to Purified Viral Particles of White Spot Syndrome Virus, shrimp Pathogen - HILDA GRACIA VALENZUELA*

Section - Seafood Chemistry

1. Immobilization of Glucose Oxidase onto Langmuir Blodgett films - ANUOLUWAPO RUTH AMUSAN*

2. Molt-related Chitinase and Chitin Synthase Messenger RNA from Whiteleg Shrimp *Penaeus vannamei* - JORGE GUSTAVO ROCHA-ESTRADA*

3. Possible Chemico-structural Changes in Biologically Active Compounds in Pickled Shrimp and Octopus - MARITZA-MARÍA MORENO-VÁZQUEZ*

4. The ATP Synthase Complex of the Shrimp *Penaeus vannamei:* Analyzing the Genic Expression of Catalytic Subunits α and β During Hypoxia – ARLETT ROBLES ROMO*

5. Extraction, Purification and Biochemical Characterization of Transglutaminase from Bluefish (*Pomatomus saltatrix*) - VIDYA SUBRAMANIAN*

6. Investigating Suitability of Commercial Histamine Test Kits for Application to Traditional Fish Products - SEVIM KÖSE*

7. Antimicrobial Agents in Imported Aquacultured Seafood - PAMELA TOM*

8. True lipases in *Penaeus vannamei*: Insights Into Fat Digestion - CRISALEJANDRA RIVERA-PÉREZ *

Section – Seafood By-products and Seafood Protein

1. Using the pH-shift Solubilization Process to Produce Protein Concentrates from Shrimp Cephalothorax Waste - CRISTY CATZÍN-YUPIT*

2. The Effect of Drying Temperature on Aspartic Acid Racemization in Fish Meals from By-catch Species – FERNANDO L. GARCÍA-CARREÑO*

3. Effects of Storage Time and Temperature on the Biogenic Amine Concentrations in Raw and Processed Fish Meal from Pink Salmon (*Oncorhynchus gorbuscha*) By-products - TED H. WU*
4. Interaction of Fish protein and Pure Carrageenan as Affected by Various Salts - ANGEE HUNT*

5. Properties of Recovered Solids from Stickwater Treated by Centrifugation and pH Shift - C. GARCÍA-SIFUENTES*

6. Phospholipids from Pacific Sardine - J. D. PARK*

7. Effect of Protein Concentration and Proteolytic Activity on the Gel Quality of a Giant Squid (*Dosidicus gigas*) Protein Concentrate Obtained by Acid Dissolution and Isoelectric Precipitation - JUAN A. CORTES-RUIZ*

8. Effect of Two Thermal Processes on *Dosidicus gigas* By-Products Meals on Growth and Postharvest Shrimp Quality of *Litopenaeus vannamei*. - FRANCISCO JAVIER VALDEZ-IBARRA*

9. Proteomic Studies of Atlantic Salmon (*Salmo salar*) Skin Mucus Proteins During Smoltification - P. DUNNE*

10. Barrier and Tensile Properties of Alaskan Fish Skin Gelatin Films - R.J. AVENA-BUSTILLOS*

11. Partial Characterization of Pepsin Soluble Collagen (PSC) from Jumbo Squid (*Dosidicus gigas*) Mantle, Arms, and Fin - WILFRIDO TORRES ARREOLA*

12. Anti-oxidative and Anti-aging Activities of Collagen Hydrolysate - CHENGCHU LIU*

13. Potential Application of Collagen Extracted from the Mantle of Giant Squid (*Dosidicus gigas*) in the Preparation of collagen and Chitosan Biofilm - M.H. URIARTE-MONTOYA*

14. Comparison of Myosin Cross-linkage and Gel Forming Properties of Frozen Surimi Prepared from Silver Carp (*Hypophthalmichthys molitrix*) in Summer and Winter Seasons - CHENGCHU LIU*

6:00 p.m. – 7:30 p.m. PFT President's Seafood Reception, hosted by California Fisheries & Seafood Institute at Fisherman's Wharf – Pier 45 Seafood (On Pier 45, Shed B, Unit 11) (Transportation on your own) PFT Name Tag Required

9:15 p.m. – Midnight Cards and Social Hour – Room 745

TUESDAY, February 5, 2008

7:00 a.m. – 8:00 a.m.	Continental Breakfast - Ballroom
7:00 a.m. – 4:30 p.m.	Registration and Check In – Ballroom Foyer
8:00 a.m. – 9:15 a.m.	**Environmental Management** **Session Moderator:** WAYNE HEIKILLA
8:00 a.m. – 8:15 a.m.	How to Successfully Comply with the Clean Water Act and Avoid Costly Government Enforcement and Third Party Lawsuits – ALAN ISMOND*
8:15 a.m. – 8:30 a.m.	Responsible Fisheries Assessment of the Hawaii Longline Fishery - JOHN KANEKO
8:30 a.m. – 8:45 a.m.	Seafood Sustainability-Options and Issues or What is a Seafood Eco-label? - RANDY RICE
8:45 a.m. – 9:00 a.m.	Competitiveness Improvement in Energy Resource Management, Real-time Costs, Greenhouse Gas Emission Measurement and Reporting - GLEN LEWIS*
9:00 a.m. – 9:15 a.m.	The World Fisheries Crisis, or What Happened to the Science in Fisheries Science? - VIDAR WESPESTAD
9:15 a.m. – 10:00 a.m.	**Seafood Marketing Session** **Moderator:** MICHAEL MORRISSEY
9:15 a.m. – 9:30 a.m.	Seafood Exports to the EU – What You Need to Know and Where to Find Information - STÉPHANE VRIGNAUD
9:30 a.m. – 9:45 a.m.	Green Trade in the Seafood Supply Chain – A Case Study of the Cool Blue Box - WILLIAM DAVIES*
9:45 a.m. – 10:00 a.m.	The Better Seafood Bureau: A Process to Preserve Economic Integrity - LISA M. WEDDIG
10:00 a.m. – 10:15 a.m.	**Coffee Break**
10:15 a.m. – 11:45 a.m.	**Seafood Processing and Engineering** **Session Moderators:** JAE PARK and MURAT BALABAN
10:15 am – 10:30 am	Proteolytic Degradation of Albacore Tuna Light Meat During the Canning Process - MARIA E. RUILOVA*

10:30 a.m. – 10:45 a.m.	Development of Economical Methods to Purify Fish Oil and Microencapsulation of Fish Oil – SUBRAMANIAM SATHIVEL*
10:45 a.m. – 11:00 a.m.	Phosphate-free Surimi: Feasible Challenge or Problematic – JAE PARK
11:00 a.m. – 11:15 a.m.	Comparative study on Freeze Storage of North Atlantic Shrimp (*Pandalus borealis*) and Black Tiger Shrimp (*Penaeus monden*) in Different Periods and Levels of Freeze Storage – A. M. M. NURUL ALAM*
11:15 a.m. – 11:30 a.m.	Effects of Different Slaughtering Methods on Post Harvest Quality of Farmed Atlantic cod (*Gadus morhua*) - HANNE DIGRE*
11:30 am – 11:45 a.m.	Cooking and Freezing Time Effects on Farmed White Shrimp Muscle Myofibrillar Proteins - JOSE LUIS CÁRDENAS-LOPEZ *
11:45 a.m. – 12:50 p.m.	**Luncheon (Ticketed Event) - Mezzanine**
12:50 a.m. – 1:15 p.m.	**PFT Business Meeting**
1:15 p.m. – 2:15 p.m.	**Seafood Protein** **Session Moderator:** BENJAMIN SIMPSON
1:15 p.m. – 1:30 p.m.	New Insights into the Factors Influencing Muscle Protein Gelation - TYRE C. LANIER*
1:30 p.m. – 1:45 p.m.	Functional Protein Concentrates from Jumbo Squid (*Dosidicus gigas*) Muscle Using Acid and Alkaline Solubilization Processing – HUGO PALAFOX CARLOS*
1:45 p.m. – 2:00 p.m.	Effect of Alkaline Solubilization Process on Physiochemical Properties and Gel-forming Ability of Striped Catfish (*Pangasius hypophthalmus*) Protein - PANCHAPORN TADPITCHAYANKOON*
2:00 p.m. – 2:15 p.m.	Qualification and Quantification of Protein Additives in Prepared Crabstick using ELISA - ZACHARY H. REED*

2:15 p.m. – 3:30 p.m.	**Seafood By-product Utilization** **Session Moderator:** PETER BECHTEL
2:15 p.m. – 2:30 p.m.	Alaskan Fish Gelatin Films: Thermal, Tensile, and Barrier Properties and Effects of Cross-linking - BOR-SEN CHIOU*
2:30 p.m. – 2:45 p.m.	Recovery of Muscle Protein and Collagen from Pearl Production Waste - CHENGCHU LIU*
2:45 p.m. – 3:00 p.m.	Increasing Utilization of Viscera from Fish Processing – PETER J. BECHTEL*
3:00 p.m. – 3:15 p.m.	Composition of Hydrolysate Meals Made from Alaskan Pollock, Salmon and Flatfish Processing By-products: Comparisons with Traditional Alaskan Fishmeals – SCOTT SMILEY*
3:15 p.m. – 3:30 p.m.	Chemical Characterization of Heads and Livers of Yelloweye Rockfish (*Sebastes ruberrimus*) Harvested in Alaska - NECLA DEMIR*
3:30 p.m. – 3:45 p.m.	**Refreshment Break - Mezzanine**
3:45 p.m. – 5:00 p.m.	**Seafood Chemistry** **Session Moderator:** FERNANDO L. GARCÍA-CARREÑO
3:45 p.m. – 4:00 p.m.	Kazal Proteinase Inhibitor: A Recombinant Protein from *Penaeus vannamei* Hemocytes – CRISALEJANDRA RIVERA-PÉREZ*
4:00 p.m. – 4:15 p.m.	Protein Digestion System in Crustaceans - FERNANDO L. GARCÍA-CARREÑO*
4:15 p.m. – 4:30 p.m.	Effects of Fumonisin B_1 on Growth, Survival, and Ice Storage Life of White Shrimp (*Litopenaeus vannamei*) - JOSAFAT MARINA EZQUERRA-BRAUER*
4:30 p.m. – 4:45 p.m.	The Effect of Trypsin Phenotype in the Degree of Hydrolysis of Protein by Shrimp *Penaeus vannamei* - JULIO H. CÓRDOVA-MURUETA*
4:45 p.m. – 5:00 p.m.	Digestive Cathepsin L and D in the European Lobster *Homarus gammarus* - LILIANA ROJO ARREOLA*

5:00 p.m. – 5:30 p.m. Break

5:30 p.m. – 6:30 p.m. **Poster Session - Mezzanine**
Session Moderators: SUBBA RAO GURRAM and JUAN CARLOS RAMIREZ-SUAREZ

Session - Seafood Processing and Education

1. Assessing the Need for Training in the Retail Seafood Sector of Seattle, Washington - MARK H. GLEASON*

2. The 2007 International Smoked Seafood Conference; Review of the Meeting and Lessons Learned - LIZ BROWN*

3. California Sea Grant Fisheries Extension – PAMELA TOM*

4. Shelf Life Extension of Shrimp (White) Using Modified Atmosphere Packaging - J.C. ACTON*

5. Effect of different Methods of Cooking on Proximate Composition and Fatty Acid Profile in the, *Fenneropenaeus indicus* – PARISA DELFIEH*

6. Effect of Collagen Edible Coating from Skate Ray (*Raja kenojei*) Skin on Shelf-Life of Pork as a Natural Shelf-Life Enhancer in Pork - JONG-BANG EUN*

7. Functional Protein Concentrates from Jumbo Squid (*Dosidicus gigas*) Muscle Using Acid and Alkaline Solubilization Processing. – FERNANDO L. GARCÍA CARREÑO*

8. Impact of Brine, Phosphate and Salt Levels on Textural Properties of Restructured Albacore Hams as Analyzed by Texture Profile Analysis - JOSEF G. ROBLERO*

9. Effect of a Natural Antimicrobial on Shelf-life of Frankfurters Made from Jumbo Squid *(Dosidicus gigas)* Mantle Muscle – JUAN CARLOS RAMIREZ-SUAREZ*

10. Development of a Restructured Crabmeat Product: Examining the Physical, Chemical and Microbiological Attributes - LAURETTA-LYN KATSRIKU*

11. Gel Characteristics of Common Carp Surimi and Kamaboko Prepared by Alternative Methods - ALI JAFARPOUR*

12. Effects of CO Treatment on the Color of Frozen Tilapia and Catfish - WENDY M. MARIN GOMEZ *

13. Grading of Pink Salmon Skin Watermarking Using a Machine Vision System - ALEXANDRA C.M. OLIVEIRA*

14. Effects of CO Treatment on the Color and Quality of Atlantic Salmon - MAX OCHSENIUS*

15. Effect of Different Methods of Cooking on Proximate Composition and Fatty Acid Profile in the Muscle of*, Otholithes rubber* - S. NOORI ESTAHBANATI*

16. Fish Processing Discards as Feedstock for Biodiesel Production - A.N.A. ARYEE*

17. Stability and Processing Characteristics of Coated, Spray Dried-squid Oil by Fluidized Bed Coating Technology - K.S. YOUN*

18. Purification of Commercial Alaska Pink Salmon (*Oncorhynchus gorbuscha*) Oils and Pollock (*Theragra chalcogramma*) Oils Using Chitosan - NECLA DEMIR

19. Stabilizing Carp (*Cyprinus carpio*) Hydrolysate Using Potassium Sorbate - AMANDA ROSELL*

5:30 p.m. – 7:00 p.m. **Cocktail Hour - Mezzanine**

7:00 p.m. – 9:00 p.m. **Banquet (Ticketed Event) - Ballroom**

- White King Salmon? – GEORGE BERKOMPAS
- How to Argue with an Auditor and Still Pass - BRUCE FERREE
- Recognition of Outgoing and Incoming PFT Officers – PAMELA TOM
- Presentation of Student Paper Competition Awards – DONALD KRAMER

9:15 p.m. – Midnight Cards and Social Hour – Room 745

WEDNESDAY, February 6, 2008

8:00 a.m. – 9:15 a.m.	**Current Regulatory Issues** **Session Moderator:** ERIC STAIGER
8:00 a.m. – 8:15 a.m.	Oregon Update – DAWN SMITH
8:15 a.m. – 8:30 a.m.	Hot International Topics - TIMOTHY HANSEN
8:30 a.m. – 8:45 a.m.	FDA Updates - JANET McDONALD
8:45 a.m. – 9:00 a.m.	What Will the 2008 Revised Edition of the FDA Fish and Fishery Products Hazards and Controls Guidance Cover? - DEBRA DeVLIEGER
9:00 a.m. – 9:15 a.m.	Seafood and Import Safety: What's on the Horizon – LISA M. WEDDIG
	Seafood Inspection and Audit Session **Moderators –** MAS HORI and GEORGE BERKOMPAS
9:15 a.m. – 9:30 a.m.	An Overview of Key International Food Safety Auditing Programs – Which One Suits Your Company? – CLARE WINKEL
9:30 a.m. – 9:45 a.m.	**Coffee Break - Ballroom**
9:45 a.m. – 11:45 a.m.	Expert Tips on Complying with a Seafood Audit or Inspection Panel
9:45 a.m. – 10:00 a.m.	Surviving Audits with Your Sanity Intact - KATE ABRAHAM
10:00 a.m. – 10:15 a.m.	How to Pass a Seafood Audit - TIMOTHY HANSEN
10:15 a.m. – 10:30 a.m.	Seafood HACCP Compliance: FDA's Approach to Inspection and Current Regulatory Issues - DEBRA DeVLIEGER
10:30 a.m. – 10:45 a.m.	The Use of Sensory Techniques within a Seafood Processor's Program - JAMES BARNETT
10:45 a.m. – 11:00 a.m.	Food Safety from FDA/Private Consultant Perspective – CHRISTOPER E. REZENDES

11:00 a.m. – 11:15 a.m.	Seafood Safety Inspections, an International Perspective- DANIEL E. BROOKS
11:15 a.m. – 11:45 a.m.	Q/A Panel Discussion with Audience
11:45 a.m. – 12:00 p.m.	**Closing Remarks – 2008-2009 PFT President**
12:00 p.m.	**Adjourn**

*****Presenting author.

Abstracts

KEYNOTE ADDRESS

Is the Devil in the Deep Blue Sea? Weighing the Benefits and Risks of Eating Seafood
Joyce A. Nettleton. *Science Voice Consulting, Editor, PUFA and Fats of Life Newsletters, Denver, CO 80205*

Few foods are as controversial as seafood, not because it is unhealthy or harmful, but because the excuses to shun it are so numerous. Whether it is declining resources, fear of contaminants, opposition to aquaculture, concern about farmed fish diets, turtle exclusion devices, dolphins or simply taste aversion, Americans have opted out. Fish consumption in the U.S. and consequently breast milk docosahexaenoic acid levels are among the lowest in the world. US rates of heart disease mortality are double those of fish-eating countries; mental illnesses are among the world's highest; and degenerative diseases such as age-related macular degeneration, Alzheimer's disease and Parkinson's disease are all linked to low DHA status. Strident campaigns to convince consumers that mercury in fish damages the brain have convinced some that it's not worth taking the chance. Recommendations from various government sources are muddled and conflicting; even scientists are at loggerheads. While risk assessments of potential harm are inherently uncertain, nearly all have ignored the benefits one loses by not eating fish, and almost none has considered the anti-toxicants in fish that render mercury harmless. This paper discusses the evidence of the diverse health benefits of eating fish compared with the potential risks of contaminants. New evidence suggests that the potential toxicity of mercury in fish has been exaggerated, while certain diseases may possibly be prevented entirely by having sufficient long-chain omega-3 fatty acids that are found almost exclusively in seafood. Recent findings may explain several discrepancies between the real-world observations among fish-eaters and the specter of contaminant toxicities. The balance between benefits and risks has become clearer.

SESSION: NATIONAL PERSPECTIVES ON MERCURY

Methylmercury Risk Assessment
PHILIP SPILLER. *U.S. Food and Drug Administration, College Park, MD***.**

Starting as early as 2004, the U.S. Food and Drug Adminstration began examining the feasibility of quantifying the risk from methylmercury in commercial seafood through the range of U.S. exposures as part of a new phase of risk management for methylmercury. This examination included a study of how and whether potential health benefits from fish consumption could be included in an assessment. The traditional focus of FDA's food safety program has been on the safety of the food itself, without taking

benefits into account in any formal, systematic way. The FDA project team concluded that a quantitative risk assessment for methylmercury is feasible and has conducted it, at least as an initial version. The project is now in the final stages of development.

In certain respects, this project is in keeping with recent recommendations from the United States National Academy of Sciences, which urged public health agencies such as FDA to quantify risk through the range of exposures being experienced by the general population that when evaluating risk from a contaminant such as methylmercury in fish. By contrast, the current "safety assessment" approach develops one level of exposure to a contaminant deemed to be without appreciable risk, but does not measure the risk to those who may be exposed above that level. As a result, risk managers are often compelled to act on the basis of prudence without a clear picture of whether their actions are significantly lowering the risk to consumers.

Moreover, risk managers might not know whether limiting fish consumption in order to protect against a risk that has not been measured could be inadvertently increasing risks in other areas. There is a growing body of evidence that fish can be protective or beneficial for various health endpoints. The National Academy of Sciences stressed the need to take potential benefits into account when providing consumption advice about risks.

Dietary Selenium in Prevention and Treatment of Mercury Toxicity

N.V.C. RALSTON, C.R. Ralston and L.J. Raymond. *Energy & Environmental Research Center, University of North Dakota, Grand Forks, ND.*

Ocean fish are rich sources of selenium (Se), a nutrient that counteracts potential toxicity of the methylmercury (MeHg) that they also contain. Therefore, it is important to understand the protective and therapeutic effects of Se in the normal dietary range. Experimental diets that were nutritionally complete other than being low in Se (0.1 μmole/kg; ~0.01 ppm), were supplemented with sodium selenite to normal (1.0 μmole/kg), or rich (10 μmole/kg) levels, and prepared with or without MeHg added at 50 μmole/kg (10 ppm) (3 x 2 feeding study). Weanling male Long Evans rats fed these diets were monitored for MeHg-dependent effects on growth and motor function. MeHg-fed rats on Se-rich diets grew and behaved normally and no signs of MeHg toxicity were observed. MeHg fed rats fed normal Se diets gained weight slower than their respective control group, but showed no other signs of MeHg toxicity. In contrast, MeHg fed rats low Se diets showed depressed weight gains relative to untreated control groups after 2 weeks, started to lose weight and showed hind limb crossing after 11 weeks, and were terminally ill after 18 weeks on the diets. The Se-Treatment study started on week 11 of the Se-Protection study using parallel groups of rats that had been fed the low-Se MeHg supplemented diets. Rats that were rescued by starting them on Se-rich diets on week 11 began gaining weight after a week and thereafter grew rapidly regardless of whether their diets still contained 10 ppm MeHg or not. Progressive declines in motor function that characterize MeHg toxicity stopped shortly after beginning on Se-rich diets, but functional defects that had already accumulated were irreversible. In summary, diets that are Se-rich protect against growth impairment, neurological deterioration and lethality from MeHg toxicity, and are a therapeutically effective treatment to prevent its pathological progression.

Selenium and Mercury Molar Ratios of Pelagic Fish in the Central North Pacific near Hawaii

JOHN KANEKO MS, DVM[1]* and Nicholas Ralston[2]. *[1]PacMar, Inc., Honolulu, HI. [2]Energy and Environmental Research Center, University of North Dakota*, *Grand Forks, ND.*

There is growing evidence that the interactions between selenium and mercury and their molar ratios in seafood are the essential factors in evaluating risks associated with dietary mercury exposure, and not mercury concentration alone. The absolute and molar concentrations of mercury and selenium were determined in edible portions of 15 species of commercially important pelagic fish collected from the central North Pacific Ocean near Hawaii. A molar excess of selenium over mercury was found in almost all fish species evaluated. Mean Se:Hg molar ratios listed in rank order from high to low are striped marlin

(17.6)> yellowfin tuna (14.1)> mahimahi (13.1)> skipjack tuna (12.8)> spearfish (11.4)> wahoo (10.8)> sickle pomfret (6.7)> albacore tuna (5.3)> bigeye tuna (5.2)> blue marlin (4.1)> escolar (2.4)> opah (2.3)> thresher shark (1.5)> swordfish (1.2)> mako shark (0.5). Mako shark with a Se:Hg molar ratio of less than 1, was the only fish containing a net molar excess of mercury. A Selenium Health Benefit Value is proposed as a more comprehensive seafood safety criterion, based on the absolute amounts and relative proportions of selenium and mercury in seafood.

SESSION: DID YOU GET WHAT YOU ORDERED? — SPECIES IDENTIFICATION

Update on the Seafood List, FDA's Policy for Determining if a Name is an Acceptable Market Name, and Reported Species Substitution Cases

S. RANDOLPH* and Williams R. Jones. *U.S. Food and Drug Administration, College Park, MD.*

The Food and Drug Administration (FDA) has received an increase in reports of species substitution. Some of the substitutions have caused food safety hazards to be misidentified and/or not detected. The Seafood List was created to assist in identifying the species, and reduce confusion in the marketplace. In the previous publication, FDA had provided some brief guidance regarding the determination of acceptable market names. However, in our next revision we have included additional information so that the process of determining if a name is an acceptable market name may be better understood. FDA believes that the use of this guidance in determining acceptable market names would assist in properly identifying seafood and help identify the appropriate potential hazards that may exist with a species. Identifying and controlling appropriate potential hazards involves knowing the identification of the species that you are processing, selling or consuming. Controlling potential food safety hazards of mislabeled product is difficult because the potential food safety hazards are not being identified for the right species. The use of the market name as listed in The Seafood List can help determine and control a product's potential food safety hazards because these market names are used in FDA's Fish and Fisheries Products Hazards and Controls Guidance. Also, it gives the name that would be most widely used for particular species in the US, so that there is a common reference for vernacular and regional names.

Species Identification Programs for the Seafood Industry

LeeAnn Applewhite[1] and SELESTER BENNETT[2]* *Applied Food Technologies, [1]3610 NW 42nd Terrace, Gainesville, FL 32606. [2]1700 Kraft Drive, Suite 1350, Blacksburg, VA 24060*

A global challenge facing the seafood industry today is the need to meet consumer demands for high quality seafood products in the face of ever shrinking resources. International trade in fishery products has increased dramatically over the past 10 years and the U.S. has become dependant on imported products to help satisfy the nation's appetite for safe, high value seafood. With the increase in imports there has also been an increase in fraudulent species substitution and product mislabeling. Even though federal and state regulatory agencies have tried to combat this growing problem, their enforcement is limited by the inadequate diagnostic tools currently available.

Applied Food Technologies (AFT) is a molecular diagnostics company engaged in the research, development and commercialization of analytical products and services for the seafood industry. The company has built a strong species diagnostic program based on its AUTHENTI-KIT^{SM} technology. AUTHENTI-KIT^{SM} is designed to reliably and accurately identify the species of animal tissues used in food production by utilizing unique genetic markers. The foundation of our identification method is based solely on taxonomically validated reference species. To our knowledge, it is the only such system in the United States. AFT has successfully used its technology to identify crab, shrimp, and catfish at the species level.

AFT has also used the AOAC Official Method 980.16, Identification of Fish Species- Isoelectric Focusing (IEF) method, for species identification. Since DNA testing is rapidly displacing protein IEF methods as the industry standard, AFT is working closely with FDA and Fish-BOL to standardize a DNA sequencing method suitable for species identification. We are in the process of developing a sequence database for all reference species currently in our collection. We anticipate being able to perform all our species identifications for the industry based on DNA technology in the very near future.

Rapid Identification of Imported Asian Catfish after Cooking

YUN-HWA P. HSIEH*, Kamil Gajewski, and Yi-Tien Chen. *Florida State University. Department of Nutrition, Food and Exercise Sciences, Tallahassee, FL 32306-1493.*

Asian farm-raised Pangasius catfish including tra *(Pangasius hypophthalmus*) and basa (*Pangasius bocourti*) is the fastest growing fish commodity on the US market. Over 50 million pounds of Pangsius fish were imported into U.S. seafood market in 2006. Fillets of basa and tra often found to be misrepresented as domestic catfish fillets or served in the restaurants as wild-caught grouper. This paper reports the rampant mislabeling problems associated with these imported fish and the development of monoclonal antibody (MAb)-based immunoassay for the rapid identification of tra and basa.

Crude sarcoplasmic protein extract from cooked (100^{o}C, 30 min) tra was used as the immunogen to develop MAbs. The immunoreactivity of MAbs was examined against raw and cooked samples of 57 seafood species, 11meat species and 5 other food proteins using indirect enzyme-linked immunosorbend assay (ELISA). The antigenic proteins which are responsible for the binding of the MAbs were determined by Western Blot.

Two IgG class MAbs showing specificity to only Pangasius fish, tra and basa, were selected. MAbs T7E10 binds to two major proteins (75 kDa and 35 kDa) in raw and cooked tra and basa extracts, while MAbT1G11recognizes several protein bands (between 13 and 18 kDa) in the extracts. Both MAbs exhibit a stronger reaction with tra than basa without any cross reaction with other seafood, meat and food proteins tested.

The MAbs developed in this study can be employed in various formats of immunoassay, such as microplate, lateral flow strip test, immunostick, and immunosensor, for rapid distinguishing of tra and basa, from other fish species. Such assay would provide a powerful tool to discourage the illegal practice in the market. These MAbs are also valuable for the studies of the chemical, biological, and physiological properties of these species-specific, thermo-stable sarcoplasmic proteins explored in this study.

Genetic Identification and Traceability in Pacific Salmon: Implications for Management and Marketing

MICHAEL MORRISSEY. *Oregon State University Food Innovation Center, 1207 NW Naito Parkway, Portland, OR 97209-2834.*

Poor return of Klamath River Stock Chinook salmon severely limited commercial fishing of salmon along the Oregon Coast during the 2006 season. While Klamath Stocks are weak, other stocks are healthy and a fundamental question is whether there are approaches to gaining access to these stocks without impacting Klamath stocks. One approach is to combine genetic information with digital traceability systems to track Chinook salmon stocks and individual fish for management and marketing purposes. A previous project (GAPS: Genetic Analysis of Pacific Salmonids) has developed a baseline for genetic identification of Chinook salmon. Each river basin has a unique genetic identity which can be determined by individual fish microsatellite DNA. By taking DNA samples from a small fin-clip (< 10 grams) scientists can use differences in patterns of genetic markers in the microsatellite DNA to determine the home basin (or hatchery) of an individual fish in less than 48 hours. During the 2006 season, 3,100 fish tissue samples were processed, and 2,567 samples provided stock identification information. Some 2,097 fish were assigned > 90% to river of origin ranging from Alaska to California. Interestingly, approximately 60% of

the fish caught off the Oregon coast were from the Sacramento River system. This information has potential to be used to make rapid management decisions about opening and closing areas for fishing. Using genetic information about a fish's home basin can also be used to market more abundant stocks and increase value to fishermen. For example, salmon could be marketed according to their home basin. This type of "branding" could be used to improve the price to fishermen and create new niche markets for ocean-caught salmon.

Species Authentication of Raw and Commercial Salmon Products Using PCR-RFLP
ROSALEE RASMUSSEN*, Michael T. Morrissey and Jessica Walsh. *Oregon State University Seafood Lab, 2001 Marine Dr., Room 253, Astoria, OR 97103.*

In order to prevent fraudulent mislabeling of commercial salmon products, there is a need for species identification methods that are rapid, inexpensive and reliable. The objective of this study was to validate and improve upon a genetic method for the diagnosis of six commercial salmonid species based on restriction fragment length polymorphisms (RFLPs).

Reference samples of rainbow trout and Atlantic, coho, chinook, chum and sockeye salmon originating from Idaho, Oregon, Alaska and Canada were obtained and morphologically verified. Crude DNA was obtained for all species and a 464 bp fragment of the mitochondrial cytochrome *b* gene was amplified with the polymerase chain reaction (PCR). The PCR amplicons were then digested with the restriction enzymes Sau3AI and NlaIII and the results were visualized by agarose gel electrophoresis. Commercial salmon products (n = 28), including salmon jerky, canned, smoked and fresh samples, were also purchased locally and analyzed using this method to determine the feasibility of PCR-RFLP in fraud detection.

All 6 reference salmonid species could be recognized based on differences in their restriction enzyme profiles. These results were consistent with previous studies, indicating that these restriction enzyme sites are relatively resistant to intraspecies variation. Further, this procedure proved to be more rapid than previous reports by eliminating the need for an overnight digestion. Salmonid species were identified in all 14 commercial smoked salmon and fresh fillet products; however, more extensive DNA extraction methods had to be employed to verify species in canned products. Overall, PCR-RFLP proved to be a simple, cost-effective method for the identification of salmonid species in raw and commercially smoked products.

SESSION: EDUCATION AND OUTREACH

A New Internet Training Course on Current Good Manufacturing Practices (GMPs)
KEN GALL[1]*, Debra Devlieger[2], Doris Hicks[3], Lori Pivarnik[4], Mike Jahncke[5], Abigail Villalba[5], Victor Garrido[6], Steve Otwell[6], Barry Nash[7] and Dave Green[7]. *[1]Cornell University and New York Sea Grant. [2]U.S. Food and Drug Administration. [3]University of Delaware. [4]University of Rhode Island. [5]Virginia Tech. [6]University of Florida. [7]North Carolina State University.*

A new Internet training course that summarizes the requirements of the current Good Manufacturing Practices (21 CFR Part 110) has been completed. The course includes 12 Modules designed to review each of the requirements in the current GMP regulation and provide practical suggestions for meeting these requirements. This Internet training course is specifically designed to train middle level managers, supervisors, quality control personnel and others who have responsibility for compliance with current GMPs in food processing, wholesale and warehouse operations. The course is applicable to firms and regulators that handle or inspect any food commodity. The Internet course will be hosted and managed by Cornell University Cooperative Extension, and will be available on demand in 2008. Course features include examples of good and bad practices on "GMP TV", downloadable PDF files of the course content and checklists, and extensive links to additional resources. Students will have the option of viewing course materials "live" on the Internet, downloading content to their computer, or listening to audio files of each page of the course. A Spanish language version of the course will be completed in 2008. Individuals who

complete the 12 course Modules online using their unique Username and Password will receive a Certificate of Course Completion. Students who complete the course will also have access to five In-Plant Training Modules which can be used for additional on-site training of line and production workers on critical components of the GMPs such as hand washing, personal hygiene, cleaning and sanitizing, and process controls. This project was partially funded through a grant from the National Integrated Food Safety Initiative (Grant No. 05-51110-03291) of the Cooperative State Research, Education and Extension Service, U.S. Department of Agriculture.

Top Ten Seafood Myths and Misconceptions

Lucina E. Lampila. *Prayon Inc., PO Box 1295 Hightstown NJ, 08520-0849.*

The food industry is often a target for negative media attention. Despite solid science supporting the positive attributes to seafood consumption, bad science exists and when not adequately disputed; it becomes the common perception that takes on a life of its own. This presentation will focus on the top ten myths and misconceptions related to seafood and its consumption. Fallacy versus Fact will be discussed as well as Features and Benefits to support the positive attributes of seafood consumption will be covered. Some of the Top Ten will include farmed versus wild; organic; mercury levels; phosphates and economic fraud; algal versus seafood omega-3 fatty acids; and pesticides will be among the key topics.

Consumer Response to New Technologies

CHRISTINE BRUHN. *Center for Consumer Research, Department of Food Science and Technology, University of California, Davis 95616.*

New technologies offer real benefits to consumers and the seafood industry. Although some consumers are skeptical about new technologies and prefer unprocessed products or traditional processing methods, many are receptive to new approaches that offer advantages they care about. Consumer research in the United States and Europe indicates that people are ready to buy high pressure processed products that offer good taste and nutrition. Several products processed by high pressure are in the marketplace. High pressure processing preserves taste, extends shelf life and reduces the risk of foodborne illness. Companies offering oysters find that high pressure processing offers economic benefits because of greater efficiency and a higher quality product. Restaurants have chosen not to label these products, however labeling might increase purchase among risk adverse consumers, since the high pressure processes reduces the risk from eating raw oysters. Applications to shrimp and lobster are being explored. Promotion should focus on the product, not the technology used to process it. Information about a new processing technology should include the benefits of the new process while also addressing worker safety and environmental impact. Endorsement by respected experts enhances message credibility. Information should be presented in a variety of sources, with the web widely used by food professionals and young adults.

SESSION: SEAFOOD SAFETY RESEARCH

Field-Based Monitoring for Marine Biotoxins: Tools for Volunteers and Fisheries

GREGG LANGLOIS[1]* and Peter Miller[2]. *[1]California Department of Public Health. [2]University of California Santa Cruz.*

Traditional monitoring programs for marine biotoxins have relied on the laboratory analysis of sentinel species (e.g., mussels) and end-product testing for public health protection. These programs have proven effective over the decades but have been challenged in recent years by an increasing frequency and variety of toxic blooms. In 1991 a dramatic event occurred in Monterey Bay that changed the direction of biotoxin monitoring in California. The discovery of a new marine toxin in California waters, domoic acid, resulted in the establishment of a unique volunteer-based monitoring program for phytoplankton along the California coast. Building on this approach, the California Department of Public Health and the University

of California Santa Cruz have partnered to evaluate simple and cost-effective field-based tools and decision criteria for detecting harmful algae and the toxins that some species produce.

Qualitative sampling of sea water with a phytoplankton net, coupled with a portable field microscope, can enable volunteers, shellfish aquaculture companies, and fisheries to detect the early stages of an increase in a toxic phytoplankton species. Decision criteria are being evaluated to link phytoplankton monitoring with the use of a simple qualitative test for the detection of either domoic acid or the paralytic shellfish poisoning (PSP) toxins in shellfish or other seafood species. Initial results have shown a good correlation between the observations of *Pseudo-nitzschia* and the increase of domoic acid in shellfish. Field observations in San Luis Obispo and Santa Barbara in the Spring of 2007 detected increases in *Pseudo-nitzschia*, prompting the screening of shellfish samples with the field diagnostic kits. Positive results for domoic acid with these field kits allowed a shellfish grower to cease harvesting before concentrations exceeded the regulatory alert level. These diagnostic kits have also proven reliable for the detection of the PSP toxins when compared with the standard regulatory method.

Effects of Frozen Storage on Reducing *Vibrio parahaemolyticus* in Pacific Oysters

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Vibrio parahaemolyticus is a major cause of diarrhea associated with seafood consumption around the world. The U.S. Centers for Disease Control and Prevention estimated that 2,800 cases of *V. parahaemolyticus* illness associated with raw oyster consumption occurred in the U.S. each year. Numerous outbreaks of *V. parahaemolyticus* infection resulted from oyster consumption have been documented in the U.S. since 1997, including recent ones reported in the Pacific Northwest in 2006 and 2007. This study investigated effects of frozen storage on inactivating virulent strains of *V. parahaemolyticus* in Pacific oyster stored -10, -23 and -30°C. Raw Pacific oysters were inoculated with five-strain cocktail of clinical isolates of *V. parahaemolyticus* at a level of approximately 3.5×10^5 MPN/g. Inoculated oysters were subjected to an ultra-low (liquid nitrogen) freezing process and stored at -10, -23 and -30°C for 4 months. The densities of *V. parahaemolyticus* decreased faster in inoculated oysters stored at -10°C than at -23 or -30°C. Populations of *V. parahaemolyticus* in oysters were reduced by 2.45, 1.71, and 1.45 log MPN/g in oysters after one month of storage at -10, -23, and -30°C, respectively. The reductions increased to 3.82 (-10°C), 3.14 (-23°C), and 2.28 (-30°C) log MPN/g after four months of storage. Holding raw Pacific oyster at -10°C for three months or at -23°C for four months was capable of achieving greater than 3-log (MPN/g) reduction of *V. parahaemolyticus* in the oysters.

Degradation of Histamine by Extremely Halophilic Archaea Isolated from Salt-Fermented Fishery Products

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The presence of high levels of histamine is detrimental to the quality and safety of some Thai fermented fishery products. Histamine is heat stable and if present, can post a risk of food intoxication. Therefore, this study was related to a method for removing histamine by using a pure culture of selected halophilic bacteria or its enzyme. Of 156 extremely halophilic archaea isolated from salt-fermented fishery products, HDS3-1 from fish sauce exhibited highest histamine degradation activity when cultured in JCM168 broth containing 500 ppm histamine and 25% (w/v) NaCl. The strain was classified in *Halobacteriales* as a novel member of genus *Natrinema*. The strain did not exhibit decarboxylase activity toward histidine, and showed no toxic to baby hamster Syrian kidney and human liver hepatocarcinoma cells proven by the MTT-bioassay. Based on

direct histamine determinations by both HPLC and AOAC fluorometric detection, histamine degrading activities were located in both extracellular and intracellular fractions of HDS3-1. Both fractions required the presence of phenazine methosulfate (PMS), a hydrogen acceptor for their activity, suggesting a link to the dehydrogenase activity. To demonstrate the application of HDS3-1 for fish sauce fermentation, an experiment was conducted by adding HDS3-1 into the salted anchovy supplemented with 500 ppm histamine at two levels of inoculation, 10^4 and 10^6 CFU/g fish. Compared to control (without inoculation), histamine contents of fish sauce obtained from inoculated samples were significantly much lower especially for that inoculated with HDS3-1 at 10^6 CFU/g. At 90 days of fermentation, fish sauce resulted from fish inoculated with 10^6 CFU/g had the lowest content of histamine (465 ppm), followed by that inoculated with 10^4 CFU/g (895 ppm), and control (1,018 ppm), respectively. The data suggested that *Natrinema* sp. strain HDS3-1 and its enzyme is likely to provide significant opportunity for histamine reduction in salt-fermented foods.

Effects of Electrolyzed Oxidizing Water Treatments on Reducing Histamine-producing Bacteria and Histamine Formation in Fish

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Scombroid poisoning is commonly associated with consuming fish containing high levels of histamine formed through bacterial enzymatic decarboxylation of histidine.

This study was conducted to determine (1) growth of histamine-producing bacteria (*Enterobacter aerogenes, Enterobacter cloacae, Proteus hauseri, Morganella morganii*, and *Klebsiella pneumoniae*) and histamine formation in yellowfin tuna stored at 5, 15 and 25°C and (2) effects of treatments of electrolyzed oxidizing (EO) water and ice on reducing HPB on food contact surfaces (ceramic tile and stainless steel) and fish skin (Atlantic salmon and yellowfin tuna).

Enterobacter aerogenes and *Morganella morganii* were identified as the most prolific histamine formers capable of producing >1,000 ppm histamine when grown in broth culture at 25°C for 12 h. Both bacteria grew well at 15-25°C and produced histamine in broth and tuna meat when populations increased to $\geq 10^6$ CFU/ml (or CFU/g). However, growth of the bacteria was inhibited at 5°C.

Enterobacter aerogenes and Morganella morganii survived well on food contact surfaces and fish skin. Treatments of EO water (50 ppm chlorine) for 5 min completely inactivated the bacteria on the surfaces (>1.7 to >5.4 log CFU/cm^2 reductions). Soaking salmon skin in EO water (100 ppm chlorine) for 120 min reduced *E. aerogenes* and *M morganii* by 1.3 and 2.2 log CFU/cm^2, respectively. Holding fish skin in EO ice (100 ppm chlorine) for 24 h reduced *E. aerogenes* and *M. morganii* by 1.6 and 2.0 log CFU/cm^2, respectively, on salmon skin and 2.4 and 3.5 log CFU/cm^2, respectively, on tuna skin.

EO water can be used as a sanitizer for decontaminating histamine-producing bacteria on food contact surfaces. Holding fish in EO ice (100 ppm chlorine) could be used as a post-harvest treatment to reduce histamine-producing bacteria contamination on fish skin and decrease probability of histamine formation in fish during storage.

Improving Food Safety in Seafood Products through Pathogen Growth Suppression

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Seafood and especially RTE fish products have the attention of legislative authorities as being high-risk products for listeria and other pathogens. Prevalence of *Listeria monocytogenes* is not high compared to other food borne pathogens but the fatality rate of Listeriosis is as high as 30%. Consumers are increasingly aware of the dangers of pathogens in foods. Product recalls can be expensive, detrimental to brands, companies and to the industry.

For more than a decade, research has documented control of *Listeria monocytogenes* and other pathogens using PURAC products in foods. In recent years the amount of research with lactate and (di)acetate and other ingredients in seafood products has increased. Research will be presented documenting the efficacy of PURAC products in cold smoked salmon, seafood salads, dips and spreads, fresh fish products, frozen fish products and surimi. Studies from around the world will show how seafood processors safely extend shelf life and suppress the growth of *Listeria monocytogenese*, *Clostridium botulinum*, spoilage organisms and a variety of other bacteria.

PURAC is the world leader in natural antimicrobials. We offer a variety of ingredients designed to address food safety and product quality issues in seafood products. Seafood products can now be prepared providing significantly improved pathogen growth suppression without compromising flavor, texture or color.

Investigating Some Quality Parameters of Several Traditional Fish Products in Relation to Food Safety

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Traditionally processed fish products are reported to carry high potential risk for human health due to biogenic amines, nitrosamines as well as halophilic pathogenic bacteria that are likely to be produced by bacterial and enzymatic activities during ripening process under poor hygienic and processing conditions In this study, several types of salted and fermented fish products were evaluated in relation to food safety parameters. The products were both provided from commercial companies and household productions. The salt content, pH, aw were determined in all over 50 different samples. Histamine and nitrosamine content were measured in between 10-30 samples. Total halophilic and coliform bacteria count as well as the presence of some pathogenic bacteria were tested in several products. The pH value was different from ~ 3.8 to 7.2, a_w varied from ~0.71 to 0.96, salt content was found between approximately 3-27%. Histamine values were in the range of <1.0 – 400 ppm. The values were evaluated in terms of food safety for such products and recommendations were made to control possible health hazards that might originate from such products.

Histamine forming bacteria and Pathogens were isolated from different samples. Salmonella and Shigella were mainly found in fish products from retail and household productions despite the high salt content and low pH values indicating these pathogens can survive in such products presenting health risk especially during handling when in use. Both products from local fish producers and household productions of traditional fish products present health risk for human safety. Strict control measures must be applied for such small sized producers (retail producers) and good guidance should be provided for household producers in terms of their safety.

Intestinal Tract as the Origin for Ethanol Production during Pink Salmon Spoilage

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Ethanol is recommended by regulatory agencies as a spoilage indicator at 50 ppm for canned salmon although the mechanism or biochemical pathway for this indicator remains to be elucidated. The objective of this research was to dissect various tissues for determining ethanol concentrations in whole pink salmon undergoing spoilage at an abuse temperature.

Fresh, local pink salmon (*Oncorhynchus gorbuscha*) were submerged in 10ºC seawater for 4 days. Log aerobic plate counts (APC) were determined for skin and belly cavity. Intestinal tract, viscera, coagulated blood, reproductive organs, skin, and muscle were analyzed for ethanol using AOAC method # 986.12.

In the intestinal tracts, ethanol was initially at 32 ppm, increased seven-fold the next day and plateaued at 260 ppm. Except in one instance, all other tissues had ethanol concentrations below 100 ppm during four days of fish storage. However, ethanol concentrations increased in these tissues from negligible (day 1) which may indicate permeation from the origin, intestinal tract. Aerobic bacteria were poor indicators of ethanol production since the APC were low (~ 2 log) in the belly cavity and this sampling location was too general for the internal tissues tested. Although bacterial counts were higher for skin (APC ~ 5 log), ethanol concentrations were 3-10 times lower than for the intestinal tract.

Future research will determine if anaerobic bacteria, specifically isolated from pink salmon intestinal tracts, are producers of ethanol that eventually winds up in cans.

SESSION: POSTER

SECTION: SEAFOOD SAFETY RESEARCH

Histamine Level and Species Identification of Billfish Meats Implicated in Two Food-Borne Poisonings

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Two incidents of food borne poisonings causing illness in 59 and 43 victims due to ingestion of billfish meats occurred in May, 2004, in Pingtung, southern Taiwan and in December, 2004, Taichung, central Taiwan, respectively. One fried billfish fillet and five frozen billfish fillet samples collected, respectively, from the suspected restaurants in Pingtung and Taichung, respectively, were tested to determine the histamine levels and identify fish species. Analyses of histamine showed that the suspected billfish samples in two food poisonings contained more than 150 mg/100g of histamine, which is greater than the hazard action level of 50 mg/100g. Judging from the allergy-like symptoms of the victims and the high histamine levels in the suspected billfish samples, both food-borne poisonings were strongly suspected to be caused by histamine intoxication. A polymerase chain reaction- restriction fragment length polymorphism (PCR-RFLP) method was used to identify the species of the suspected billfish samples in both food poisonings. The 348 bp amplified fragment of the mitochondrial cytochrome *b* gene by PCR was digested with *Bsa*JI, *Cac*8I and *Hpa*II enzymes to distinguish the species of the suspected billfish samples. Consequently, the species of Pingtung and Taichung billfish samples implicated in food poisonings were identified as *Makaira nigricans* and *Xiphias gladius,* respectively.

Reduction of *Vibrio parahaemolyticus* in Pacific Oysters during Refrigerated Seawater Circulating Process

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Vibrio parahaemolyticus is a major cause of gastroenteritis associated with seafood consumption. In year 2006 and 2007 several outbreaks of *V. parahaemolyticus* infections associated with raw oyster consumption have occurred. These reports brought the topics of seafood safety issue back to the public and raised the need of developing post-harvest process for decontaminating *V. parahaemolyticus* in oyster.

This study investigated the efficacy of reducing *V. parahaemolyticus* by holding raw oysters in circulating seawater at 5°C. Shellstock Pacific oysters (*Crassostrea gigas*) were inoculated with a mixture of five

clinical strains of *V. parahaemolyticus* and held in a pilot scale recirculating system equipped with a UV light and a refrigeration unit and filled with cold seawater (5°C). Reductions of *V. parahaemolyticus* in oysters were monitored for up to 96 h. Results showed that the populations of *V. parahaemolyticus* inoculated to oysters decreased by about 3 log MPN/g after 96 h of process at 5 ºC.

Holding raw oysters in recirculating refrigerated seawater (5ºC) for 96 h did not result in any noticeable fatality of oysters and appeared to be relatively a simple procedure for reducing *V. parahaemolyticus* contamination for post harvest oysters. A good direction for further study is to assess the fatality impact of such a low temperature for oysters.

PCB Analysis of Carp (Cyprinus Carpio) Harvested from Utah Lake

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Common carp (*Cyprinus carpio*) of various sizes (small, <1000 g; medium, >1000 g but <3000 g; large, >3000 g) that were harvested from Utah Lake were divided into edible fillet (15 samples) and non-edible offal (11 samples) portions on which Polychlorinated Biphenyl (PCB) analysis were performed. The PCB analysis was performed by GERG Laboratories using EPA method to analyze for 209 PCB congeners. PCB congeners were classified into groups according to the EPA relative level of highest concern classification system (EPA PCB Report, 1998). On average, the offal portion contained 38.3% more total PCBs than the fillet. The average number of congeners that were detected in the offal was slightly greater than found in the fillet. PCB congeners found in the 4, 5, 6, and 7 chlorination groups comprised 92.8% of the total PCBs in the fillets. As carp size increased, the number of PCBs detected in fillet and offal increased. PCBs of highest EPA concern comprised 63.2% of the total PCBs detected in the fillet. The small, medium, and large offal samples as well as the medium and large fillet samples exceeded the EPA standard of .02 ppm. However, the PCB levels in fillets from the small carp only averaged .0064 ± .0042 ppm, which is below the EPA level of concern. Additional PCB analyses were performed on the protein and fat fractions of hydrolyzate prepared from whole carp, and 70.3% of the total PCBs were found to be in the fat fraction, indicating that the PCBs primarily accumulate in the fatty tissues of the carp. It can be concluded that the fillet of the small carp (<1000 g) harvested from Utah Lake are safe for human consumption based on EPA and FDA standards.

***Vibrio parahaemolyticus* in Oyster: It's Accumulation from Culture Water and Changes of Population during Storage**

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China is a leading country of oyster production with annual production of 3.8 million tons accounting for nearly 80% of the world's production. *Vibrio parahaemolyticus* occurring naturally in coastal water is frequently found in molluscan shellfish including oysters. To limit growth of *V. parahaemolyticus* in contaminated oysters, time-to-temperature regulations Have been established in the United States but such regulations have not yet been established in China. This study investigated the accumulation of *V. parahaemolyticus* in oysters from culture water and effects of storage temperature on growth of this pathogen to provide needed information for improving safety of oysters for consumption.

Freshly harvested oysters (*Ostrea plicatula*) were placed in tanks with seawater containing *V. parahaemolyticus* (10^6 CFU/mL) at 16, 20, 26, and 32˚C. Accumulation of *V. parahaemolyticus* in oysters were determined at 0, 4, 8, 16, 32, 64, and 96 hours using the most probable number (MPN) method. In addition, oyster inoculated with *V. parahaemolyticus* (10^4 CFU/g) at room temperature were stored at 0, 5, 10, 15, and 20˚C to determine effects of storage temperature on the growth of *V. parahaemolyticus* in oysters. *V. parahaemolyticus* in stored oysters were determined every 12 hours.

The population of *V. parahaemolyticus* in oysters increased rapidly from to 6.0-log CFU/g after 4 hours in the seawater containing *V. parahaemolyticus* at all temperatures (16-32˚C) and maintained at similar levels through 96 hours. The populations of *V. parahaemolyticus* in oysters increased from 10^4 CFU/g to 6-7 log CFU/g when oysters were stored at 15 and 20˚C for 48-60 hours but decreased slightly (0.5-1.0 Log MPN/g) in oysters stored at low temperature (0, 5, and 10˚C).

These results demonstrated that *V. parahaemolyticus* could accumulated very rapidly in oysters when exposed to growth environments contaminate with *V. parahaemolyticus* and harvested oysters should be stored at less than 10˚C to retard the growth of this pathogenic bacterium in oysters.

A Simple Method to Purified Viral Particles of White Spot Syndrome Virus, Shrimp Pathogen

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Introduction: Penaeid shrimp culture is a worldwide economic activity especially important for intertropical developed and developing countries. Along the increase of shrimp farming has come the development of many infectious diseases, especially from viral origin, reducing shrimp production and resulting in vast economic losses. One of the most devastating problems is the infection by White Spot Syndrome Virus (WSSV) that has led to severe mortalities in many countries. The abstention of viral particles is realized in the most of the cases using ultracentrifugation. In this work one easy method to purification WSSV from WSSV infected shrimp muscle and haemocytes was developed using differential filtration with microfilters of 100 kDa.

Objective: Virus purification from WSSV infected shrimp muscle and haemocytes using a simple differential filtration method.

Methods: The virus inoculum was prepared from homogenized WSSV infected *L. vannamei* muscle and haemocytes. After centrifugation at 10,000 g for 10 min, the supernatant was filtered through a 0.45 µm (f1), 0.2 µm (f2), and 100 kDa (f3) membrane. F1, f2 and f3 was used as WSSV inoculum. Twenty healthy shrimps were inoculated by intramuscular injection in the second abdominal segment with 50 µl of WSSV inoculum. Hemolymph taken after 24 h post-injection was tested by PCR for WSSV presence.

Results and discussion: The purified obtained after f2 but before f3 was analyzed by SDS-PAGE, obtaining only virus proteins. The virus purified infectivity was tested inoculating health shrimp. Signs of WSSV infection and positive PCR hemolymph tests, but not death where observed only in shrimps injected with f2, showing that the purification process did not affect the virus integrity.
Conclusions: This method can be used for bioassays with shrimps, obtaining the viral particles easily and economically.

SECTION: SEAFOOD CHEMISTRY

Immobilization of Glucose Oxidase onto Langmuir Blodgett Films

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The immobilization of biomolecules onto a transducer surface is an important step in the development of biosensors. However, the performance of the biosensor depends on the enzyme layer and factors such as immobilization method, as well as thickness and stability of the membrane used. The Langmuir-Blodgett

technique is among the various methods available for enzyme immobilization. It is capable of producing enzymes into highly ordered monolayer with high degree of packing and molecular orientation.
This work describes the formation of glucose oxidase-polystyrene-β-poly (methyl methacrylate) films at different conditions. The Langmuir films were prepared by covalent bonding of glucose oxidase to polystyrene-b- poly (methyl methacrylate) and spreading directly unto the sub-phase. Composition of the sub-phase was varied by using different buffers with different ionic strengths. The effect of pH on the monolayer formation was also investigated as well as the effect of the type of spreading solution used. Surface pressure isotherms were obtained under the set conditions to provide information on the reorientation of the enzyme, conformational changes and phase transitions. The stability of the glucose oxidase polystyrene-β-poly (methyl methacrylate) film at the interface was studied at various surface pressures as well as the amount of glucose oxidase used for the glucose oxidase polystyrene-β-poly (methyl methacrylate) film formation. The study provides a new way to prepare biomimetic films of glucose oxidase with increased stability and activity and could be useful for the design of glucose biosensors for industrial use.

Molt-Related Chitinase and Chitin Synthase Messenger RNA from Whiteleg Shrimp *Penaeus vannamei*

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Crustaceans grow discontinuously by shedding and regeneration of the exoskeleton in a cyclic process known as molt cycle. The whole cycle is divided into stages A through E, and it is known to induce biochemical, physiological and behavioral changes, including gene expression and feeding, therefore, it is a major event in crustaceans' lifecycle. Chitin (N-Acetylglucosamine), a homopolysaccharide widely present in nature, is a major component of crustacean exoskeleton, in which it is interacting with structural proteins to form the rigid matrix. Molt cycle is hormone-regulated and involves cleavage of cuticular chitin previous to ecdysis and chitin synthesis in the postmolt stage (A-B). Chitinases (E.C. 3.2.1.14, poly [1,4-(*N*-acetyl-β-D-glucosamine)] glycanhydrolase) and chitin synthase (E.C. 2.4.1.16, UDP-*N*-acetyl-D-glucosamine: chitin 4-β-*N*-acetylglucosaminil transferase) are responsible for exoskeleton chitin cleavage and synthesis, respectively. In this work, we aim to study the expression of chitinase and chitin synthase genes in cuticular tissue and digestive gland from the white shrimp through the molt cycle stages, using dot blot hybridization with DIG-labeled probes. We have identified and cloned sequences of chitinase (*PvChi2*) using *Penaeus vannamei* integument, and a chitin synthase (*PvChS*) that is expressed in digestive gland. Partial cDNA sequences for both genes have been obtained. Chitinase is similar to the cuticular tissue expressed *Penaeus japonicus Chi2*. Chitin synthase genes or proteins have not been previously reported for any crustacean, and the *PvChS* fragment has 86% identity to a *Manduca sexta* chitin synthase. We are currently investigating if the expression of these genes is involved in the molt cycle through coordinated expression of opposite-function protein.

Possible Chemico-Structural Changes in Biologically Active Compounds in Pickled Shrimp and Octopus

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In addition to its high nutritional value, marine organisms are an important source of biologically active compounds. These types of compounds that might be considered as "extra-nutrients," may have antibacterial, antiviral, antimutagenic, and antiproliferative among others. Previous studies have detected these kinds of biologically active compounds in both, shrimp and octopus in their lipidic fraction. However,

the activity of these compounds might be altered when these seafood are subjected to high temperatures when cooked or low pH when pickled. The aim of this study was to determine the effect of the temperature + low pH on previously detected antimutagenic fractions in pickled shrimp and octopus. Fresh shrimp and octopus were obtained from local market and then pickled, homogenized in 5 parts of chloroform and the lipidic fractions from each species were fractionated using a TLC procedure (using chloroform-acetone 9:1 and silica gel without binding as mobile and stationary phases, respectively). Rf's from biologically active bands previously determined from fresh shrimp and octopus were compared with obtained from pickled species. Changes in the Rf of these fractions were observed for both species when they were pickled, however, whether these changes were due either to temperature or low pH is still to be determined. Since migration of compounds during TLC depends on chemical structure and composition, and these characteristics are crucial for biological activity of certain compounds, we conclude that pickling process might affect the antimutagenicity properties of certain compounds present in both species.

The ATP Synthase Complex of the Shrimp *Penaeus vannamei:* Analyzing the Genic Expression of Catalytic Subunits α and β during Hypoxia

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The ATP synthase plays a central role in the energy production of living organisms. This complex catalyzes the synthesis and hydrolysis of ATP, by means of the proton gradient formed along the respiratory chain. Subunits α (ATPα) and β (ATPβ), are important portions of the enzyme since they are directly involved in the catalysis. Marine crustaceans are frequently stressed by hypoxic environments, showing metabolic responses in order to maintain the cellular homeostasis. Under these conditions, ATP production and consumption must be actively adjusted, and as a consequence, the synthesis of ATP synthase should also be subjected to regulatory changes.

The objective of the present study was to evaluate the mRNA concentrations of subunits ATPα and ATPβ from the ATP synthase complex of whiteleg shrimp *P. vannamei,* under hypoxic and normoxic conditions. To date mRNA of gills and pleopods have been extracted, and real-time PCR conditions have been established for quantitative analysis of transcripts concentration. Our first results showed that mRNA concentrations of ATPβ are significantly higher than those of ATPα, in both evaluated tissues. The expected changes caused by the effect of hypoxia presume an increment on the ATP transcripts under hypoxic conditions vs those at normoxic conditions.

Extraction, Purification and Biochemical Characterization of Transglutaminase from Bluefish (*Pomatomus saltatrix*)

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Transglutaminases (TGase) are Ca^{2+} dependent enzymes belonging to the group of enzymes known as transferases. They catalyzes acyl transfer reactions between free amine groups and the γ-carboxyamide groups of proteins or peptide bound glutamine residues thus leading to the modification of proteins. Cross-linking of proteins, acyl transfer reactions and deamination are the three important reactions catalyzed by TGases.

TGase-mediated cross-linking of proteins has significant effects on the physical and chemical properties of these biomolecules. This has triggered the use of these biocatalysts in a wide range of industrial sectors, from cosmetics to the food industry. Due to the involvement of this group of enzymes in many physiological and pathological processes, TGases have found important applications in the pharmaceutical

industry also. Their biotechnological potential is best reflected in the rapidly growing number of patent applications.

In this study, TGase was extracted and purified from the digestive glands of bluefish (*Pomatomus saltatrix*) and its the performance characteristics were investigated and compared with those of commercial TGase with respect to influence of temperature, pH, inhibitors, reducing agents (dithio-threitol, DTT) and metals ions (namely calcium, sodium, strontium, magnesium and barium).

Investigating Suitability of Commercial Histamine Test Kits for Application to Traditional Fish Products

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In this study, seven commercial histamine test kits were compared to two different HPLC methods for detecting histamine in several fish products. Different types of salted fish products were used in this research. Results showed that the values of certain types of fish products analyzed using some of the commercial test kits significantly agreed with HPLC results although there were significant differences in the results of some of the samples ($p<0.05$) between commercial test kits as well as HPLC methods. The results of two HPLC methods were significantly differed in certain samples that may cause by the presence of salt during the derivatisation step of the methods. The commercial test kits, namely Veratox, and Food EIA (Ridascreen) were in agreement with HPLC method that is confirmed by a Reference laboratory. This result indicates that these kits can be used for several types of traditional fish products in terms of food safety for histamine analysis.

Antimicrobial Agents in Imported Aquacultured Seafood

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Over 80% of the seafood consumed in the United States is imported. Among this group of imported seafood, more than 40% is aquacultured. Applications of prohibited antibiotics or chemicals in aquaculture raise significant public health concerns. This presentation provides information on US Food and Drug Administration (FDA) prohibited antimicrobial agents that have been detected in imported aquacultured seafood. The agents include: 1) Chloramphenicol; 2) Crystal Violet (Gentian Violet), Brilliant Green, Malachite Green and Leuconostoc Green; 3) Fluoroquinolones; and 4) Nitrofurans. The FDA has a "zero tolerance" policy on these agents which pose direct and indirect health hazards to humans. Between 2001-2007, residues of these agents have been found in aquacultured basa, catfish, dace, eel, shrimp, tilapia, walking clarias fish, and whitespotted clarias.

Both sophisticated chromatographic analytical methods and rapid commercial immunoassay kits have been developed and used by regulatory agencies and seafood industries for screening, identifying, and confirming the presence of minute chemical residues in seafood. As long as prohibited antimicrobial agent residues persist in imported aquacultured seafood, Hazard Analysis Critical Control Point (HACCP) plans for processors should include a critical control point at the receiving step when the product first arrives at the plant. Monitoring, a required step in HACCP, for prohibited antimicrobial agent residues (a chemical hazard) can be conducted using rapid screening methods.

With seafood consumption and importation continuing to rise, ensuring the quality and safety of the seafood supply is of paramount importance for fair trade and consumer protection.

True Lipases in *Penaeus vannamei*: Insights into Fat Digestion

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Molting in crustaceans involves stages with different feeding behavior and therefore, use of energy from food or reserves, with lipids as a main energy supply. In crustaceans, lipids are stored in the mid gut gland. Lipid hydrolysis is achieved by lipases (3.1.1.3), which digests fats to free fatty acids and glycerol. In this work, we investigated, in the white-leg shrimp, *Penaeus vannamei*, the effect of starvation as a general stimulant of the digestive system and digestive lipase activity as the independent variable. Starved organism were sampled periodically for 120 h and compared with a continuously fed group. Midgut gland extracts from *P. vannamei* were evaluated for concentration of protein by Bradford method and lipase activity using β–naphtylcaprylate as substrate as measured by spectrophotometry. The liberation of fatty acids from tributiryn emulsion was measured by titrating in pH-stat at pH 8. An increase of lipase activity was observed during starvation, the highest activity was registered at 120h starvation. In addition six true lipase were identify in midgut gland, which molecular weights are >200, 151.5, 50.5, 36.59 and 24.14 kDa, suggesting possible isoezymes. These results suggest that *P. vannamei* is well adapted to cope with extended periods of food deprivation, storing energy as fats when food is readily available and having a clearly sequential process for mobilizing energy when food is scarce.

SECTION: SEAFOOD BY-PRODUCTS AND SEAFOOD PROTEIN

Using the pH-Shift Solubilization Process to Produce Protein Concentrates from Shrimp Cephalothorax Waste

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Pond farming of whiteleg shrimp *Litopenaeus vannamei* along the Pacific coast of Mexico is a major industry, one that generates huge waste from cephalothoraxes and exoskeletons, about 40–45% of whole shrimp weight. Organic waste creates serious pollution. Shrimp wastes can be recovered as a byproduct to produce chitin, proteins, and pigments. The shrimp cephalothoraxes are ~50–65% protein (dry weight basis) and are usually dried and used as a protein ingredient in feed for pond-reared fish and crustaceans. However, the indigestible chitin has limited its use in artificial feeds. In this study, the pH-shift process was evaluated as an alternative for rapid and efficient isolation of high value components from the cephalothorax. About 21% of the raw material (wet weight basis) was solubilized at pH 7; from this, 60% was recovered by centrifugation after iso-electric precipitation at pH 4. The material obtained after precipitation contained 60% protein. The soluble fraction was freeze-dried and its protein content was 68%. The insoluble fraction, at pH 7, contained 49% protein and is a source of chitin and pigments. This study demonstrated that the pH-shift solubilization process is a technology for rapidly separating high-value components from shrimp-wastes.

The Effect of Drying Temperature on Aspartic Acid Racemization in Fish Meals from Bycatch Species

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The shrimp commercial fishery is an important economic activity, contributing about 50% of the annual production of all shrimp raised or captured in Mexico. During fishing operations, other species are caught and discarded. This work analyzes the value of the by-catch to produce fish meal to enhance economic return and ameliorate a problem. Previous studies showed that proximate composition varies among species, operational variables change the biochemical properties of the catch, and indices are needed to evaluate the impact of these changes. This study evaluates proximal composition and an index on the effect

of drying temperature on aspartic acid racemization of fish protein. Nine fish species, *Gillichthys seta*, *Oligoplites saurus*, *Eucinostomus entomelas*, *Synodus scituliceps*, *Diplectrum pacificum*, *Pseudopeneus grandisquamis*, *Xenistius californiensis*, *Arius seemanni*, and *Orthopristis reddinigi* were caught as bycatch by the shrimp commercial fleet of Guaymas, Sonora. All fish viscera were removed; the rest was ground, and processed to produce meals by using three drying processes: freeze-drying and heating at 65°C and 110°C. Moisture, lipids, proteins, ash, and fiber were measured using standard methodologies. DL-Asp and L-Asp contents were measured by HPLC. Protein content (dry weight basis) among species varied between 57 and 77%. The species with the highest lipid content (>16%) were *X. californiensis* and *O. reddinigi*. *S. scituliceps* had the lowest quantity of lipid (<1%). In general, ash content was high in all species because samples included bones, skin and scales. Racemization rate increased with drying temperature, but only species with low lipid content showed significant changes. Based on analyses, the quality and quantity of bycatch are suitable to use as a feed ingredient. However, to maintain optimal values of bioavailability and bioconversion, we recommend drying at low temperatures.

Effects of Storage Time and Temperature on the Biogenic Amine Concentrations in Raw and Processed Fish Meal from Pink Salmon (*Oncorhynchus gorbuscha*) Byproducts

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Byproducts from pink salmon are processed into fish meal and oil in several Alaska locations. When efficient transportation or close proximity to a processing plant is not feasible, byproducts are sometimes held unrefrigerated for several days. When storage time is prolonged and temperatures are raised, biogenic amine concentrations can increase to unacceptable levels. While biogenic amine levels in fish and other foods for human consumption are routinely studied, little is known about the levels in fish byproducts. The objective of this study was to evaluate the biogenic amine concentrations in raw pink salmon byproducts stored at two temperatures before and after processing into fish meal.

Pink salmon heads and viscera were collected from a commercial plant in Kodiak, AK. The heads and viscera were mixed together and aged at two temperatures (6 and 15°C) for up to 10 days. Samples were removed and processed into fish meals on days 0, 1, 2, 3 and 4 at 15°C and 0, 1, 2, 3, 4, 6, 7, 8, 9, 10 at 6°C. The raw and processed samples were separated and quantified for seven biogenic amines on a reverse phase C18 column with a Beckman Coulter 166 HPLC.

Most biogenic amine concentrations of raw byproduct stored at 15°C increased at day 1 and by day 2 there were many significant differences. For byproducts stored at 6°C changes in biogenic amines were evident by day 2, and by day 6 elevated levels were noted in most biogenic amines. The rate of biogenic amine formation in the raw byproducts was approximately 743 mg/kg a day at 15°C and 145 mg/kg a day at 6°C. The maximum histamine values in fish meal were 121 mg/kg (15°C) and 91 mg/kg (6°C) at the last respective sampling days. The data suggested time and temperature effects on the formation of biogenic amines and some loss of the biogenic amines occurring during processing.

Interaction of Fish Protein and Pure Carrageenan as Affected by Various Salts

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Carrageenan is utilized as a gelling and thickening agent in food products. There are three forms of carrageenan: kappa, lambda, and iota. In fish protein gels, carrageenan forms an independent network, which supports the principal structure formed by proteins during gelation. However, no studies reported interaction of pure carrageenan with Alaska pollock fish proteins as affected by functional salts.

To investigate the textural and rheological effects of purified iota and kappa carrageenan, respectively, in Alaska pollock fish protein gels.

Iota and kappa carrageenan were added (0, 0.25, 0.5, 0.75, and 1.0%), to Alaska pollock surimi, which was reduced from 79 to 78, 77, 76, and 75%, respectively. Moisture level of chopped pastes was adjusted to 78% using ice water and 2% salt was added. Sample pastes were subjected to dynamic rheology and cooked in stainless steel tubes (90 °C water bath for 15 min). Cooked gels were evaluated at 0, 3, and 9 cycles of freeze/thaw for breaking force and deformation, color, whiteness, and water retention ability (WRA).

Lower concentrations of iota (0.25, 0.5%) maintained similar breaking force to 0% carrageenan control (CON). Kappa carrageen at 0.25 and 0.5% also maintained breaking force values similar to CON, however, deformation values were noticeably lower. Whiteness values of fish protein – iota gels decreased as carrageen concentration increased from 0-1.0% due to an increase in b* values. In contrast, kappa carrageenan (0.25, 0.5%) maintained whiteness values similar to CON. Iota carrageenan addition maintained similar WRA to CON, whereas, kappa carrageen addition contributed to lower WRA values.

At lower concentration (0.25-0.5%) iota carrageen can be effectively added to Alaska pollock surimi. Utilizing potassium chloride and/or calcium chloride as a full or partial replacement for sodium chloride further enhanced carrageenan function in Alaska pollock fish protein gels.

Properties of Recovered Solids from Stickwater Treated by Centrifugation and pH Shift

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The sardine fishmeal process generates pollution and waste with potentially useful protein. In this study sardine stick water (SW) from fishmeal operation was submitted to a complementary centrifugation step followed by a pH adjustment (acidic + alkalinic) to recover solids for their compositional, functional and nutritional properties evaluation. Solid fractions (IF_1 and IF_2) had a chemical composition of 76 ± 4 % and 16.9 ±3.1 % of protein, 12 ± 6.2 % and 2.9 ± 1.9 % of fat, 7.9 ± 2 % and 75.4 ± 2.6 % of ash, respectively. IF_1 and IF_2 were good sources of Ca^{++}, Mg^{++}, P^{3-}, K^{+} and essential amino acids. IF_2 was whither than IF_1 but less color stable over time. Solubility of proteins from IF_1 and IF_2 was higher than that of commercially used materials such as egg albumin and sodium caseinate. IF_1 chemical, nutritional and functional characteristics suggest its potential used as food/feed compositional ingredient.

Phospholipids from Pacific Sardine

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As a human food resource, sardines (*Sardinops sagax*) are a relatively new fishery for the Oregon-Washington coastal area. To expand market opportunities and upgrade value, isolation of proteins using the pH-shift method would be an effective way to make sardine fish protein isolates. However, phospholipids in sardine cellular membranes are known to be primary substances for lipid oxidation. Therefore, characterization of sardine phospholipids needs to be investigated.

The objective of this study was to isolate phospholipids from sardine and determine the fatty acid profile.

Pacific sardines were obtained from West Bay Marketing INC. (Astoria, OR, U.S.A.). Sardines were minced and mixed with hexane:methanol (2:1) to obtained crude lipids. Neutral lipids and phospholipids were isolated from sardine according to the method of Christie (1992) with a slight modification. Neutral lipids and phospholipids were isolated by using solid phase extraction column (SPE column). Isolated lipids were subjected to thin layer chromatography (TLC) to verify phospholipids. Fatty acid profiles in isolated lipids were determined by gas chromatography (GC).

TLC analysis showed that high purity of phospholipids was obtained utilizing SPE column separation. Phospholipid fraction contained higher levels of unsaturated fatty acids compared to the neutral and total lipid fractions. The predominant fatty acid in total and neutral lipid fractions were 16:0 (palmitic acid), while 22:6n3 (docosahexaenoic acid, DHA) was the major fatty acid in the phospholipid fraction. SPE column extraction with hexane and methanol (2:1) was a suitable and simple technique to purify phospholipids, resulting in high purity. Phospholipids from Pacific sardines contained a high concentration of polyunsaturated fatty acids and could, therefore be easily oxidized, possibly promoting negative effects to sardine protein isolate.
Removal of phospholipids during pH shift processing of sardine muscle would be beneficial for improving quality and shelf life of fish protein isolate from sardine for human consumption.

Effect of Protein Concentration and Proteolytic Activity on the Gel Quality of a Giant Squid (*Dosidicus gigas*) Protein Concentrate Obtained by Acid Dissolution and Isoelectric Precipitation

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Two protein concentrates (APC and NPC) from giant squid mantle (SM) (*Dosidicus gigas*) were produced. The APC was prepared by acidic dissolution of proteins and its subsequent isoelectric precipitation, while the NPC by neutral dissolution. Both concentrates were characterized in relation to their protein content and evaluated respect to their gel-forming ability. The APC presented higher protein content than NPC (16 vs. 9.1 %) and produced more functional gels (folding test: AA vs. C-AA; gel strength: 455 vs. 175 g_f.cm). When protein content of sol/gel from both concentrates was equaled to 9.5% a significant reduction on functionality was observed for the APC (folding test: B-A vs. B-AA; gel-strength: 116 vs. 145 g_f.cm). Proteolityc activity was practically null in concentrates and mantle muscle. Confirming the previous results, protein electrophoretic patterns from muscle and concentrates showed not evidence of myosin hydrolysis at 0°C and 60°C. Addition of NaCl during sol preparation did not promote myosin hydrolysis under the conditions used in this study. Results indicate the feasibility of applying the proposed acid dissolution methodology to squid for producing a functional protein concentrate.

Effect of Two Thermal Processes on *Dosidicus gigas* By-Products Meals on Growth and Postharvest Shrimp Quality of *Litopenaeus vannamei*

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The growth of the penaeid shrimp is affected by the source, level, and quality of the protein, among other factors. Overheating can diminish the quality of the protein, which can increase enzyme activity and reduce the storage life of shrimp. The growth rate and ice storage life of white shrimp (*Litopenaeus vannamei*) fed one of three diets for 40 days, were evaluated by several methods. The test diets were: Fish meal (control); Dry squid meal (PI); and Cooked-Dryed squid meal (PII). Dry squid meal (PI) showed low chemical score (51%), while PII diet had the highest degree of hydrolysis (DH 27.5%). Growth was not affected by the source of protein ($p>0.05$). However, shrimp fed with PI had less survival-rate. During ice storage, shrimp fed PII lost less firmness than shrimp fed with PI or control diet. In regard to the electrophoresis pattern of myofibrillar extract of the samples from shrimp fed with PI diet, a major decrease in the intensity of two bands (molecular weight 200 kDa and 45 kDa) was observed when compared to the shrimp fed with control or PI diets. Under the conditions of this work, it was evident that the best thermal process for meal production from jumbo squid by-products was cooking at 100°C and drying at 75°C.

Proteomic Studies of Atlantic Salmon (*Salmo salar*) Skin Mucus Proteins During Smoltification

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Smoltification is a developmental phase encompassing morphological and physiological changes enabling salmonids to migrate from fresh to salt water. This study is part of an ongoing investigation into the role of skin mucus proteins and proteolytic enzymes in hatchery reared 'and wild Atlantic salmon undergoing smoltification.

Skin mucus was sampled from Atlantic salmon in the Marine Institute, Newport, Co. Mayo, Ireland. Hatchery reared salmon used in an ongoing salmon ranching programme, referred to as "ranch" salmon were sampled bi-weekly from March 22nd to May 4th 2006 and wild smolts were sampled on May 4th 2006. Protein analyses were conducted using 1D and 2D electrophoresis. Skin mucus protease activities were investigated by zymography. Data analysis was aided by Alpha Imaging and Gel Fox technology.
From March to May 2006, 1D protein profiles of ranched smolts showed protein band intensities increasing at 15kDa and decreasing at 32kDa, confirming earlier studies from 2004. In addition, increasing protein band intensity at 16.5kDa was evident. Zymography of ranch smolt skin mucus showed increasing protease activity at 57kDa, 65kDa and 106kDa. 2D protein profiles (pI 3-11) of ranched smolts showed increasing numbers of skin mucus proteins between pI 4-8 and 45-66kDa. Proteins with increasing intensity at 57kDa and 65kDa had pI values indicative of metalloproteinases and a protein with increasing intensity at 106kDa had a pI value indicative of serine protease. Greater protease activity was detected in wild smolts at 57kDa and 106kDa. Five different proteins were detected in the 2D protein profiles of wild smolts (Table 1.0).

pI Value	Molecular Weight
4.5	35.5 kDa
5.0	39.0 kDa
5.4	39.0 kDa
5.9	29.5 kDa
7.0	41.5 kDa

Table 1.0: Proteins detected in wild Atlantic salmon skin mucus

In conclusion, during smoltification protein band intensities increased at 15kDa and 16.5kDa and decreased at 32kDa in ranch Atlantic salmon skin mucus. Protease activity increased at 57kDa, 65kDa and 106kDa. Further analysis to identify the five proteins detected in wild Atlantic salmon skin mucus will be carried out by amino acid sequencing.

Barrier and Tensile Properties of Alaskan Fish Skin Gelatin Films

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Gelatins from cold and warm-water fish skins are becoming more readily available. Differences in amino acid composition and molecular weight distribution between fish and mammalian gelatins affect their physical properties and potential applications. Some applications include edible coatings and films, which reduce water vapor and oxygen permeability of foods and drug systems to increase shelf life.

Our objective was to evaluate water vapor (WV) and oxygen (O_2P) permeability, tensile strength, and puncture resistance of cold-water fish, warm-water fish, and mammalian gelatin films and relate these properties to protein molecular weight distribution, amino acid composition, and gel properties.

Cold-water fish gelatins were extracted from Alaskan pollock and salmon skins. Pork skin, cowhide, and warm-water catfish skin gelatins were obtained from commercial sources. Pollock gelatin WV and O_2P are significantly lower than salmon and catfish gelatins, which have lower WV and O_2P values than mammalian gelatins. There was no difference in WV or O_2P between bovine and porcine gelatins. Tensile strength and elongation were also significantly lower for pollock gelatin. Tensile and puncture strength decreased and elongation and puncture deformation increased at higher % relative humidity (RH) for each film. Pollock gelatin has lower proline and hydroxyproline content than salmon, catfish and mammalian gelatins and in general, the amino acid profiles of salmon and catfish gelatins are intermediate between pollock and mammalian gelatins. Fish gelatins have α- and β-chains with slightly lower molecular weight than that of mammalian gelatins.

This study demonstrated significant differences in barrier and mechanical properties between mammalian and fish gelatins. Lower WV and O_2P of fish gelatin films can be useful, particularly for applications related to reduced water loss in cold or frozen foods and reduced oxidation degradation of dried foods and drugs. However, lower tensile and puncture properties of fish gelatin films need to be taken into account.

Partial Characterization of Pepsin Soluble Collagen (PSC) from Jumbo Squid (*Dosidicus gigas*) Mantle, Arms, and Fin

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Collagen is the major protein component of connective tissue, plays an important part in squid swimming mechanisms. Scarce information is available on jumbo squid (*Dosidicus gigas*) collagen. Each swimming part would have different collagen amount and degree of aggregation. The purpose of the present study was to compare the content as well some physical and chemical properties of pepsin-soluble, and insoluble collagen in mantle, arm, and fin from fresh jumbo squid (*Dosidicus gigas*) by electrophoresis profile, amino acid analysis, scanning electron microscopy study and differential scanning calorimetry (DSC). The total collagen content, as well SDS-electrophoresis profile was different in each part evaluated, the highest insoluble collagen value was in arms. Same structural soluble collagen arrangement was observed in the three anatomical parts evaluated. However, comparing with insoluble collagen, different structural arrangement was detected in mantle, arms, and fin. DSC showed a very high transition at 115-120°C for pepsin soluble collagen. The highest Tmax and ΔH was detected in arms collagen. The thermodynamic properties observed (endotermic rx) is related with a high degree of cross-linked collagen.

Anti-oxidative and Anti-aging Activities of Collagen Hydrolysate

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Collagen is a family of fibrous proteins present in skin, bone, tendon, cartilage of multi-cellular organisms. With high content of glycine, proline, hydroxyproline and some bioactive peptides, collagen and its hydrolysate have widely utilized in medical treatments, health care, food processing, cosmetics and other industrials. This study reports antioxidant activities of collagen hydrolysate. Collagen was prepared from squid skin and pearl oyster mantle and hydrolyzed with trypsin, pepsin and papain digestion (30-50 ºC, pH 2-8, 20-60 min). Results show that all kinds of collagen hydrolysate remarkably prolonged the lifespan of fruit fly *Drosophila melanogaster*. The maximum lifespan for the hydrolysate-treated fruit flies increased to 80 to 84 days when compared with those of the control group (60 days), similar to vitamin E. The anti-

ageing effect of the hydrolysate might be related to their anti-oxidant activities. The collagen hydrolysate greatly inhibited the activity of polyphenol oxidase *in vitro* and decreased the production of lipofuscin (brown pigment characteristic of ageing) in fruit fly by 21~25% when compared with the controls. The molecular weight of major polypeptides with highest antioxidant activities isolated from the collagen hydrolysate ranged from 7 to12 KD. The most abundant amino acids in the polypeptides were leucine, lysine, and glutamine, glycine and alanine. These results suggest that the collagen hydrolyzate from squid skin exhibited anti-ageing activity in fruit fly and might be used as neutraceutical ingredients in functional food, cosmetics and other industrials for healthcare purpose.

Potential Application of Collagen Extracted from the Mantle of Giant Squid (*Dosidicus gigas*) in the Preparation of Collagen and Chitosan Biofilms

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Giant squid (*Dosidicus gigas*) is an important and profitable fishery in volume and economic value in the North Pacific of Mexico. Nevertheless, its consumption is limited to the mantle and occasionally to the tentacles, producing large quantities of waste from which several byproducts with high technical and economical appraisal can be obtained, such as collagen. Thus, the objective of this study was to extract the collagen from the mantle of Giant squid and to evaluate its potential application as a plasticizer agent in the preparation of biofilms in composites with chitosan. The mantle collagen was extracted and four different fractions were obtained. Blends of high viscosity commercial chitosan with different acid-soluble collagen concentrations (0, 5, 10, 15, 20, 30 and 50%) were prepared in order to obtain the films, which were elaborated by casting using petri dishes. The films were analyzed by infrared spectroscopy (IR) and differential scanning calorimetry (DSC). The IR spectra of the blends showed the presence of molecular interactions, mainly hydrogen bonding between the two polymers, and also exhibited miscibility and alternation of each of the components. The 85:15 chitosan-collagen blend produced the film with best properties. The thermogram of this film showed the presence of two peaks, the first endothermal at 98°C and the second exothermal at 142°C which corresponded to the chitosan and collagen, respectively. Because the film tolerated a temperature higher than 120°C, it can probably be obtained by extrusion and be applied industrially, yet more studies are still necessary to corroborate that.

Comparison of Myosin Cross-linkage and Gel Forming Properties of Frozen Surimi Prepared from Silver Carp (*Hypophthalmichthys molitrix*) in Summer and Winter Seasons

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Silver carp is the second largest supply of freshwater cultured fish in China and is usually sold alive with a relatively low value. In order to upgrade its commercial value and study the potential of silver carp for surimi production, processing conditions for silver carp surimi to reach maximum myosin heavy chain (MHC) cross-linking and gel forming ability were investigated. Results showed the optimum conditions for MHC cross-linkage were: (1) the number of washing cycles was two; (2) the concentration of additional $CaCl_2$ was 0.2‰; (3) incubation temperature and duration was 35 ºC for 4-6h. It was also found MHC cross-linking behaviors of surimi were remarkable different between summer and winter surimi gels. The rates of MHC cross-linking reaction were dramatically higher in summer gels than in winter gels at all test temperatures. More than 50% of MHC decreased when summer gels were incubated at 25-40°C for 6h, while only 20% reduction was observed in winter samples when setting at the same temperatures for even 10h. To compare breaking force between kamaboko gels prepared from summer and winter surimi, kamaboko gels were prepared by two-step heating. The pre-incubation was performed at 20 to 40°C for

different duration of time followed by a further heating at 85°C for 30min. Results show preheating at any testing temperature for a suitable period of time, the breaking force of all set samples were higher than controls (without setting). Through two-step heating process, both summer and winter surimi could form strong kamaboko gels with breaking force of 600-700 g. However, the optimum setting condition was different. Winter surimi needed to be set at 30 °C for 3-10h and summer surimi at 35 °C for 5-6h. Silver carp showed a great potential to be used as a material for surimi production.

SESSION: ENVIRONMENTAL MANAGEMENT

How to Successfully Comply with the Clean Water Act and Avoid Costly Government Enforcement and Third Party Lawsuits

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Complying with a seafood processing wastewater permit can be a daunting task, and the devil is in the details. In recent years, state and federal governments and citizen groups have targeted seafood processing facilities that exceeded their NPDES wastewater permit limits, failed to comply with other permit requirements, and/or violated the Clean Water Act in discharging process wastewater. Some companies have had to pay fines, settlements, and attorney fees in excess of $1,000,000.

Avoiding fines and lawsuits requires a technical understanding and correct deployment of the permit. This includes the proper conveyance and treatment of the wastewater, complying with sampling and monitoring requirements, and accurate and timely reporting of the data. A basic understanding of the legal aspects of an NPDES permit is also essential. Reviewing actual enforcement actions and law suits in the seafood industry provides useful information on liabilities and pitfalls to avoid.

Responsible Fisheries Assessment of the Hawaii Longline Fishery

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Sustainable seafood comes from responsible, well-managed fisheries. But what makes a fishery responsible? The Food and Agriculture Organization (FAO) of the United Nations adopted the Code of Conduct for Responsible Fisheries in 1995 exactly for this purpose. The Code consists of a comprehensive set of standard norms and practices to help guide nations in developing and managing responsible and sustainable fisheries. The Hawaii longline fisheries (bigeye and swordfish) were evaluated as part of the NOAA-funded Hawaii Seafood Project (PacMar Inc.) using the Code and its provisions as a score card. After the project team made its initial assessment, the agencies involved in the management system reviewed and commented to be certain that their particular roles were accurately described and scored. In all, 282 detailed and prescriptive Code provisions were scored dealing with fisheries management, fishing operations, integration with coastal area management, post-harvest and trade practices and fisheries research. The Hawaii longline fisheries received a score of 93 % compliance with the Code. This confirms that Hawaii's longline fisheries are among the most intensively and responsibly managed fisheries in the world based on an international standard. The high score is an acknowledgement of the exemplary integrated management system and fishery in Hawaii. It also gives recognition to the vital roles of the various organizations, agencies and the fishing industry in achieving and maintaining a model responsible fishery. Based on feedback from the FAO experts, this assessment of the Hawaii longline fisheries is the most complete case study in which the Code has been comprehensively applied to the assessment of a specific fishery.

Seafood Sustainability-Options and Issues or What is a Seafood Eco-label?
RANDY RICE. *Alaska Seafood Marketing Institute, Seattle, WA*.

The issue of sustainable seafood resources and responsible fishery management has become one of the key drivers in seafood merchandising in some markets. Increased interest on the part of seafood buyers and retailers has resulted in a proliferation of various endorsements and certifications. These endorsements and certifications profess the ability to improve fisheries management because consumers will select products with a logo identifying those fishery sources that are responsibly managed. Little data exist that show consumers consciously make such choices, and the seafood industry is increasingly concerned over certification and logo usage costs. Fishery managers report increasing demands by Non Government Organizations (NGO) 3rd party certifiers and increasing complexity in the fishery certification process. There are suggestions from the seafood marketing sector that the proliferation of logos and labels is confusing to consumers.

In this presentation we will examine the various certification schemes that are in play in the global marketplace, the role of NGO groups, and the need for a common denominator set of equivalence standards for responsible fishery management. Criteria from the United Nations Food and Agricultural Organization (FAO) Code of Conduct for Responsible Fisheries and recognized fishery management leaders, e.g. Alaska, are presented as a baseline to assist seafood buyers in their evaluation of responsible sources for procurement. The need for education of buyers on such criteria is emphasized in order to facilitate corporately responsible seafood purchasing decisions, without the need of outside cost-added 3rd party certification schemes.

Competitiveness Improvement in Energy Resource Management, Real-time Costs, Greenhouse Gas Emission Measurement and Reporting
GLEN LEWIS* and Pamela Tom. *University of California, Food Science and Technology Department, Davis, CA 95616.*

A short-term Enterprise Energy Management (EEM) pilot project beginning fall 2007 through spring 2008 at a California seafood company is designed to explore and demonstrate Best Practices in energy and environmental management technologies to sustain seafood industry competitiveness.

The project objectives are to:

- Assist in the achievement of sustained seafood industry competitiveness in regional, national and global markets by improving both the acquisition and management of energy and environmental information for effective short and long-term decision making (e.g. operations and financial management, capital investment and regulatory compliance).

- Provide energy and environmental benchmarking data integrity to use in legislative and regulatory decision making having a direct and/or indirect impact on seafood industry competitiveness (e.g. C02 emissions impacts that may negatively impact seafood national and international competitiveness).

- Enable seafood companies and utilities to effectively collaborate, identify and measure energy efficiency and environmental operating efficiency and cost savings opportunities in seafood operations.

The EEM pilot method consists of advanced, award-winning energy management technologies to effectively measure usage, costs and C02 emissions at a zip code level on 15 minute intervals. The EEM pilot is focused on electricity with eventual expandability to holistically manage all water, air, gas, electricity, steam (WAGES) resources. Preliminary results will be discussed at the Conference.

The World Fisheries Crisis, or What Happened to the Science in Fisheries Science?
VIDAR G. WESPESTAD. *American Fishermen's Research Foundation, PO Box 992723 Redding, CA 96099.*

In recent years there have been repeated statements in the press that marine ecosystems are collapsing and fish stocks are verging on the edge of extinction, while at the same time world demand and consumption for seafood is at an all-time high. FAO statistics show that aquaculture has increased dramatically in recent decades while capture fisheries have peaked and possibly declined slightly in recent years. In the case of capture fisheries it is unlikely that fisheries yield will significantly increase from present levels because most of the depleted fisheries are low latitude fisheries with low productivity. The most productive fisheries are the high latitude pelagic species which have highly variable abundance levels, but long term yield isn't much above present levels. I use the current and projected future of world fisheries given the present understanding of technology, biology, competing uses and governance. For the short term there are problem stocks of fish, most are species that are fished in common and exhibit all of the problems of the commons, but where stock ownership has been established there have been improvements in stewardship and yield. Some regions of the globe have greater problems to overcome, but nearly all North American fisheries are adequately managed or developing improved management regimes. An increasing challenge to management is how to recognize and account for changes do global warming and changes in fisher behavior due to greatly increased fuel costs.

SESSION: SEAFOOD MARKETING

Seafood Exports to the EU – What You Need to Know and Where to Find Information
STÉPHANE VRIGNAUD. *Fisheries Trade Attaché-U.S. Mission to the European Union.*

The European Union is the world's biggest importer of fishery and aquaculture products. Exporters need to understand how to navigate through this complicated U.S.-EU environment to find the right and accurate information.

The difficult European legislative environment often confuses newcomers in the world of international seafood exports. The legislative framework covering European Food Law is complex and covers a variety of subjects such as labeling and nutrition, chemical and biological safety, biotechnology, food packing material and controls.
Depending on the regulatory status of the exporting country, import rules for fishery and aquaculture products maybe harmonized within the twenty-seven Member States (MS). If not, U.S. seafood exporters may have to comply with twenty-seven different rules.

In the U.S. there are several competent authorities for the certification of these products. And the services provided by U.S. Federal Agencies in that field are frequently unknown to the business communities. Furthermore, to each category of products corresponds a specific certificate that needs to be correctly filled in by the proper competent authority.

From FDA approval to certification and ultimate delivery to the European customer, the export journey must be well documented and well prepared to be a success, not only for the exporter but also for the ultimate consumer.

The objective of this presentation is to give the audience an overview of the correct resources, contact networks and online tools that are valuable for successful seafood exports to the EU.

Green Trade in the Seafood Supply Chain – A Case Study of the Cool Blue Box
Mike Dillon, WILLIAM DAVIES* and Rory Dillon. *Grimsby Institute of Further and Higher Education, Nuns Corner, Grimsby, UK, DN34 5BQ.*

With consumers demanding environmental progress more seafood companies are asking: What are the first steps to greening seafood trade? This paper presents 'three lessons of green trade', with reference to the Humber region. With 65-70% of all UK added value chilled seafood production and 85% of all added value frozen, the Humber is cutting edge of UK seafood trade: this makes us first in line to exploit opportunities in the green economy.

Lesson 1: Doing something is always better than doing nothing. The environmental debate has moved beyond blaming business towards a focus on providing products in greener ways. The Cool Blue Box encapsulates this, by replacing environmentally damaging disposable fish boxes. Encouraging similar significant improvements can make changes that green the supply chain step by step.

Lesson 2: Take a holistic view. It is important to be aware of how reducing your carbon footprint links to other issues. In some sectors environmental standards are becoming barriers to trade (Dillon *et al* Dublin 2007). In the Humber we pursue green and social commerce, introducing innovations alongside our Trade Corridor program. This initiative will see the Humber actively sourcing and investing in new trade partners, preventing their exclusion and improving sustainability and congestion.

Lesson 3: Compromise. Is it possible to pursue a green agenda and while trading with companies based thousands of miles away? Yes! Being a green industry is not all about draconian regulation. Green trade must be about providing solutions to problems and encompass a win/win vision for sustainable business development. We must allow that moving goods from one region to another takes energy while aspiring use as only as much as is necessary.

The Better Seafood Bureau: A Process to Preserve Economic Integrity
LISA M. WEDDIG. *Director, Regulatory and Technical Affairs, National Fisheries Institute, 7918 Jones Branch Road, Suite 700, McLean, VA 22102.*

The National Fisheries Institute (NFI) recently formed the Better Seafood Bureau – an independent body that establishes accountability for lawful business practices in seafood distribution and retailing– to ensure that seafood buyers have a means of recognizing suppliers who uphold high standards for business operations. The program, the culmination of NFI's Economic Integrity Initiative, is designed to identify companies doing things well and to provide a mechanism for buyers to report unresolved complaints. Three primary areas of focus of the Better Seafood Bureau are mislabeling of weights or counts of products, mislabeling of products or species substitution, and trans-shipment of products subject to anti-dumping and countervailing duties. The presentation will report on the development and current activities of the Better Seafood Bureau, including the process and product audit portion of the program.

SESSION: SEAFOOD PROCESSING AND ENGINEERING

Proteolytic Degradation of Albacore Tuna Light Meat during the Canning Process MARIA E. RUILOVA*, Tyre C. Lanier and Penny M. Amato. *Food Science Department, North Carolina State University, Raleigh, NC 27695.*

The canning process for tuna first involves a pre-cook step which takes the internal backbone temperature of the gutted fish to about 60C, which upon subsequent cooling facilitates hand separation of meat from bone, skin, and dark muscle. This temperature range is known however to stimulate activity of many heat-stable proteases that often are present in the meat of fishes. The present investigation explored the kinetics of heat-induced proteolysis in albacore light meat during the cooking and cooling process. Samples from the dorsal, belly or tail of the fish were subjected to isothermal treatments to determine rate constants of proteolytic activity. The maximum rate of heat-induced proteolysis occurred in belly meat, near 50C, while the minimum rate was in dorsal meat at 70C. Proteolysis proceeded during the cooling process even in meat previously heated at 70C. Samples exhibiting high proteolytic activity were softer (by Kramer force

testing and sensory analysis) and had a grainy texture/mouthfeel. Based on drained weights and the standard industry press test it was determined that tuna canned from dorsal and belly portions precooked at 50C exhibited higher mass losses from the meat cake than those precooked at 70C. Mathematical modeling of heat transfer within the fish in conjunction with rate constants measured will allow prediction of proteolytic breakdown and textural degradation when precook parameters are input.

Development of Economical Methods to Purify Fish Oil and Microencapsulation of Fish Oil

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Small fish processors and entrepreneurs are interested in producing small scale, cost effective fish oil extraction, clarification, and stabilization methods for human consumption. Unpurified oils produced from fish byproducts contain non-triglycerides, such as free fatty acids, oxidized components, protein, minerals, and insoluble impurities that reduce quality. These components need to be removed before the oil will be acceptable for many markets. Conventional fish oil refining steps are degumming, neutralizing, bleaching, and deodorizing. An alternative process for further refining edible oils is the adsorption process, which removes non-triglycerides materials in a cost effective process. Adsorption technology can potentially provide a simplified process for refining fish oil for human consumption. We are seeing a dramatic growth in the number of food products that are fortified with long chain n-3 fatty acids. However, attempts to incorporate fish oil into food formulations has had limited success because of 'fishy' flavors in the finished products. One of the technologies proposed for overcoming these problems is microencapsulation of fish oil. The microencapsulation process makes it possible to transform the oil into a powder. The microencapsulation of the fish oil can provide many benefits such as providing an oxygen barrier resulting in an extended shelf life, a taste profile barrier eliminating fish oil taste and odor, high nutritional density and nutritional availability, and a protective barrier when microencapsulated oils are incorporated into food products. The talk will focus on fish oil purification and microencapsulation techniques.

Phosphate-free Surimi: Feasible Challenge or Problematic

JAE W. PARK. *Oregon State University, Seafood Research and Education Center, 2001 Marine Drive, Room 253, Astoria, OR 97103.*

Phosphate has been used in various food applications due to its outstanding functional properties. Particularly in seafood, the use of phosphate has been perceived as either magically functional or economic fraud. Sodium polyphosphate has been successfully used as a food ingredient in frozen surimi over the last 40 years to maintain neutral pH and as a chelating ingredient, which has contributed to extended shelf life. For the production of fish fillet, sodium phosphate is often used to prevent moisture loss, regardless of whether fish is frozen or chilled. Phosphate has also been successfully used as a processing aid to facilitate shell removal of Oregon pink shrimp during the de-shelling process. However, in the late 1980s, abuse of sodium phosphate surfaced in the scallop industry. Recently, in the surimi industry, there is a demand for phosphate-free surimi. The question then is: "Can phosphate-free surimi seafood be made and subsequently labeled as a "natural" product?"

This presentation will review the basic function of phosphates in various foods, physicochemical effectiveness of phosphates made with mechanical vs. chemical blending, the effect of phosphate in surimi as well as the feasibility of phosphate-free surimi.

Chemically blended STP and TSPP showed improved emulsion and cooking stability as well as water retention ability. These phosphates also maintained significantly less damage to surimi gel texture during repeated 9 cycles of freeze/thaw. As the concentration of STP increased, salt extractable proteins and gel cohesiveness maintained higher values during repeated 9 cycles of freeze/thaw. Likewise, baking soda and

trehalose combined with or without sugar demonstrated good frozen shelf life of surimi without sodium phosphate.

Frozen surimi can be made without sodium phosphate, by utilizing baking soda and/or trehalose. Without substituting other ingredients, phosphate-free surimi must be used within a short period of frozen storage to maintain acceptable textural properties.

Comparative Study on Freeze Storage of North Atlantic Shrimp (*Pandalus borealis*) and Black Tiger Shrimp (*Penaeus monden*) in Different Periods and Levels of Freeze Storage

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Norway is one of the leading countries to produce and export North Atlantic shrimp worldwide. To sustain the business as well as to compete with tropical shrimps it is important to know more about the quality parameters of North Atlantic shrimp especially beneficiary fatty acid profile. The objective of this investigation was to compare the fatty acid profile and physical properties of North Atlantic Shrimp and Black Tiger Shrimp during different periods and levels of freeze storage.

These two types of shrimp were stored in the freezer at -20^{o}C and -40^{o}C for 0, 2, 4 and 6 months. The fatty acid profile was determined by standard method with GC. Drip loss was measured as weight loss upon thawing. Texture was done with TA-XT2 Texture Analyzer

During the study the PUFA content was higher in Atlantic Shrimp than Tiger Shrimp and relatively more stable in -40ºC stored samples than that of -20ºC and EPA, DHA contents remained high in the Atlantic Shrimp and -40ºC stored samples in general. Drip loss was higher in Tiger shrimp than Atlantic shrimp. Due to the size the shear force were higher in Tiger shrimp than in Atlantic shrimp, but both species increased during freeze storage at -40^{o}C and decreased during storage at -20^{o}C.

Effects of Different Slaughtering Methods on Post Harvest Quality of Farmed Atlantic Cod (*Gadus morhua*)

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It is well known that physical activity and stress associated with fish harvesting can have negative impacts on fillet quality. Greater muscle activity (handling stress) immediately prior to death results in a rapid drop in muscle pH due to anaerobic metabolism. In addition, it is possible that the fish can experience distress or pain during harvesting. As fish welfare is of major concern for the aquaculture industry and consumers, it is clear that the harvesting technology used must be satisfactory from that point of view. Therefore, finding a suitable sedation and killing method of farmed fish are important to comply with customer demands and the upcoming legislation related to animal welfare.

The main objective of the study was to find the most suitable sedation and killing method of farmed Atlantic cod (*Gadus morhua)* with respect to post harvest quality and fish welfare. Several trials have been carried out and the following sedation and killing methods have been evaluated: refrigerated seawater live chilling combined with mild carbondioxide anesthesia, saturated carbondioxide, AQUI-S^{TM}, percussion and electrical stunning. For comparison exhausted fish (chasing >30min) were included in the experiments. To assess fish welfare and potential handling stress, the following indicators were used: fish behavior, blood parameters (blood chemistry and stress hormones), ATP-depletion, rigor, initial muscle-pH and twitch-response. In addition fillet color and texture was assessed after 7 days of ice-storage.

The results showed that cod sedated with AQUI-S^{TM} (concentration: 17ppm, exposure time: >20minutes) followed by percussion stunning and gill cut exhibited the highest initial muscle-pH and had an extended

pre-rigor time compared with the other harvesting methods. Electro stunning (electrical current 3A, 40V (100Hz)) in air exhibited the lowest initial muscle pH, together with the exhausted cod. There were some significant differences related to fillet color and texture between cod harvested by the different methods.

Cooking and Freezing Time Effects on Farmed White Shrimp Muscle Myofibrillar Proteins

G. Guerrero-Manjarrez, O. Rouzaud-Sández, J.L. CÁRDENAS-LOPEZ* and J.M. Ezquerra-Brauer. *Universidad de Sonora, Hermosillo, Sonora, México.*

Shrimp is a high-priced seafood that is gaining market throughout the world. In the case of México, Sonora is the main shrimp grower, and most of the production is exported to the USA or other markets. An ongoing processors concern is finding new shrimp products that satisfy specific consumer demands. In the case of Europe, there exists a demand for ready to eat shrimp products and they prefer full body shrimp. We studied the effects of the cooking and freezing time on the myofibrillar proteins of the muscle of cooked farmed whole white shrimp (*Litopenaeus vannamei*) and the relationship with texture. Since most of the studies of cooking and freezing times have been done with captured beheaded shrimp, we had to establish cooking times for our samples and established two treatments: at 1.5 min and at 8 min in boiling water. A raw shrimp control was used. Fast freezing was done by immersion in a Dewar flask at -40°C and the freezing curves were obtained. The different treatments were stored frozen for 4 months at -18°C and samples were taken every month. Extraction of proteins was done in the monthly samples and analyzed. The analyses consisted of differential scanning calorimetry, electrophoresis of protein fractions and firmness. We found greater protein modifications in the shrimp cooked for 8 min and as early as 30 days of frozen storage, while the shrimp cooked for 1.5 min showed minimal changes al least for 60 days of frozen storage. Applications of the findings to a ready to eat cooked shrimp frozen product from aquaculture for the European market could be immediate.

Stabilizing Carp (*Cyprinus carpio*) Hydrolysate Using Potassium Sorbate

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Common carp (*Cyprinus carpio*) that were harvested from Utah Lake were enzymatically hydrolyzed to prepare a carp hydrolysate. In order to make the resultant carp hydrolysate economically feasible to use, it needs to be stable when stored under ambient conditions. Potassium sorbate is widely used as an antimicrobial agent in various food products such as bread and yogurt and therefore has been selected to be evaluated in carp hydrolysate. The objective of this experiment was to determine the optimum (1) pH level, (2) potassium sorbate level and (3) to evaluate the storage stability of carp hydrolysate. The influence of pH (3, 4, 5) and potassium sorbate level (0.0125, 0.025, 0.05, 0.1%) on stability were evaluated. Results indicated that pH 3 was the most effective pH. It was found that at ambient temperatures and at approximately pH 3, there was no difference in stability between the levels of potassium sorbate ($P>0.05$) so the lowest level (0.0125%) was selected. Experiments evaluating the storage stability were also conducted by adding potassium sorbate (0.0, 0.0125, 0.025, 0.05 and 0.10%) adjusting the pH (3.5, 4, or 4.5) and placing the samples in heat chambers at temperatures of 27, 49 and 60° C. Mold growth, pH change and smell were monitored and recorded. The heat stress trials showed that the optimum sorbate and pH levels were the same as were observed at ambient temperatures. It can be concluded that potassium sorbate can be used to effectively stabilize the hydrolysate product. It was found that pH 3 was the optimum pH and because there was no difference in stability for the varying amounts of potassium sorbate added, the lowest amount of sorbate was found to be sufficient in keeping the product stable.

SESSION: SEAFOOD PROTEIN

New Insights into the Factors Influencing Muscle Protein Gelation

Bradley J. Wright and TYRE C. LANIER*. *Department of Food Science, North Carolina State University, Raleigh, NC 27695.*

Gels made from meat protein isolates produced by alkaline pH shifting are generally stronger and more deformable when compared to gels prepared similarly from lean meat or surimi (water-washed meat). We hypothesized that pH shifting causes more disruption of the myofibrillar structure, allowing for greater dispersion of the proteins and thus stronger gel formation. To evaluate effects of ultrastructural disruption and dispersion independent of pH shifting, fish myofibrils were treated with isolated calpain to disrupt Z discs and thereby possibly effect a similar level of myofibrillar dispersion as does the alkaline pH shifting recovery process (adjust meat slurry to pH 11 followed by isoelectric precipitation at pH 5.5). TEM was used to observe changes in ultrastructure in gels produced by subsequent addition of NaCl and heating. A trained panel (n = 10) evaluated the disruption and dispersion observable in micrographs. Torsion testing was used to evaluate gel fracture properties. Fracture stress and strain values for the calpain treated samples were not significantly different than for the pH shifted samples, and these were greater than for mince or surimi. Panel evaluation of TEM micrographs supported this order of gelation, showing greater disruption/dispersion of myofibrillar microstructure associated with stronger, more deformable gels.

Functional Protein Concentrates from Jumbo Squid (*Dosidicus gigas*) Muscle Using Acid and Alkaline Solubilization Processing

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The aim of this work is to give value to the jumbo squid (*Dosidicus gigas*) fishery of the Pacific coast of Mexico. One approach is to increase knowledge supporting technology for transforming muscle protein. Squid muscle has properties that may be useful for producing protein concentrates that can be used in food products as raw material or ingredient. Development of new products would increase the prosperity of the fishery and people involved. This work describes two procedures for processing muscle of jumbo squid to obtain protein concentrates (PC) with functional properties for economic revenue. Squid muscle with different preparations (frozen/ground combinations) was used to evaluate its effect on PC´s functionality. Process is based on solubilization and precipitation of much of the muscle protein. Squid muscle proteins were extracted using acid and basic solutions. About 85% of initial muscle proteins were solubilized at pH 3.0 and 11.5, of which about 90%, were recovered after precipitation at pH 5.5 regardless the pH of solubilization. The total yield for both procedures was 75%. Functional characterization showed that the PCs from both acid and alkaline processes have excellent emulsion capacity (34-44%) with values higher than control group: albumin (32.8%) and squid muscle (28%). Foaming capacity of PCs from both acid and alkaline processes was lower (160.2%) than compare with control group (432% and 187%, respectively). PC from alkaline process showed the best gel strength (358 N.mm/g) respect to PC from acid process (503 N.mm/g) and even squid muscle (59.6 N.mm/g). The different preparations of squid muscle had effect on the PC´s functionality. About 90% of the water used in the process is recovered. This study demonstrated that acid and alkaline processing conditions are an efficient and feasible alternative for recovering functional PC from squid muscle even if the muscle underwent frozen denaturizing conditions.

Effect of Alkaline Solubilization Process on Physiochemical Properties and Gel-Forming Ability of Striped Catfish (*Pangasius hypophthalmus)* Protein

PANCHAPORN TADPITCHAYANGKOON* and Jirawat Yongsawatdigul. *School of Food Technology, Institute of Agricultural Technology, Suranaree University of Technology, Nakhon Ratchasima, 30000, Thailand.*

Striped catfish (*Pangasius hypophthalmus)* is an abundant fatty freshwater fish species in the Mae Kong River of Thailand. Utilization of fish mince as value added products is limited due to its high lipid content, dark-fleshed meat and muddy odor. A means to overcome such drawbacks is needed in order

to increase utilization of this species. Recently, a newly-patented process, using alkaline solubilization, has shown potential as a high protein recovery process.

The objective of this research was to investigate the effect of washing treatment (alkaline solubilization, conventional and alkaline washing) on the physiochemical properties and gelforming ability of striped catfish proteins.

Striped catfish was minced and washed using various washing treatments. Protein compositions and autolytic activity of samples were investigated. Fatty acid profile was also determined using gas chromatography. Textural and color properties of gel samples were determined using a texture analyzer and colorimeter, respectively.

The alkaline solubilization process produced a product with higher total protein (98.77 % dry wt. basis) and alkaline-soluble protein (70.04 mg N/g), lower stroma protein (0.20 mg N/g protein) and fat content (0.98 % dry wt. basis), as well as reduced autolytic activity when compared to the other washing processes. Fatty acid content was highly reduced by the alkaline solubilization process followed by alkaline and conventional washing. Gel-forming ability of alkaline-solubilized gel was markedly improved when set at 40 oC for 30 min. Alkalinesolubilized gel showed higher breaking force, but lower deformation values than water and alkaline-washed gels. Salt addition improved whiteness and deformation of alkaline-solubilized gel but adversely affected gel breaking force.

Alkaline solubilization could be used to increase utilization of striped catfish by increasing protein recovery and reducing fat content. Unlike other results, it should be noted that alkaline solubilization improved breaking force, but negatively affected elasticitiy of striped catfish gel.

Qualification and Quantification of Protein Additives in Prepared Crabstick Using ELISA

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Surimi, along with protein additives such as egg white and whey protein concentrate, are used as base ingredients for crab-flavored seafood (crabstick). Protein additives are often added to surimi as enzyme inhibitors and to crabstick products as a gel enhancer, particularly when the surimi content is reduced to cut costs and increase profits. However, no attempt has been made for qualification and quantification of protein additives in surimi and crabstick.

Our objective was to create and optimize an enzyme-linked immunosorbent assay (ELISA) that would qualify and quantify the presence of egg white (DEW) and whey protein concentrate (WPC).

Extracts of crabsticks containing varying levels of egg white and whey protein concentrate were used in an indirect ELISA assay. Extracts were quantified using standard curves created from purified ovalbumin (OA) for egg white and β-Lactoglobulin (β-LG) for whey protein concentrate.

Four extraction methods were compared with phosphate buffered saline and 1% (w/v) sodium dodecyl sulfate, the samples were heated at 90 °C for 1 hour to obtain the highest protein extraction. A key to the success of the indirect ELISA assay was the interaction of the antibody with the protein of interest. Due to crabstick's highly processed nature, antibodies that recognize denatured proteins were successfully used. The dynamic range of protein additives was optimized using purified ovalbumin and β-lactoglobulin and showed high R^2 values (OA = 0.9862, β-LG = 0.9967). Crabsticks spiked with either DEW or WPC also showed good R^2 values (DEW = 0.9753, WPC = 0.9769).

Using the indirect ELISA method, the qualification and quantification of DEW and WPC in crabstick was successful when samples were probed for denatured ovalbumin and β-lactoglobulin, respectively. This

study possesses great potential as a significant tool for the qualification and quantification of protein additives in commercial crabstick products.

SESSION: SEAFOOD BYPRODUCT UTILIZATION

Alaskan Fish Gelatin Films: Thermal, Tensile, and Barrier Properties and Effects of Cross-linking

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Gelatin was extracted from the skins of Alaska pollock (*Theragra chalcogramma*) and Alaska pink salmon (*Oncorhynchus gorbuscha*). These skins were by-products generated from the Alaskan fishing industry. Films were then cast from the fish gelatin and their thermal, tensile, water vapor permeability, oxygen permeability, and biodegradation properties were compared to those of bovine and porcine gelatin films. In addition, glutaraldehyde cross-linkers were added to fish gelatin films to improve their mechanical and water barrier properties. Pollock and salmon films had comparable tensile properties, but had lower tensile strength and percent elongation than those of mammalian gelatin films. This might be due to higher denaturation levels found in mammalian gelatin films. Adding 0.50% (w/w) glutaraldehyde was sufficient to react most of the amino groups in fish gelatin. However, the cross-linkers did not affect tensile properties of the gelatin films. Pollock gelatin films had the lowest water vapor and oxygen permeability values, whereas the mammalian gelatin films had the highest permeability values. Salmon gelatin films had intermediate permeability values. Cross-linking resulted in lower water vapor permeability for salmon gelatin films and higher oxygen permeability for pollock gelatin films. However, all fish gelatin samples still had better water vapor and oxygen barrier properties than mammalian gelatin films. Also, fish gelatin films degraded faster than mammalian gelatin films over a sixty-four day period. However, there did not seem to be any relationship between cross-linker concentration and degradation rate.

Recovery of Muscle Protein and Collagen from Pearl Production Waste

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China produces 1500 metric tons of pearl each year accounting for nearly 95 % of the world's production. *Hyriopsis cumingii* is a freshwater pearl oyster that is widely cultured in China for pearl production with an annual cultivation of 500 to 800 million pearl oysters in 57000 hectare of cultivated water area. Nearly 30000 metric tons of waste is generated from the industries each year. This study developed procedures for systematically recovering muscle protein and collagen from the pearl production waste and determined the properties of recovered products. The recovery procedures involved an initial extraction of pearl oyster muscle and mantle with alkaline water (pH 8-12) at 5-20ºC and followed by a centrifugation process. The supernatant was precipitated with HCl solution until the isoelectric point of the protein at room temperature to isolate muscle protein. While the pellets was extracted with 0.5M acetic acid solution containing 1% pepsin to obtain crude collagen solution and followed by a purification procedure with salting out in 2.5M NaCl solution and dialyzed against 0.5M acetic acid solution. The recovered protein contained high levels of essential amino acids (40%) with serine (10%) being the most abundant followed by lysine (7%). When compared with soybean protein isolate, this protein had similar or even better solubility, water-absorbing ability and emulsion stability. The lyophilized collagen product had a molecular formula as $\alpha 1_2 \alpha 2$ with a molecular weight of 430KD and contained 85% collagen and 71% amino acids of total weight. Its intrinsic viscosity value was 11.2dL/g and denaturation and shrink temperatures were 31ºC and 55ºC, respectively. This study demonstrates that pearl production waste is a good source of both muscle protein

and collagen that might be utilized as ingredients in food processing, health care, cosmetics and other industrials.

Increasing Utilization of Viscera from Fish Processing

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In excess of 2.4 million mt (Mmt) of fish was commercially harvested during 2005 in Alaska. Over half was pollock (58%), followed by salmon (17%), Pacific cod (10%) and a number of other species. Calculation indicated there was the potential production of 1.3 Mmt of byproducts, such as heads, viscera, frames and skin. These byproducts are derived from fish processed for human consumption and can be collected separately. The largest volume of individual byproduct was viscera at over 400,000 mt.

From a fish processing stand point viscera is the generic term used to describe the organs and tissue removed after the belly cavity is opened and its contents emptied. The major components are the reproductive tissues (roe and milt), stomach, liver, and digestive track. Usually viscera does not include the heart as this organ is often removed with the head during processing. From a fish processing stand point what can be done with viscera?

Initially the high valued byproducts such as roe are removed. In some cases milt and stomachs will also be collected for different food markets. The usual out come of viscera with these products removed will be to combine it with heads, frames and other byproducts to produce wet reduction fish meals and oils. Other possibilities include uses in compost. There are other possible products that can be made from viscera including liver food products, liver meals and liver oils, viscera meals with high levels of soluble proteins, and palatability additives and attractants for uses as ingredients in the pet, farm and aquaculture industries. Viscera components can be further fractionated to separate enzymes, biochemicals, and other ingredients for supplements. This presentation will discuss some of the recent research findings in this area and future research opportunities.

Composition of Hydrolysate Meals Made from Alaskan Pollock, Salmon & Flatfish Processing Byproducts: Comparisons with Traditional Alaskan Fishmeals

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Alaska annually processes roughly 2.2 million mt (Mmt) of fish harvested for human food, generating some 1.5 Mmt of fish waste, depending on season, species composition and product form. In the western Gulf of Alaska and along the Bering Sea, larger seafood processing operations are mandated by regulation to effectively handle the by-products of seafood processing. These concerns employ wet- reduction processing to manufacture co-products such as fish meal, bone meal, fish oil and concentrated stick water from this material. Other seafood processing operations in Alaska, although smaller and often seasonally operated, could potentially employ less capital intensive methods such as enzymatic hydrolysis, to cost effectively handle processing byproducts. In this project, dried hydrolysate meals were made from the byproducts of seafood processing, derived from commonly encountered Alaskan commercial species, collected during the different harvesting seasons. To establish their utility, the meals were chemically characterized as to color, mineral content, lipid class, proximate, fatty acid and amino acid analyses. Comparisons with wet reduction meals show these hydrolysate based co-products to be of high quality. The data from this study may be

useful in developing markets for hydrolysates made from the processing byproducts derived from these species.

Chemical Characterization of Heads and Livers of Yelloweye Rockfish (*Sebastes ruberrimus*) Harvested in Alaska

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Due to their large size and fillet quality, yelloweye rockfish (YER) are a highly prized species in both commercial and recreational Alaska fisheries. In 2006 catches for YER in Alaska averaged about 300 T, which mainly occurred as by-catch of the commercial halibut fisheries. Processing yields for YER are relatively low (skinless fillets ~ 23%); thus byproduct volume is significant at up to 77% of whole fish weight (WFW).

The objective of this research was to characterize yields and important nutritional parameters of YER heads and livers.

Six whole fresh YER (> 48 hr post-mortem; average wt. 4 Kg) were procured from a commercial fishing vessel (Kodiak, March 2005). Fish were immediately processed, and heads and livers promptly analyzed for their proximate composition, fatty acid (FA) and amino acid profiles, lipid classes, and mineral composition.

Heads of YER were the major byproduct constituting 42% of WFW. Yelloweye rockfish livers made up only 2% of WFW. Livers contained high levels of lipids (28.5%) but were of small size, while lipid content of heads was 7.5%. Recovered oils were of high quality being predominantly triacylglycerides (> 90%). Oils were similar in many aspects to oils from other demersal cold water marine finfish and were rich in omega-3 and omega-9 FA, and low in omega-6 FA. Protein content in heads and livers were 16% and 11.5%, respectively. Amino acid analysis of these byproducts revealed that the protein was of high quality and the mineral profile of heads was typical for this type of marine byproduct.

Overall, results indicated that YER byproducts can be utilized for the production of high quality specialty ingredients that can be used as feed components or further purified for nutraceutical use. This research is part of an ongoing effort to promote full utilization of Alaska fisheries resources.

SESSION: SEAFOOD CHEMISTRY

Kazal Proteinase Inhibitor: A Recombinant Protein from *Penaeus vannamei* Hemocytes

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Serine proteinase inhibitors are found in arthropod hemolymph either in plasma or in hemocytes. Proteinase inhibitors regulate physiological processes, some affecting post mortem biochemistry and nutrition. Also, inhibitors are useful food technology. A Kazal serine proteinase inhibitor, PI_Pv, identified in the hemocytes cDNA of white-leg shrimp *Penaeus vannamei* was successfully expressed in the *Escherichia coli* BL21 (DE3) expression system. The expressed recombinant PI_Pv in the soluble fraction was purified by affinity chromatography. The molecular mass of PI_Pv was 24.6 kDa with *pelB* leader and His ● Tag. Considering that the specificity of each domain depends chiefly on the P1 residue at the reactive site, PI_Pv inhibitory capacity was tested for trypsin, α-chymotrypsin and subtilisin. The inhibitor exhibited potent inhibitory activities for trypsin and subtilisin, and not for chymotrypsin. The inhibition mechanism for

trypsin and subtilisin were competitive. The origin and function of the inhibitor of PI_Pv in shrimp suggests a probable role as a defense component in immune response

Protein Digestion System in Crustaceans

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The Biochemistry Group (BQ Lab) at CIBNOR has advanced studies of digestion of crustacean food proteins for more than a decade. This presentation summarizes the main results of the research on this biological system. Digestive enzymes of crustaceans have evolved into a complex to efficiently transform proteins in food to free amino acids as de novo building blocks for creating their own proteins. The biological system includes mechanisms to control spontaneously activated proteases and compensate for difficult food conditions.

The biological system is primarily composed of endo- and exo-proteases that act sequentially. By having trypsin and chymotrypsin and specific carboxypeptidases, crustaceans can free seven out of the ten essential amino acids. The system synthesizes zymogens along with specific inhibitors to prevent autoproteolysis of digestive tissues.

Isotrypsins and isochymotrypsins generate phenotypes. Phenotypes seem to have evolved to improve digestion capabilities. In the shrimp P*enaeus vannamei*, three isotrypsins (A, B, and C) are coded at two loci: locus α, which is heterozygous, yielding isotrypsins A and B, and locus β, which is homozygous, yielding isotrypsin C. Isotrypsin C has higher physiological efficiency and specific activity, lowest K_m, and requires higher concentrations of Ca^{+2} to reach the same activity as the other two isotrypsins. Crustaceans' genomes codify for proteinases belonging to different classes.

Paradoxically, each class has a different optimal pH, at least for the serine, cysteine, and aspartic proteinases. Some crustaceans, such as *P. vannamei*, rely more on serine proteinases, while the European lobster *Homarus gammarus* relies on aspartic proteinases. *Crangon crangon* and *C. allmanni* shrimp of the North Sea have intermediate proteinase status, with a minority of individuals or populations having trypsin proteinases and a majority having cysteine proteinases. This may reflect different strategies of food utilization acquired during adaptive radiation in crustaceans to cope with food proteinase inhibitors.

This presentation provides a general view, methods used, and examples of the protein digestive system in crustaceans.

Effects of Fumonisin B_1 on Growth, Survival and Ice Storage Life of White Shrimp (*Litopenaeus vannamei*)

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The effects of fumonisin B_1 (FB_1) addition to feed on growth, survival, muscle proteins and ice storage life were studied on juvenile (5-6 g) white shrimp (*Litopenaeus vannamei*). Muscle protein concentration, thermal behavior of muscle by differential scanning calorimetry, muscle histology by SEM, and firmness by instrumental analysis were evaluated. Shrimps were exposed to feeds spiked with 0.0, 0.2, 0.6, and 2.0 μg FB_1/g during 30 days. Growth was affected in all FB_1 concentrations tested. FB1 at all concentrations evaluated did not affect shrimp survival. Muscle protein concentration decreased after 30 days in shrimp exposed to FB_1. Changes in thermodynamic properties of myosin were observed in shrimp fed with FB1. Marked histological changes in shrimp tissue fed on diet containing FB1 at 0.6 and 2.0 μg/g were observed. Firmness was not affected by FB_1. All parameters evaluated during ice storage life were not affected in all

FB_1 concentrations tested. FB_1 in diet affected mainly development of white shrimp during culture, but not its ice storage life.

The Effect of Trypsin Phenotype in the Degree of Hydrolysis of Protein by Shrimp *Penaeus vannamei*

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Previously, our group (Sainz, et al. 2005), demonstrated that individuals of the whiteleg shrimp *Penaeus vannamei* may belong to one out of three trypsin phenotypes named I, II and III; I, trypsins A, B and C; II, trypsins C and B; and III, trypsins C and A, with each trypsin having different kinetic parameter values. In the present work we evaluated the digestive capabilities of shrimp possessing different trypsin phenotypes using the pH-stat method. We used enzymatic extracts from the mid-gut gland of *Penaeus vannamei*. For the analysis, 50 specimens were decapitated to obtain the digestive glands, homogenized individually (1:3) (w/v) in dH_2O, centrifuged for 30 min at 10,000 *g*, and the supernatant separated (enzymatic extract). The concentration of the soluble protein was measured by the method of Bradford (1976). Total protease activity was measured using azocasein as the substrate. Trypsin phenotypes were identified by the composition of isotrypsin by electrophoresis. One activity unit of enzymatic extract from each individual was used in triplicate pH-stat assays. Three individuals of each phenotype were used. The substrates used were fishmeal from SIGMA and casein as control. Total protease activity ml^{-1} was the highest (P= 0.047) for shrimps of trypsin phenotype I. The degree of hydrolysis on casein or fishmeal for phenotype I individuals was higher than the other two phenotypes (P = 0.036 and P = 0.0036, respectively). This study is intended to select families of organisms having higher digestive capabilities and growing potential as demonstrated in salmons of different isotrypsin phenotypes. Results of an assay designed for evaluating aquafarming performances in individuals having one of the three trypsin phenotypes will be presented.

Digestive Cathepsin L and D in the European Lobster *Homarus gammarus*

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The European lobster, *Homarus gammarus*, is a high-value species. Investigation on its digestive physiology is necessary for an appropriate management of this species. Recent works on proteolytic enzymes from the digestive system of the European lobster have demonstrated that aspartic and cysteine proteinases are the main partakers in the total proteolytic activity of the digestive juice. In this study we performed RT-PCR and enzyme activity assays to investigate the expression of aspartic (Cathepsin D) and cysteine (Cathepsin L) proteinases. We analyzed those genes expression in different tissues. Our results revealed that such genes are highly expressed in the digestive gland with no apparent expression in the gonads or in the muscle. We also analyzed fasting-induced changes in the expression of cathepsin L (CatL) and cathepsin D (CatD) mRNA using RT-PCR. Obtained products were visualized electrophoretically and semi-quantified by densitometry of bands. Starvation caused a slight but significant increase of CatL mRNA expression, with a subsequent rise in the cathepsin L proteolytic activity, while re-feeding diminish its expression and activity. Such activity was measured spectrofluorometrically using a specific substrate (Z-Leu-Arg-AMC). The mRNA levels of CatD weren't affected by starvation, but refeeding provoke a significant decrease in the mRNA levels of CatD. Those findings offer new information about cathepsin D and cathepsin L genes that support its role as digestive protease and provide knowledge of its regulation during food intake. Further studies using real-time PCR should be done.

SESSION: POSTER

SESSION: SEAFOOD PROCESSING AND EDUCATION

Assessing the Need for Training in the Retail Seafood Sector of Seattle, Washington MARK H. GLEASON[1]* and Pete Granger[2]. *[1]Washington Sea Grant College Program & University of Washington School of Marine Affairs. [2]Washington Sea Grant College Program, University of Washington, Box 355060, 3716 Brooklyn Avenue, N.E., Seattle, WA 98105-6716.*

Recently there has been increasing awareness of the fact that consumer demand for many seafood products has driven the harvest of some species to unsustainable levels (Quinn-Smits, 2006). The failure to reign in this harvest has led to a corrective effort dubbed the "sustainable seafood movement." This movement rewards well-managed, low impact fisheries through active marketplace promotion while discouraging seafood purchases from poorly managed, high impact fisheries. One tool that has been employed to achieve this end is consumer education regarding the environmental implications of seafood purchases. While this educational effort is a laudable first step, there is still much to be accomplished if consumer demand is to positively impact the conduct of fisheries.

Many in the sustainable seafood movement realize that consumer education is not enough. The next step is to educate restaurateurs, wait-staff, distributors, and retail seafood workers (WSG, 2006). These workers are "on the front line." As such, they provide the pivotal link between the consumer and the fish they consume. The information they provide often means the difference between an informed, sustainable seafood purchase and one that is not. In recognition of this, Washington Sea Grant has initiated a project to examine the current state of training for retail seafood workers in the Seattle area and to determine the need for additional training program development.

In order to assess these needs, 12 formal and numerous informal interviews and meetings were conducted with members of Seattle's retail seafood "community." Data from these interviews is still being analyzed. However, a few notable trends have emerged. In particular, the current state of training is inadequate. Furthermore, additional training resources and materials are needed. And finally, the industry as a whole will benefit from a well-educated workforce that regards seafood retailing as a career, not simply a job.

The 2007 International Smoked Seafood Conference; Review of the Meeting and Lessons Learned

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Conferences are excellent venues for exchanging the newest information and networking with peers. Coordinating the International Smoked Seafood Conference in Alaska in March, 2007 was a great deal of effort on the part of many people and a great deal of money from many organizations. The meeting included academics, the seafood industry and regulatory agencies and was quite successful. This presentation will include helpful information for those who would attempt to stage a conference including how decisions were made, the sequence of events, and lessons learned from the smoked seafood conference. A summary of the information presented at the conference will be included.

California Sea Grant Fisheries Extension

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The University of California Sea Grant Extension Program engages in research and extension education to support fisheries and seafood safety and technology. The program includes the Seafood Network Information Center based in the Department of Food Science and Technology on the UC Davis campus and nine marine advisors conducting applied research and educational programs from Crescent City to San Diego.

One of the world's first seafood technology network information centers, *SeafoodNIC* is a portal to Internet resources addressing information needs of seafood processors, inspectors, researchers, importers, and food educators in areas of seafood safety and quality. *SeafoodNIC* is also designed to assist the seafood industry and regulators implement Hazard Analysis and Critical Control Point (HACCP) regulations as required by the US Food and Drug Administration. This scientifically based regulation helps US processors and importers ensure the marketing of safe seafood in the US.

Marine advisors in the extension program also work with commercial and recreational fishermen assessing fisheries and infrastructure needs and providing educational programs about the fishing industry. Applied research programs address the human dimensions of fisheries as they relate to fishing communities and resource management, socioeconomic impacts of changing fisheries management and designation of marine protected areas, fish and invertebrate fisheries, and shellfish aquaculture.

Shelf Life Extension of Shrimp (White) Using Modified Atmosphere Packaging

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Introduction: Wild caught shrimp have a short shelf life when compared to farm raised shrimp due to their biological characteristics and on-ship limitations. The loss of freshness in shrimp is partly due to autolytic reactions caused by endogenous enzymes such as polyphenol oxidase.

Objective: The objective of this study was to determine the effect of sulfites combined with modified atmosphere packaging (MAP) on enhancing the shelf life of non-frozen shrimp.

Methods: Fresh South Atlantic White Shrimp were subjected to one of four treatments, (1) no bisulfite rinse-air packaged, (2) 1.25% bisulfite rinse-air packaged, (3) 1.25% bisulfite rinse-MAP (60% CO_2, 18% O_2, 22% N_2) and (4) 1.25% bisulfite rinse-MAP (36% CO_2, 64%N_2). The quality and freshness of shrimp was measured by determining total aerobic bacterial populations, package head space analysis, shrimp volatiles (GC-MS), meat pH, nucleotide degradation, and sensory analysis.

Results and discussion: The rate of hypoxanthine production was slowed by both MAP treatments during storage indicating slowing of shrimp degradation. MAP also slowed bacterial growth having 2 to 3 log cycles lower populations after 10 days of refrigerated storage compared to non-MAP treatments. No black spots were observed by panelists on MAP shrimp while significant spotting was reported for non-MAP shrimp after 6 days.

Conclusion: Fresh non-frozen shrimp treated with a combination of sulfites and MAP maintained the shelf life of fresh non-frozen shrimp up to 10 days, 4 days longer than non-MAP shrimp.

Effect of Different Methods of Cooking on Proximate Composition and Fatty Acid Profile in the, *Fenneropenaeus indicus*

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In this paper the effects of different cooking methods (baking, boiling, microwave and frying) on proximate composition and contents of fatty acids in Indian white prawn (*Fenneropenaeus indicus*), were determined. Mean moisture, fat, protein and ash contents of raw shrimp were 81/40±0 /168, 1/49± 0/411, 16/24± 0/377 and 0/85±0/040 respectively. In all cooking method, moisture decreased and protein increased. Fat content of fried shrimp was significantly higher than other samples. Protein content in all cooking methods increased and there were significant differences between them and raw shrimp. Monounsaturated fatty acids (MUFA) content of white Indian prawn was 5 percent. MUFA composition of shrimp, in all cooking methods decreased except samples fried. The content of polyunsaturated fatty acids (PUFA) in fried shrimp was significantly more than other treatments. All heat treatments caused changes in fatty acid contents of white Indian prawn. In fried shrimp, ratio of n-3/n-6 was less than what was found in shrimps cooked by other methods and had significant difference with them. The highest and lowest amounts of EPA+DHA were observed in raw shrimp and boiled shrimp respectively. Comparing raw and cooked shrimp it was found that cooking has very important effect on proximate composition and fatty acids content of white Indian prawn. Finally it can be implied from this study that the most healthy and safe methods for cooking of shrimp are Baking and microwave

Effect of Collagen Edible Coating from Skate Ray (*Raja kenojei*) Skin on Shelf-Life of Pork as a Natural Shelf-Life Enhancer in Pork

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Extended storage of cut meats under retail conditions can cause oxidative degradation. It has been interested in edible coatings and films in recent years because of their potential to maintain quality and shelf-life of foods. Collagen was extracted from skate ray skin by pretreated with $Ca(OH)_2$ and NaOH solution and lyophilized to obtain two kinds of collagen, $Ca(OH)_2$ and NaOH collagen. Aqueous solution (5%, w/v) of collagen powder containing 2.5% (w/v) glycerol and 0.125% (w/v) of $CaCl_2$ were used to coat pork (2.5 cm^3) by dipping for 1min. Collagen edible coatings were used to reduce oxidative degradation and microbial growth of pork stored at 4°C for 5 days. The objective of this study was to determine the effect of collagen powder edible coating to the color, thiobarbituric acid-reactive substance (TBARS), peroxide value (PV), weight loss (%), and microbial counts in pork. The TBARS and PV reduced ($p<0.05$) by collagen coating compared to control. The percent inhibition (PI) of TBARS compared to the control was 39.8 and 43.4%, respectively, for collagen coated pork. The PI of PV compared to control was 45.4 and 47.1%, respectively, for $Ca(OH)_2$ and NaOH collagen coated pork. Moisture loss of pork was reduced by collagen coating compared to control ($p<0.05$). Reduction of sample weight loss by 45.7 and 39.1% over control was achieved by $Ca(OH)_2$ and NaOH collagen coating, respectively. While relative moisture loss reduced by 47.8 and 38.8% over control by collagen coating. Both $Ca(OH)_2$ and NaOH collagen coating of pork significantly inhibit the growth of total aerobic bacteria and *Escherichia coli.* However, collagen coating of pork meat didn't inhibit the growth of lactic acid bacteria count. Data show that collagen powder coating can effectively be used as natural edible coating to extend quality and shelf-life of cut pork.

Functional Protein Concentrates from Jumbo Squid (*Dosidicus gigas*) Muscle Using Acid and Alkaline Solubilization Processing

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The aim of this work is to give value to the jumbo squid (*Dosidicus gigas*) fishery of the Pacific coast of Mexico. One approach is to increase knowledge supporting technology for transforming muscle protein. Squid muscle has properties that may be useful for producing protein concentrates that can be used in food products as raw material or ingredient. Development of new products would increase the prosperity of the fishery and people involved. This work describes two procedures for processing muscle of jumbo squid to obtain protein concentrates (PC) with functional properties for economic revenue. Squid muscle with different preparations (frozen/ground combinations) was used to evaluate its effect on PC´s functionality. Process is based on solubilization and precipitation of much of the muscle protein. Squid muscle proteins were extracted using acid and basic solutions. About 85% of initial muscle proteins were solubilized at pH 3.0 and 11.5, of which about 90%, were recovered after precipitation at pH 5.5 regardless the pH of solubilization. The total yield for both procedures was 75%. Functional characterization showed that the PCs from both acid and alkaline processes have excellent emulsion capacity (34-44%) with values higher than control group: albumin (32.8%) and squid muscle (28%). Foaming capacity of PCs from both acid and alkaline processes was lower (160.2%) than compare with control group (432% and 187%, respectively). PC from alkaline process showed the best gel strength (358 N.mm/g) respect to PC from acid process (503 N.mm/g) and even squid muscle (59.6 N.mm/g). The different preparations of squid muscle had effect on the PC´s functionality. About 90% of the water used in the process is recovered. This study demonstrated that acid and alkaline processing conditions are an efficient and feasible alternative for recovering functional PC from squid muscle even if the muscle underwent frozen denaturizing conditions.

Impact of Brine, Phosphate and Salt Levels on Textural Properties of Restructured Albacore Hams as Analyzed by Texture Profile Analysis

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Restructured albacore tuna (*Thunnus alalunga*) hams were researched as a potential value-added seafood product. Because of their abundance on Oregon's coast they represent a substantial commercial value. Also, with their high Omega-3 fatty acid content, they represent a healthful alternative to conventional hams.

The objective of this project was to create restructured albacore hams and determine the effect of brine, sodium tri-phosphate (TPP) and salt levels on textural properties using Texture Profile Analysis (TPA).

Albacore tuna were sliced across the loin every two inches. Scrapings and trim from the remaining carcass were ground through a 1.27 cm plate. A ratio of ground meat to loin pieces of 1:3 was used to provide more cohesion to hams. Various combinations of salt (2.1, 3.1%), TPP (0, 0.3%), and brine (12, 18, 24%) were added to the tuna flesh. Sugar and nitrite were also added at a fixed concentration for flavor and stability. Mix was tumbled for two hours at 4 C, 16 rpm and 48 cm Hg vacuum, and stuffed into 65 mm fibrous casings. Hams were cooked in an Enviro-Pak oven to a core temperature of 71 C. TPA was performed on hams by extracting cores and analyzing on a TA-XT texture analyzer. Parameters evaluated were hardness, springiness and cohesiveness.

Increasing salt concentrations at the different brine percentages and 0.3% TPP showed significant differences in hardness ($p<0.01$) and cohesiveness ($p<0.01$) but showed no significance in springiness. Samples without TPP showed no significant differences in the studied parameters, except for the experiment with 12% brine and 2.7% salt, which was significantly harder than all samples ($p<0.01$).

These results show that brine and salt levels, as well as presence of TSP, will lead to significant changes in the textural properties of albacore hams, which would likely have an effect on sensory attributes.

Effect of a Natural Antimicrobial on Shelf-life of Frankfurters Made from Jumbo Squid *(Dosidicus gigas)* Mantle Muscle

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Jumbo squid (*Dosidicus gigas*, d'Orbigny 1835) is quite abundant in the Gulf of California and represents a great potential for Mexican fisheries of the region. However, most of their capture is dedicated for Asian markets with minimum process. Preliminary studies indicated that squid frankfurters are an option to produce value-added products using this raw material. However, microbiological results indicated that they had a shelf-life of just 21 days.

Thus, our objective was to evaluate the effect of a natural antimicrobial (PRONAT™) on the shelf-life of frankfurters derived from Jumbo squid mantle muscle.

Frankfurters, Control and PRONAT™-added at 0.1%, from squid mantle muscle were vacuum packed in 200 g bags and stored at 2-4°C for up to 34 days. Samples were removed for analysis at days 0, 2, 5, 7, 10, 14, 21, 23, 26, 28, 31 and 34. Effects on moisture loss, pH, TBA, peroxide value, texture (TPA and shearing force), folding test, water holding capacity, drip loss and color were evaluated. Spoilage (Total aerobic and anaerobic counts) and pathogen (total and fecal coliforms) growth were assessed.

Results showed PRONAT™ kept lower microbiological counts than control; however, results did not surpass permissible limits according to Mexican norms. Pathogens growth was suppressed by PRONAT™. Unacceptable appearance started to develop at day 28 for treatments, where mainly color changed, becoming whiter, less red and more yellow ($p < 0.5$) and drip water became more viscous, probably due to microorganism growth or solids lixiviation (i.e. starch). Other physicochemical parameters results did not show a significant ($p > 0.05$) difference between treatments.

The use of PRONAT™ (at the concentration used in the study) on Jumbo squid frankfurters did not greatly improve their microbiological and physicochemical characteristics, as treatments showed similar shelf-life. However, testing of different antimicrobial concentrations is further recommended on future studies.

Development of a Restructured Crabmeat Product: Examining the Physical, Chemical and Microbiological Attributes

LAURETTA-LYN KATSRIKU*. *University of Maryland Eastern Shore, Princess Anne, MD 21853.*

Special (flake) crabmeat consists of flakes of white body meat from the main body of the crab, and is the lowest value of several grades of white body meat. The size per piece of this grade is small and returns a much lower price to the industry than does larger lump grades. Restructuring special crabmeat to form higher value lump-like meat is considered a way to expand the total utilization and value of the flaky/special crabmeat.

The objective of this study was to evaluate and compare the physical, chemical, microbial and sensory attributes of a restructured crabmeat product, formulated with various salt and phosphate levels.

The restructured crabmeat products were prepared with the following ratios of raw crab mince and special grade crabmeat: 10:90, 20:80, 30:70, 40:60, 50:50, and 100:0. 1.5% food grade salt was used in one formulation and compared with another which contained 1.0% food grade salt and 0.25% sodium tripolyphosphate.

All treatments had a water activity (aw) less than 0.91, except treatment 6 (100:0 raw mince: special crabmeat +1.5% salt) whose a_w was 0.918. Aerobic plate count (APC) for all treatments was between 0-0.51 log CFU/g on day 1 and increased to 4.32-4.63 log CFU/g after 21days of storage. There was no

significant ($p<0.05$) differences between treatments for protein content (18.53-18.78%), ash content (1.55-1.59%), fat content (0.84-0.93%), and moisture content (72.57 to 74.50%).

The color measurements obtained for the restructured crabmeat products were similar to that obtained for fresh picked blue crabmeat, which served as control for the color measurements. Treatments 4 and 14 (40:60) showed the highest values for hardness, springiness and firmness, whiles treatment 6 and 16 (100:0) showed the lowest.

The optimum physical, chemical and microbiological measures were obtained with treatment 4 (40:60- raw crab mince to special grade ratio with 1.5% salt).

Gel Characteristics of Common Carp Surimi and Kamaboko Prepared by Alternative Methods

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Common carp (*Cyprinus carpio*) is cheap and prolific in Australian waters but its reputation as a surimi product is generally perceived as poor. This study demonstrates the benefits of a modified method (MM) using centrifugation for concentrating protein in surimi processing over the traditional method (TM) and the alkaline aided method (AAM). The traditional method was altered by replacing the decanting and pressing steps for dewatering with centrifugation after each washing cycle. Surimi prepared by MM was significantly ($p < 0.05$) whiter (lower b^* value) than surimi prepared using either TM or AAM. Breaking force and breaking distance for kamboko gel from MM, at *ca.* 268 g and 6.95 mm, respectively, were significantly ($p < 0.05$) greater than those from TM and AAM. This texture improvement was supported by scanning electron microscopy (SEM) study that showed (a) an increase in the number of polygonal structures/mm^2 and (b) a decrease in polygonal area in the kamaboko gel matrix produced by MM compared with AAM and TM kamaboko. Centrifugation (rather than decanting or adjusting pH) improved the gel characteristics and potentially reduces manufacturing costs. Centrifugation retains more myofibrillar protein than decanting does, leading to the texture improvement. Furthermore, centrifugation might result in the removal of more sarcoplasmic proteins than AAM. These issues are the subject of further work.

Effects of CO Treatment on the Color of Frozen Tilapia and Catfish

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Although carbon monoxide (CO) treatment of aquatic food products has potential advantages, there are also concerns about economic fraud. One possibility is to "improve" the color of inferior quality seafood by CO treatment.

Our objectives were to determine the extent of color changes of frozen tilapia and catfish fillets treated with CO after thawing.

Fresh Tilapia and Catfish were obtained alive from local farms. The fish were filleted and frozen at -20 C for 1 month. Samples were then thawed and treated (room T and 5 C refrigeration) for 24 hrs with 100% CO in a system similar to the one used by Balaban and others (2005). All treated fish were either kept on ice for one week, or frozen for one week. Microbial analysis (total plate count TPC) was performed at days 0, after thawing, after treatment, and after storage. Images of the samples were taken using a machine vision system. The average L*, a*, and b* values were obtained using Lens Eye Software.

The a* values (redness) of fresh tilapia (17-19) were reduced to about 16 and color was brown after freezing/thawing. Co treatment increased a* values to 19-21, higher than that of original fresh samples. After storage for a week, the frozen samples' a* values were 17-18, while that of samples on ice were reduced to 16. It is possible to "improve" the color of frozen tilapia by CO treatment after thawing. Similar data on catfish will also be presented.

The initial microbial load of tilapia was 10^3 CFU/g. After freezing/thawing these numbers did not change drastically. TPC of CO treated samples at room temperature was 1 log higher than refrigerated samples. The final microbial load was around 10^5 CFU/g in all refrigerated samples and controls, and 10^6 CFU/g in the samples CO treated at room temperature.

Grading of Pink Salmon Skin Watermarking Using a Machine Vision System

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Pacific salmon are anadromous and undergo drastic physiological and biochemical changes during spawning migration. Lipid soluble pigments leach from the muscle into skin and cause skin watermarking (SW) in migrating salmon. Commercially caught salmon in Alaska are graded according to the degree of SW.

Watermarking is visually inspected; however large natural variability cause difficulties during sorting. Machine vision (MV) has been successfully applied to measure quality of seafoods. Its ability to determine color (L*a*b* values) for each pixel of the sample's image allows the entire surface of the food to be analyzed. Our goal was to test the ability of MV to sort pink salmon according to its degree of SW.

Ninety fresh pink salmon with various degrees of SW (grades A through F) were procured from a processor in Kodiak. Fish were graded by experts, and images were taken using MV. Software that we developed controlled the camera settings, captured and analysed images. Variability in the samples prevented accurate classification of fish into SW grades using average L*a*b* values for the entire fish surface. Therefore, a rectangular "region of interest" (ROI) was selected that was bounded by the lateral line at the top, the end of the dorsal fin at the back, just the back of the gill plate at the front, and the level of pectoral fin at the bottom. The average L*a*b* values of the ROI were calculated. Within the ROI, all the pixels with an L* value less than 80 were counted, and their percentage to the total number of ROI pixels determined. This parameter (range 0 to 100%) accurately classified salmon by SW, and found errors in judgement of experts in a few cases. Percent of the described ROI with L*<80 can be used to automate the classification of whole pink salmon by SW.

Effects of CO Treatment on the Color and Quality of Atlantic Salmon

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The potential advantages of using carbon monoxide (CO) to treat aquatic food products are the preservation of red color during freezing/thawing cycles, and retarding the lipid oxidation due to binding to myoglobin and hemoglobin.

Our objectives were to quantify the changes in color, lipid oxidation, and microbial loads in Atlantic salmon treated with CO.

Atlantic salmon from Chile was received chilled from a certified distributor from Miami Fl, not more than 3 days after harvest. The fish were filleted and divided in 2 groups: control, and CO treated. The samples to be CO treated were placed in a box built with Lexan sheets, and flushed with 100% CO. The gas was flushed seven times the volume of the box to assure the desired concentration. Treated samples were kept in the box for 48 hours in a refrigerator. Then control and treated samples were vacuum packed and stored for 30 days at -30 ^{o}C, and then thawed. Microbial analysis (Total Plate Count TPC) was performed before and after treatment, at days 0,2, and day 32 after freezing and thawing. Lipid oxidation was measured every 2 days in triplicate. Color was analyzed by machine vision system and the average L a* b* values were obtained.

CO did not significantly change the color of Atlantic salmon fillets. Before treatment all samples showed less than 100 cfu/g. After the treatment at day 2 the control samples had 10^2 cfu/g, and treated samples had 10^3 cfu/g. At day 32 after thawing they had 10^3 cfu/g for both control and treated, and at day 39 10^4 cfu/g.

The TBARS values for lipid oxidation were less for the CO treated salmon compared to the controls. Potential advantages of CO treatment of salmon will be discussed.

Effect of Different Methods of Cooking on Proximate Composition and Fatty Acid Profile in the Muscle of *Otholithes ruber*

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In this paper the effects of different cooking methods (baking, boiling, microwave and frying) on proximate composition and contents of fatty acids in *Otholithes ruber*, were determined. Compared to raw fish, moisture content in fried, baked, boiled and microwaved fish, showed significant changes. During frying, baking, boiling and microwave cooking methods, fat increased significantly and so did protein. In frying and microwave cooking methods, ash had significant change. Fried fish had the most fatty acids content in one hundred gram dry matter. Palmitic acid content was the most among other fatty acids. The least amounts of fatty acids content observed in boiled and raw fish. MUFA content during frying showed significant changes but there was not significant difference in other cooking methods. Polyunsaturated fatty acids (PUFA) in fried fish were significantly more than other treatments. Composition of these fatty acids in boiled and microwaved fish was less than in other methods. Linoleic acid (C18:2) in fried fish was more than what was observed in other treatments. Ratio of n-3/n-6 in fried fish was the lowest than other cooking methods and had significant difference with all of them. The highest amount of EPA+DHA content was observed in raw fish and the lowest amounts were observed in fried fish.

Fish Processing Discards as Feedstock for Biodiesel Production

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Increasing demands for oils and fats from oil seeds for biodiesel production can be expected to affect the supply of these feedstocks. To sustain biodiesel production will therefore require widening of the feedstock base to include not only food crops but also by-products and discards from livestock and fish processing plants. This study was conducted to assess the potential of fish processing discards as feedstock for biodiesel production via enzymatic transesterification. This approach is expected to expand the usefulness of fish processing discards and create alternative uses for these raw materials. A suitable bioconversion process was developed to address the high variability of seafood by-products. The choice of fish samples were based on their availability and predicted higher oil content. The suitability of lipases in carrying out enzymatic transesterification was also investigated. Oil from fish processing discards holds enormous potential as a great step forward towards broadening the feedstock base of biofuel production and the

realization of an energy sustainable society and improved environmental protection. The availability of sufficient supplies of low-cost fish processing discards will also provide competitive feedstock supply.

Stability and Processing Characteristics of Coated, Spray Dried-squid Oil by Fluidized Bed Coating Technology

S.H. Hwang and K.S. YOUN*. *Dept. of Food Science and Technology, Catholic University of Daegu, Korea.*

Squid oil is an abundant source of polyunsaturated fatty acids, especially EPA and DHA. These PUFA's play an important role in human health. Microencapsulation of fish oil can effectively protect it from environmental influences for extended shelf-life and allow for the use of fish oil as a dietary supplement. In addition, the fluidized bed micro-coating technique improves flow ability, controls solubility and processing compatibility.

This study was carried out to extend stability and improve the process aptitude of microencapsulated and coated squid oil.

Squid liver oil was refined and microencapsulation was achieved by the spray drying method and fluidized bed coating. Coating solution (HPMC-FCC(6%) and Zein-DP(8%), respectively) and microencapsulated powder of squid liver oil were mixed 4:1 (w:w).

Efficiency of the fluidized bed coating of HPMC-FCC, and zein-DP was higher than 90%. Bulk density with zein-DP was 0.6 g/mL, indicating flow ability was improved due to an increase in specific gravity. Particle size of zein-DP was 248μm, which was slightly bigger than HPMC-FCC(214 μm). Water uptake for HPMC-FCC coating was higher than zein-DP. Solubility of artificial gastric and enteric fluids with HPMC-FCC was 59.9 and 0%, respectively, whereas with zein-DP solubility was 0 and 31.0%, respectively. Polyunsaturated fatty acid retention, with regard shelf-life, showed that zein-DP coating was higher than HPMC-FCC, followed by microencapsulated squid liver oil powder.

These results showed that applying microencapsulation and fluidized bed micro-coating technique improved stability and processing compatibility of squid liver oil. Flow ability and solubility control were also improved.

Purification of Commercial Alaska Pink Salmon (Oncorhynchus gorbuscha) Oils and Pollock (*Theragra chalcogramma*) Oils Using Chitosan

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Significant quantities of crude pollock oil (PO) and pink salmon oil (SO) are produced yearly from Alaska fishery byproducts. The purpose of this study was to compare selected chemical and physical characteristics of crude and purified PO and SO.

Three batches of crude SO and PO, purchased from a fishmeal plant (Kodiak, AK) were treated three consecutive times with 5% chitosan (120g high viscosity shrimp / 3 L oil). Each time the mixture was stirred in an open system at 22°C for 15 minutes, centrifuged, and filtered to remove chitosan. The variables determined after each purification step were: color (L*a*b* values), water activity (a_w), peroxide values (PV), free fatty acids (FFA) values, thiobarbituric acid reactive substances (TBARS), fatty acids (FA) distribution and lipid classes. Data was analyzed using factorial ANOVA followed by Duncan's Test ($P<0.05$).

Chitosan treatment reduced a_w in SO and PO from 0.6 to 0.3 and 0.5 to 0.4, respectively. A significant increase in L* values (lightness) were recorded for both oils. Significant changes in a* values were also observed with an increase for SO, and a decreased for PO. Changes in b* values were not observed. A slight increase in PV and TBARS were recorded, but both values were low indicating that chitosan treatment did not substantially promote lipid oxidation. The FFA values were low in both crude oils and a slight decrease in the FFA values was observed for purified SO. As expected, saponification values and FA concentrations were not affected by chitosan treatments. In both oils the most abundant FA that comprised over 60% of the FA quantified were palmitic (16:0), *cis*-oleic (18:1ω9), EPA (20:5ω3), and DHA (22:6ω3).

Overall, one to two chitosan treatments was sufficient to positively impact the quality of the oils using these materials and conditions.

SESSION: CURRENT REGULATORY ISSUES

Current Seafood Issues in Oregon

DAWN SMITH. *Oregon Department of Agriculture, Food SafetyDivision, Salem, OR.*

Thank you for the opportunity to offer a brief update on seafood issues in Oregon. I will discuss current events including our adoption of Federal Regulations, shellfish toxins over the last two years, and our current recruitment for a Shellfish Program Manager.

Seafood and shellfish processing is regulated in Oregon by the Oregon Dept of Agriculture. Oregon has adopted the 2005 CFRs and the 2005 NSSP. The 2007 NSSP will be adopted sometime in 2008 after it is published.

One of the most significant changes made to the 2007 NSSP Model Ordinance is the rearrangement of the sanitation monitoring requirements to resemble CFR 123 more closely. Rearrangement will allow shellfish processors that also distribute other seafood items to use one set of records for SSOP monitoring. An additional CCP will now be required for temperatures at receiving. Oregon has required this receiving temperature CCP for the last 10 years.

Oregon routinely monitors commercial and recreational shellfish for PSP and ASP. We also work with ODF&W to collect phyto plankton samples for early detection of HAB.

I will offer a summary of closure dates and ranges of toxin levels during those closures.
Oregon is currently recruiting for a Shellfish Program Manager. Ms. Deb Cannon retired in Oct 07 after working as the program specialist for the last 20 years. This position is the state expert on shellfish issues and works closely with the Food Program Supervisors in ODA, industry and the FDA. I will include the website for anyone that would consider working for the beautiful state of Oregon.

Hot International Topics

TIMOTHY HANSEN. *U.S. Department of Commerce, National Oceanic and Atmospheric Administration-Seafood Inspection Program, NMFS Room 10837, 1315 East-West Highway F/SI Silver Spring, MD 20910*

Four international events that affect the seafood industry will be discussed. The first topic is the International Association of Fish Inspectors Seafood Congress in Dublin Ireland presented some very important scientific findings and policy thinking on the risks and benefits of consuming seafood. The Congress consensus was that the benefits of consumption far out weigh the risks and that governments ought to be encouraging seafood as a food choice. There were also important discussions on sustainability, aquaculture and regulatory policy. The second topic is the upcoming Codex Committee on Fish and Fishery Products session in Trondheim Norway in February. The committee will work towards the development of international standards and Codes of Practice for molluscan shellfish, smoked fish,

scallops, abalone, Asian fish sauce and caviar. These standards are important to the seafood industry because they are used by the World Trade Organization to resolve trade disputes. The third topic is the recent changes in EU certification requirements for fish and fishery products that the European Commission implemented on November 1st. There are significant changes that will affect anyone shipping to Europe. The fourth topic is the food safety problems with products originating from China and what activities the food safety agencies are taking to ensure safe seafood.

FDA Updates

JANET McDONALD. *U.S. Food and Drug Administration, San Francisco District Office.*

The major seafood problems observed by FDA's San Francisco District Office will be briefly discussed. Import Alerts and the process for removal from detention without physical examination (DWPE) will be described.

What Will the 2008 Revised Edition of the FDA Fish and Fishery Products Hazards and Controls Guidance Cover?

DEBRA DeVLIEGER**.** *US Food and Drug Administration, Office of Regulatory Affairs*.

The third edition of the FDA's Hazards Guide was issued in 2001. The fourth edition is expected to be released by the summer of 2008. Changes that are likely to occur and may affect your operations will be discussed.

Seafood and Import Safety: What's on the Horizon?

LISA M. WEDDIG. *Director, Regulatory and Technical Affairs, National Fisheries Institute, 7918 Jones Branch Road, Suite 700, McLean, VA 22102.*

In less than a one year period, the U.S. food industry saw many instances of foodborne illness outbreaks, food contamination scares, and massive food recalls – from fresh bagged spinach contaminated with *E. coli* 0157:H7, to the industrial chemical melamine in pet food, to *Salmonella* in peanut butter and potpies, to the first botulism outbreak attributed to commercially canned foods in over 20 years, to a country-wide automatic detention of certain imported farm-raised fish. All of these "special situations" have placed the entire food industry on alert, with the American public and Congress calling for action from the industry and regulatory agencies. This presentation will outline the flurry of initiatives from Capitol Hill, the White House and FDA, all with the goal of reinforcing the safety of the U.S. food supply – both from domestic and foreign suppliers. See what's on the horizon for seafood safety as we move into the second decade of regulatory HACCP.

SESSION: SEAFOOD INSPECTION AND AUDIT

An Overview of Key International Food Safety Auditing Programs – Which One Suits Your Company?

CLARE WINKEL. *IFQC SMART Solutions*, *Rivercourt Centre, Riverlane, Dundalk, Co. Louth, Ireland*

Market requirements mainly dictate which standard a company chooses to implement and be certified against. The standard is about market access. A standard that gives access to one market won't be recognized in another. A New York restaurant cares not about BRC and a French retailer cares not about SQF. On ISO 22 000, an Australian retailer will say "that's nice but you need…."

- BRC - British Retail Consortium Global Food Standard
- IFS – International Food Standard
- SQF 2000 – Safe Quality Food Scheme
- Dutch HACCP Scheme (Option B)
- ISO 22 000

The above systems are market/customer, not government, requirements, But in many cases if you want any level of market access- especially within the retail sector- you have no choice but to implement the systems. Each system is different, even within the HACCP based systems, and has different focuses. This is due to different requirements of the standards owners/stakeholders. Some have more of a GMP/pre-req program focus, others more of a HACCP system focus or more of a management system. Some markets have far more of a focus on one system beyond another i.e., BRC vs. IFS vs. ISO 22 000 vs. SQF. All very similar but not identical and your target market would make you decide which to implement.

Before adopting a standard, your company should consider the following questions:

1. What standard is suitable for your industry and sector?
2. What do your customers want/need/recognize?
3. What do your target/future customers want/need/recognize?
4. Get a copy of the standard - can you actually implement the requirements?
5. What will the system cost you to implement: staff, time, training courses, capital and equipment costs, record maintenance, auditing time and costs?
6. Can your current certification body audit to this standard while doing your other audits?

EXPERT TIPS ON COMPLYING WITH A SEAFOOD AUDIT OR INSPECTION PANEL

Surviving Audits with Your Sanity Intact

KATE ABRAHAM. *Canadian Fishing Company, Foot of Gore Avenue, Vancouver, B.C., Canada V6A 2Y7.*

Tips and tricks for getting though Government, Buyer and 3rd party audits with the least amount of hassle, the fewest grey hairs and flying colours. Based upon 15 years experience dealing with auditors and inspectors in canneries, fresh/frozen and ready-to-eat seafood operations on the Pacific coast plus QMPI Import programs and MSC paper-chases, this is a look at what works - and what doesn't.

How to Pass a Seafood Audit

TIMOTHY HANSEN. *U.S. Department of Commerce, National Oceanic and Atmospheric Administration-Seafood Inspection Program, NMFS Room 10837, 1315 East-West Highway F/SI Silver Spring, MD 20910.*

Think Like an Inspector or Investigator

- Regulators want to assess compliance not cause you problems. Don't feel intimidated.
- Compliance to laws and regulation is more important than taking regulatory action.
- Regard the inspection or audit as a learning experience.
- Ask questions. You need to understand what the inspector/investigators thought processes are.
- Inspectors/investigators make mistakes. It's okay to point out that you believe observations are not correct.

Short Circuit the FDA Warning Letter or Negative USDC Systems Audit

- If the findings listed on the FDA form 483 appear serious try to effect a correction before the investigator leaves. FDA will probably not send you a Warning Letter if you show good faith in correcting the problem.
- If the findings on the USDC audit form appear serious engage the inspector immediately for advice about a correction. It is part of the USDC mission to provide timely advice.
- Both agencies have mechanisms to appeal mistaken inspection results. USDC has a formal appeal outlined in the regulations and FDA has a policy to consider scientifically credible controls that do not meet their current guidance in the Fish and Fishery Product Hazard Guide.

Respond and Follow Through

- If you do get a Warning Letter from FDA engage the agency as soon as possible. This means contacting the district, the CFSAN Office of Compliance and the CFSAN Office of Food Safety.
- Document in writing that you are making a good faith effort to comply with food safety laws and regulations.
- Expect a follow-up FDA visit. Make sure your HACCP records show correction.
- For USDC ask questions and expect answers for corrections of observed deficiencies.

Seafood HACCP Compliance: FDA's Approach to Inspection and Current Regulatory Issues

DEBRA DeVLIEGER. *US Food and Drug Administration, Office of Regulatory Affairs.*

Inspection Approach

- Describe FDA's approach as "components" of an inspection. By outlining these "components" the audience will better understand what the FDA looks for during an inspection, how violations are documented, and what they can do to assure that their facility is in compliance.

Current Regulatory Issues

- FDA is about to issue their most recent evaluation of the Seafood HACCP program. This evaluation covers the status of domestic and international seafood processors and importers in Fiscal Years 2004 and 2005 in operating preventive controls under FDA's Hazard Analysis Critical Control Point (HACCP) Program. These Fiscal Years essentially represent the seventh and eighth years of the seafood HACCP program.

  This is the fourth biennial evaluation of the Seafood HACCP Program. In each of the eight years of Seafood HACCP industry performance has improved. FDA has used the previous evaluations to make changes to the compliance programs to focus inspection and training efforts on certain industry segments or specific food safety hazards. These efforts have paid off as evidenced by the steady improvements over the years. However, despite increased Agency efforts, certain industry segments continue to lag behind.

  In an attempt to see continued improvement in those segments of the industry, FDA will recommend:

  1. Continue to prioritize inspections - manufacturers of high risk fishery products, particularly processors of scombroid species and cooked ready-to-eat products, for annual inspection.
  2. Prioritize processors and importers of aquaculture products for increased inspection and training.
  3. Issue the fourth edition of the *Fish & Fisheries Products Hazards and Control Guidance* to facilitate compliance by processors
  4. Work on developing strategic measurable goals to concentrate on industry segments that have traditionally lagged behind.
  5. Continue outreach efforts through training, education and cooperative efforts, for example the Histamine Outreach Program.
  6. Continue developing inspection and training strategies for imports, importers and foreign inspections.

The Use of Sensory Techniques within a Seafood Processor's Program
JAMES BARNETT*. *US FDA (Retired), Marysville, WA.*

Sensory techniques are a fast and practical way to judge seafood quality to determine if a product meets the minimum standards of the US Food and Drug Administration. Sensory evaluation (SE) is the primary method that is used by FDA, other government agencies, and the seafood industry.

Seafood import entries that have been rejected by FDA due to decomposition can result in extensive delays and loss of profits for both the processor and the importer. When sensory examination is used correctly to determine compliance, it can be an effective tool to ensure that seafood imported into the USA will not be detained for decomposition due to time and temperature abuse.

This talk will highlight: why SE is important in any seafood processing operation, how SE is applied to FDA regulations, sampling factors used by the FDA to conduct a SE, what processors should know about SE spoilage runs and retaining product samples for future in-house quality control SE training, and what happens when FDA rejects a product based on a failing SE rating.

Food Safety from FDA/Private Consultant Perspective
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The common goal is safe, wholesome fish and fishery products whether you are a processor, regulatory authority, third-party auditor, or consultant. However, we should recognize the different roles of each component in achieving food safety.

Industry must meet consumer needs and demands and make a profit, while complying with the FDA and State requirements (as well as EPA, OSHA, labor, etc.). Regulatory authorities must enforce the baseline requirements of the laws and regulations mandated by congress to assure consumer confidence and a level playing field. Third party auditors must assure the requirements of the buyer's requirements are meet which includes the regulatory requirements. The consultant's role is to help industry understand the regulatory requirements, assist firms achieve or exceed the requirements either before, during or after an inspection or audit, and provided guidance to firms that are out of compliance. The consultant's only interest is helping industry members achieve compliance with the regulatory authorities and auditors. From my perspective as regulator and private consultant, the key elements for a successful food safety program are training, developing a comprehensive program, and assuring the program is given priority, adequate time and resources for implementation initially and on a continuous basis.

Seafood Safety Inspections, An International Perspective
DANIEL E. BROOKS*. *Food Audits International, Ltd. and International Food Technology, Ltd., Bangkok, Thailand.*

This presentation is a follow-up to one made at the 1998 PFT meeting. It gives an up-date on the progress of HACCP implementation and seafood safety as viewed by a third-party audit (inspection) agency working in Asia, South America and the USA for the last 15 years. The segment of the seafood processing industry observed in this period has been canning (tuna, salmon, sardines/mackerel, crab, shrimp, etc.) and freezing (shrimp, fish and other).

Development of formal HACCP programs in the seafood industry has been driven by regulatory and buyer requirements imposed in the last 10 years. Most notable of the regulatory requirements has been US FDA's Seafood HACCP Rule. Third-party inspections of seafood processing facilities always include an assessment of basic seafood safety issues via an examination of the firm's HACCP plan either in the light of regulatory requirements or international standards (Codex).

A primary precept of a documented seafood safety program is to “say what you do” (via the written HACCP program), and “do what you say” (via observations on the implementation of HACCP program on the factory floor). This presentation will cover some of our observations, in the ten years of formal HACCP programs, on how this precept has been met by the seafood plants we have evaluated and the potential implications for seafood safety.

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