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TROPICAL AND SUBTROPICAL FISHERIES TECHNOLOGICAL CONFERENCE OF THE AMERICAS

a professional and educational association of fishery technologists

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PROGRAM AND ABSTRACTS
FOR THE
11TH ANNUAL TSFT CONFERENCE
TAMPA, FLORIDA
1986

CYPRESS ROOM

DATE	TIME	SESSION
Tuesday Jan. 14	8:30-12:00 AM	RESEARCH IN SEAFOOD TECHNOLOGY
	1:30-5:00 PM	TECHNICAL SESSION Sulfites, Economics, Crawfish
Wednesday Jan. 15	8:30-12:00 AM	TECHNICAL SESSION Nontraditional Species and Products, and Handling Shrimp
	1:30-4:30 PM	TECHNICAL SESSION Chemistry, Microbiology and Depuration
	4:30 PM	TSFT Business Meeting
	6:30 PM	Social
Thursday Jan. 16	8:30-12:00 AM	SEAFOOD TECHNOLOGY UPDATE '86

**ELEVENTH ANNUAL
TROPICAL AND SUBTROPICAL FISHERIES
TECHNOLOGICAL CONFERENCE OF THE AMERICAS**

January 13-16, 1986
Holiday Inn, International Airport
Tampa, Florida

Edited By

W. Steven Otwell and John A. Koburger
Department of Food Science and Human Nutrition
University of Florida
Gainesville, Florida

The Tropical and Subtropical Fisheries Technological Society of the Americas is a professional, educational association of fishery technologists interested in the application of science to the unique problems of production, processing, packaging, distribution, and utilization of tropical and subtropical fishery species.

Individual abstracts edited by the authors of the abstracts. Some abstracts have been excluded by author request.

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TECHNICAL PAPER NO. 45
January 1986

TROPICAL AND SUBTROPICAL FISHERIES TECHNOLOGICAL CONFERENCE OF THE AMERICAS

a professional and educational association of fishery technologists

Jan. 13-16, 1986
Tampa, FL
(Holiday Inn--Intern'l Airport)

Tuesday Morning, Jan. 14 - Cypress Cove Room

RESEARCH IN SEAFOOD TECHNOLOGY

8:30 am OPENING COMMENTS

Steve Otwell, Session Chrm., Univ. Florida

8:40 am FEDERAL SK PROJECTS: Completed and New '85-86

NATIONAL REVIEW
Phyllis Bentz, NMFS--Washington, DC

9:10 am U. S. FOOD and DRUG ADMINISTRATION: 5 Year Plan

Tony Guarino, FDA Lab--Dauphin Island, AL.

9:40 am NATIONAL SEA GRANT PROGRAM: Current and Future

David Attaway, Sea Grant--Washington, DC

10:10 am BREAK

10:30 am REGIONAL FISHERY DEVELOPMENT FOUNDATIONS

MID-ATLANTIC
Kerry Muse, Exec. Dir.--Annapolis, MD

GULF OF MEXICO AND SOUTH ATLANTIC
Tom Murray, Exec. Dir.--Tampa, FL

11:10 am TRADE ASSOCIATIONS

NATIONAL FISHERIES INSTITUTE
Roy Martin, Washington, DC

SOUTHEASTERN FISHERIES ASSOCIATION
Robert Jones, Tallahassee, FL

ADJOURN

11th ANNUAL TSPT CONFERENCE

Tuesday Afternoon, Jan. 14 - Cypress Cove Room
Session Chrm. John A. Koburger

- (1) 1:30 pm SCREENING OF SODIUM BISULFITE ON SHRIMP: A MODIFIED
MONIER-WILLIAMS APPROACH
Martha Hudak-Roos, Jack Wood and Joseph Carey
 - (2) 1:50 pm BIOCHEMICAL BASIS FOR ACCELERATED MELANOSIS IN FLORIDA
SPINY LOBSTER (PANULIRUS ARGUS)
O. B. Ferrer, Marty R. Marshall and John A. Koburger
 - (3) 2:10 pm INFLUENCE OF WASHING AND COOKING ON SULFITE
RESIDUALS ON TREATED SHRIMP
Marty R. Marshall and Steve Otwell
 - (4) 2:30 pm EVALUATION OF ALTERNATIVES TO SULFITING AGENTS AS
MELANOSIS INHIBITORS IN RAW SHRIMP
Tom Wagner and Gunnar Finne
 - (5) 2:50 pm SCREENING ALTERNATIVES TO SULFITING AGENTS TO CONTROL
SHRIMP MELANOSIS
Steve Otwell and Marty R. Marshall
 - 3:10 pm BREAK
 - (6) 3:30 pm FLUCTUATIONS IN CALICO SCALLOP PRODUCTION (ARGOPECTEN GIBBUS)
Michael A. Moyer and Norman J. Blake
 - (7) 3:50 pm CRAWFISH PRODUCTION ECONOMICS AND MARKETS
Kenneth J. Roberts and Perry Pawlyk
 - (8) 4:10 pm FACTORS INFLUENCING CRAWFISH MARKET DEVELOPMENT
Lynn E. Dellenbarger and Steve S. Kelly
 - (9) 4:30 pm SOCIOECONOMIC DETERMINANTS OF AT-HOME SEAFOOD CONSUMPTION
Fred J. Prochaska and Walter R. Keithly, Jr.
- ADJOURN
- 6:30 pm Executive Committee Meeting (Cottonwood Room)

11th ANNUAL TSFT CONFERENCE

Wednesday Morning, Jan. 15 - Cypress Cove Room
Session Chrm. Marty R. Marshall

- (10) 8:30 am EDIBILITY CHARACTERISTICS OF 40 SOUTHEASTERN FINFISH SPECIES
Janet A. Gooch and Malcolm B. Hale
- (11) 8:50 am ALTERNATE SPECIES--FACT OR FICTION
Warren F. Rathjen
- (12) 9:10 am DEVELOPMENT OF A SALTED DRIED PRODUCT FROM SELECTED
UNDERUTILIZED FISH FOR INTERNATIONAL MARKETS
Yaowen Huang, Samuel L. Stephens, Lloyd W. Regier,
Melvin E. Waters, Robert Ernst, and John W. Brown
- (13) 9:30 am PROCESSING OF CANNONBALL JELLYFISH (STOMOLOPHUS MELEAGRIS)
AND ITS UTILIZATION
Yaowen Huang
- (14) 9:50 am RECENT PROGRESS IN THE PRODUCTION OF THE SOFT SHELL BLUE CRAB,
CALLINECTES SAPIDUS
John A. Freeman and Harriet M. Perry
- 10:10 am BREAK
- (15) 10:30 am AN UPDATE OF RESEARCH ON VESSEL-LEVEL STANDARDS FOR GREEN
HEADLESS SHRIMP
Debra Ellis, Ranzell Nickelson and Larry Watt
- (16) 10:50 am EFFECTS OF POST-HARVEST HANDLING ON THE QUALITY OF
MACROBRACHIUM ROSENBERGII
Linda S. Papadopoulos and Gunnar Finne
- (17) 11:10 am A PROCEDURE TO MAINTAIN QUALITY OF STONE CRAB
(MENIPPE MERCENARIA) CLAWS ICED PRIOR TO COOKING
Jenny L. Simonson
- (18) 11:30 am NEW ZEALAND AND AUSTRALIAN AQUACULTURE METHODS
Thomas L. Herrington

ADJOURN

11th ANNUAL TSFT CONFERENCE

Wednesday Afternoon, Jan. 15 - Cypress Cove Room
Session Chrm. Norman Blake

- (19) 1:30 pm USE OF FOOD GRADE PHOSPHATES TO BENEFIT THE SOUTHERN SHRIMP PROCESSING INDUSTRY
Allison Perry
- (20) 1:50 pm HYDROLYTIC AND ENZYMATIC DEGRADATION OF ADDED CONDENSED PHOSPHATES IN SHRIMP HOMOGENATES HELD AT DIFFERENT TEMPERATURES
Bokka R. Reddy and Gunnar Finne
- (21) 2:10 pm MICROBIOLOGY OF MULLET HARVESTED FROM A BRACKISH-WATER SITE
John A. Koburger and Mary Miller
- (22) 2:30 pm LOW DOSE GAMA IRRADIATION OF VIBRO CHOLERAE IN CRABS (CALLINECTES SAPIDUS)
Robert M. Grodner and Arthur Hinton, Jr.
- (23) 2:50 pm USE OF A LIQUID CHROMATOGRAPHIC TECHNIQUE FOR DETECTING AND MONITORING THE ACCUMULATION OF CIGUATOXIN AND CIQUATOXIN-LIKE TOXINS
Lowell V. Sick, Doug C. Hansen and John A. Babinchak
- 3:10 pm BREAK
- (24) 3:30 pm DEPURATION AND RELAYING OF CLAMS IN FLORIDA
John Schneider
- (25) 3:50 pm FACTOR AFFECTING THE DEPURATION OF CHEMICAL CONTAMINANTS BY MOLLUSCAN SHELLFISH
Thomas C. Siewicki, Frances M. Van Dolah, and Jane S. Sydlowski
- (26) 4:10 pm UPDATE ON ISSC ACTIVITIES
Richard Thompson
- 4:30 pm FORMAL TSFT SOCIETY BUSINESS MEETING
Open to all Registrants

ADJOURN

6:30 pm SOCIAL

11th ANNUAL TSFT CONFERENCE

Thursday Morning, Jan. 16 - Cypress Cove Room
Session Chrm. Steve Otwell

SEAFOOD TECHNOLOGY UPDATE '86

- (27) 8:30 am USE OF SULFITING AGENTS
Controlled Challenges of Sulfite-Sensitive Asthmatics
with Sulfited Shrimp and Other Foods.
Steve L. Taylor, et. al., Univ. Wisconsin, Madison.
- (28) 9:00 am OMEGA-3 FATTY ACIDS
(29)
(30) Why All The Sudden Attention?
Chris Anderson, Univ. Florida, Gainesville..
- NMFS Fish Oil Research Aids Fishing Industry and Consumers
Gloria T. Seaborn, Jeanne D. Joseph and Paul E. Bauersfeld,
NMFS--Charleston, SC
- Omega-3 Fatty Acids and Fish Oils: Is All The News Good?
Tony Guarino, FDA--Dauphin Island, AL.
- (31) 10:00 am PARASITES
Concerns for Parasites in Edible Seafoods.
Thomas Deardorff, FDA--Dauphin Island, AL.
- (32) 10:20 am IRRADIATION
Projected Use of Irradiation with Seafoods in Light
of Recent Developments.
George Giddings, Isomedix, Inc., Whippany, NJ.
- (33) 10:40 am SURIMI
Processing of Menhaden for Conventional Food Products,
Minced Intermediates and Surimi
Malcolm B. Hale and Robert C. Ernst, Jr.
- (34) 11:00 am REGULATIONS
(35) Use of the Lacy Act to Enforce Product Quality and
Safety.
Spencer Garrett, NMFS--Pascagoula, MS.
- Mandatory Inspection?
Roy Martin, NFI--Washington, DC.

ADJOURN

(1)

**SCREENING OF SODIUM BISULFITE ON SHRIMP:
A MODIFIED MONIER-WILLIAMS APPROACH**

Martha Hudak-Roos, Jack Wood and Joseph Carey
National Marine Fisheries Service
3209 Frederick Street
P.O. Drawer 1207
Pascagoula, Mississippi 39568-1207

Initial screening tests for bisulfite on shrimp have recently become of paramount importance to the shrimping industry. Investigations have been made into quick test strip methods, disposable titration cells and other color change methodology. The National Seafood Inspection Laboratory has developed a screening test which employs a color change endpoint by using a modified Monier-Williams analysis reducing analysis time from 2 hours to 45 minutes.

(2)

**BIOCHEMICAL BASIS FOR ACCELERATED MELANOSIS FOR
THE FLORIDA SPINY LOBSTER (PANULIRUS ARGUS)**

O.B. Ferrer, Marty Marshall and Jack Koburger
Food Science and Human Nutrition Department
University of Florida
Gainesville, Florida 32611

A comparison of Florida spiny lobster and South African lobster revealed that melanosis was more predominant in the Florida species. Levels of tyrosine had been shown to be higher in the Florida species when compared to the South African Species and thus was thought to be responsible for controlling melanosis formation. Melanosis could be controlled in the Florida lobster by dipping in a 1.25% sodium metabisulfite solution for 5 minutes; whereas, South African lobsters dipped in a saturated tyrosine solution did not become melanotic, indicating substrate limitation was not controlling pigment formation.

Preliminary isolation and characterization of phenoloxidase (PO) showed a 10-fold increase in PO levels from the Florida versus the South African species. When trypsin was added to Florida lobster extract, a 10-fold increase occurred. Trypsin added to both lobster extracts resulted in a 100-fold increase in PO levels between the two species. Further characterization revealed an enzyme MW greater than 300,000, which upon trypsin addition was cleaved into two smaller zymogen melanosis production in the two species, appears to be due to the extremely high levels of PO in Florida lobsters.

(3) **INFLUENCE OF WASHING AND COOKING ON SULFITE RESIDUALS
ON TREATED SHRIMP**

Marty Marshall and Steve Otwell
Food Science and Human Nutrition
University of Florida
Gainesville, Florida 32611

Processors' concern that shrimp products meet the FDA sulfite residual standard of 100 ppm as SO₂ has prompted interest in research dealing with the effects of reclamation and cooking on residual sulfite levels. Sulfite levels above the standard 100 ppm level on shrimp could be reduced from 10-40% when exposed to various thawing, washing and/or soaking methods. These levels were confirmed with standard Monier-Williams, AOAC procedure. Examining these same shrimp using the Conway Diffusion method consistently gave lower values for residual sulfite levels on shrimp.

Additional treatments indicated washing with hydrogen peroxide (3%) could reduce sulfite residuals, but washing with ozonated water had minimal effect.

Cooking studies utilizing common techniques for boiling (shell-on, shell-off), broiling and frying indicate minimal reduction in sulfite residuals. Short term high intensity cooking (saute) did result in substantial reductions (30-50%).

(4) **EVALUATION OF ALTERNATIVES TO SULFITING AGENTS
AS MELANOSIS INHIBITORS IN RAW SHRIMP**

Tom Wagner and Gunnar Finne
Seafood Technology
Texas A&M University
College Station, Texas 77843

Three groups of food additives which have proven useful against melanosis formation in other foods were tested in raw shrimp. Shrimp were treated with acidic compounds (citric acid), complexing agents (EDTA, boric acid), and reducing agents (erythrobates, ascorbates, reducing sugar). Following treatment, shrimp were placed on ice and evaluated daily for black spot formation, pH, and aerobic plate count. Untreated shrimp and shrimp treated with 1.25% NaHSO₃ were used as controls throughout the study. Treatments which proved successful in reducing melanosis will be combined and further tested in an attempt to find a safe but effective alternative to sulfiting agents.

(5) **SCREENING ALTERNATIVES TO SULFITING AGENTS
TO CONTROL SHRIMP MELANOSIS**

W. Steven Otwell and Marty R. Marshall
Food Science and Human Nutrition
University of Florida
Gainesville, Florida 32611

Attempts to demonstrate effective alternatives to sulfiting agents in controlling shrimp melanosis (black-spot) have been initiated utilizing fresh, non-frozen pink (Penaeus duorarum) and white (P. setiferus) shrimp. To date 50 alternative dip treatments have been employed using a variety of single compounds and/or mixtures prepared in varying concentrations. Dips have been prepared using both distilled water and saltwater (3.5%) to account for the possible influence of ionic strength and buffering capacity. Treatments have been selected to replace sulfites and/or reduce the necessary amount of sulfites. All applications were conducted on-board, immediately post-harvest or on the same day of harvest to exemplify actual, practical harvest conditions. All treated shrimp were stored in ice and periodically scored and photographed relative to untreated and sulfited controls.

(6) **FLUCTUATIONS IN CALICO SCALLOP PRODUCTION (ARGOPECTEN GIBBUS)**

Michael A. Moyer and Norman J. Blake
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University of South Florida
St. Petersburg, Florida 33701

During the past year there has been an unexpected and drastic drop in the numbers of scallops located in the calico scallop fishing grounds. This has forced a reduction in production by the calico scallop industry.

Production data and monthly data on the reproductive state of the calico scallop has been collected since October 1983 from the area north and south of Cape Canaveral, Florida. The data clearly indicates the minimum size for maximizing productivity based upon a constant fishing effort. The relationship between the size of the scallop and the season is examined as well as the seasonal fluctuation in the meat count.

The reproductive state of the calico scallops has been determined using wet and dry weight indices of the major components (gonads, digestive gland, adductor muscle and the remaining mantle and gills). Histological examination was performed. These parameters have been correlated with shell morphology.

(7)

CRAWFISH PRODUCT ECONOMICS AND MARKETS

Kenneth J. Roberts and Perry Pawlyk
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Center for Wetland Resources
Louisiana State University
Baton Rouge, Louisiana 70803-1900

Crawfish farming is expanding within Louisiana and other states in the region. Increased supply availability necessitates additional sales in markets outside of Louisiana. The role of processing in producing products suited to existing and expanding markets is gaining increased importance. The paper includes the results of research on the processing economics and distribution of crawfish products. A survey of 38 processing plants in 1985 provided the baseline data. Processing plant size, allocation of footage by function, products produced, techniques, and costs are among the management information items developed by the authors. Variation in results between plants is identified by area with comparisons to state averages. In this way the material will be useful to entities endeavoring to plan crawfish processing operations within existing food plants and construction of specialized facilities.

Firms also provided distribution of sales to various national markets. The results of the survey indicate variation in export volumes by product type. Overall, approximately 80 percent of the crawfish are consumed within Louisiana.

(8)

**FACTORS INFLUENCING
CRAWFISH MARKET DEVELOPMENT**

Lynn E. Dellenbarger and Steve S. Kelly
Department of Agriculture Economics
Louisiana State University
Baton Rouge, Louisiana 70803-1900

Farmers in an effort to improve their cash flow situation and financial stability are looking to aquaculture as a possible solution. Crawfish farming represents a possible solution. Yet with growth in the yields per acre and total acreage devoted to production of crawfish new markets need to be identified. This paper looks at factors influencing the development of new markets for crawfish.

A mail survey of over 550 wholesale and retail food outlets nation-wide was conducted during the fall of 1985. Characteristics such as size and price or product desired, promotional material needed to help market the product, type of payment and other factors influencing the growth in market development of crawfish were obtained and will be presented. These characteristics will be presented both on a national and regional basis.

(9)

**SOCIOECONOMIC DETERMINANTS
OF AT-HOME SEAFOOD CONSUMPTION**

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Gainesville, Florida 32611

Walter R. Keithly, Jr.
Center for Wetlands Resources
Louisiana State University
Baton Rouge, Louisiana 70803

Weekly household at-home seafood consumption in the United States was analyzed using Nationwide Food Consumption Survey data. The cross-sectional consumption study related expenditure and quantities consumed of total seafood and five specific products (fresh, frozen, canned, finfish, and shellfish) to a set of socioeconomic and demographic factors which influence at-home seafood consumption patterns.

Region, urbanization, race, household size, the stage of household growth and maturity, number of guest meals, money value of meals consumed away from home, the household having caught fish, and income were all contributing factors which helped to explain at-home seafood consumption patterns. The estimated income elasticities associated with all seafood categories were positive and inelastic.

The consumption effects were partitioned into those for existing seafood consumers and those for potential consumers. Second, consumption effects were separated into quantity and quality components. These distinctions allow for a separate study of current consumers and potential seafood consumers and for separation of consumer expenditures into those for additional volume and those for different qualities and associated marketing services.

The seafood industry and its support groups may wish to consider the study when designing and implementing a long term promotion/marketing program. Changes in factors which determine seafood consumption must be considered in seafood marketing.

(10) EDIBILITY CHARACTERISTICS OF 40 SOUTHEASTERN FINFISH SPECIES

Janet A. Gooch and Malcolm B. Hale
 National Marine Fisheries Service
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A trained sensory panel at the NMFS Charleston Laboratory began evaluating the edibility characteristics (9 flavor attributes and 7 texture attributes) of regional finfish species in 1983 using a standard protocol developed by Natick Laboratories under a NMFS contract. The major data collection phase has been completed and 40 southeastern finfish species have been evaluated by the sensory panel the required minimum of three or more times each. In general, species which occupy the same habitat or harvest area such as estuarine, reef, ocean benthic, and pelagic exhibited similar edibility characteristics. The sharks were put into a completely separated group because their sourness and textures were found to be dependent upon the maturity of the specimen.

Instrumental texture and color was performed on cooked samples in accordance with the standard protocol. Correlations between instrumental and sensory textural attributes have not been as clear and definitive as was hoped for.

Cluster analysis and multi-dimensional scaling statistical programs will be applied to the data for the purpose of grouping species according to sensory ratings of edibility characteristics. These results will be combined with other regional data developed by sensory panels at the Seattle and Gloucester Laboratories of NMFS, forming the foundation for a potential marketing system based on edibility characteristics.

(11) ALTERNATE SPECIES - FACT OR FICTION?

Warren F. Rathjen
 Center for Fisheries Engineering Studies
 Florida Institute of Technology
 Melbourne, Florida 32901

As traditional marine resources become less available due to fishing pressure, management practice or other factors the producing segment of the industry is challenged to identify alternate resources to maintain access to market opportunities. Varieties which were ignored a decade ago are being harvested or examined to fill voids in the supply of product.

Worldwide these include a wide variety including squids, krill, lanternfish, deepwater crustacea, sea mount resources and a variety of pelagic fishes. In the southeast and adjacent area significant increases are notable from aquaculture production; molluscs (scallops and clams) specialty products for export (such as mullet roe); sharks and a variety of other products which have increased their market share.

Examination of other resources is underway. These include deepwater crabs and other crustacea, small tunas, butterfish, squids and octopus and other products. Additional opportunities await identification--some of these are suggested along with a discussion of known impediments.

(12) **DEVELOPMENT OF A SALTED DRIED PRODUCT FROM SELECTED UNDERUTILIZED FISH FOR INTERNATIONAL MARKETS**

Yaowen Huang
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Marine Extension Service
Brunswick, Georgia 31523

Samuel L. Stephens
DeKalb Cooperative Extension Service
Decatur, Georgia 30033

Lloyd W. Regier, Melvin E. Waters¹ and Robert Ernst
National Marine Fisheries Service
Southeast Fisheries Center
Charleston, South Carolina 29412

and

John W. Brown
North Carolina State University
Department of Agricultural Economics
Raleigh, North Carolina 27650

Mullet, black drum, herring, and menhaden caught from the Southeastern Atlantic coast and the Gulf of Mexico were processed into a salted dried form for exporting. Preparations of the product including cutting, salting and drying were studied and developed, and estimates of cost were conducted. In order to fit into international markets, we collected and analyzed existing market products from Singapore, Hong Kong and Jamaica. Results show that prototype products made from mullet and black drum are favored by buyers at several international food shows.

¹Deceased.

(13) **PROCESSING OF CANNONBALL JELLYFISH (Stomolophus meleagris) AND ITS UTILIZATION**

Yaowen Huang
University of Georgia
Marine Extension Service
Brunswick, Georgia 31523

The cannonball jellyfish (Stomolophus meleagris) is a nuisance to commercial shrimpers of the Southeastern Atlantic coast and the Gulf of Mexico. However, it can be processed into a food product which has a high value in Oriental markets. Different processing methods were investigated to produce an acceptable dehydrated product. Preliminary results show that cannonball jellyfish have potential for exporting.

(14) **RECENT PROGRESS IN THE PRODUCTION OF THE SOFT SHELL BLUE CRAB,
Callinectes sapidus**

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Mobile, Alabama 36688

and

Harriot Perry
Gulf Coast Research Laboratory
East Beach
Ocean Springs, Mississippi 39564

The soft shell blue crab, Callinectes sapidus, forms a small but growing part of the blue crab fishery in the South Atlantic and Gulf of Mexico. Commercial shedding capabilities have recently been made more efficient and economical by the development of closed recirculating seawater systems. One factor holding back increased growth of the soft shell industry is the lack of a continuous supply of premolt crabs acceptable for holding in a recirculating seawater system. To alleviate this problem we are tests these concern the use of molting hormone (20-hydroxyecdysone) in accelerating the onset of premolt. The first phase of the study of the molt cycle for proper hormone treatment. Until now, only the premolt stages (stage D) could be determined by using paddle signs (white, pink, red line). We have defined the intermolt stages and measured their durations. The postmolt stages A and B occur during the first 24-48 hours after ecdysis and are complete by the time the late paper shell, or hard crab condition has been reached. Stage C is divided into C1, C2 and C3 based on the appearance of the cuticular lamellae in the lateral edges of the paddle. These changes can be seen in small crabs under low power magnification. Stage C1 is defined as the condition where the thickness of the exocuticle is greater than the thickness of the endocuticle while stage C2 is defined as the condition where the endocuticle is thicker than the exocuticle. Each of these stages lasts approximately 3-5 days. Stage C3 is characterized by the presence of the membranous layer which appears as a dark line between the epidermis and the cuticle. The appearance of the cuticle in the paddle will not change again until premolt when a separation of the cuticle from the epidermis occurs. The duration of stage C3 is 14-21 days. We are continuing to search for characteristics that can be employed to subdivide stage C3 into smaller increments. We also have found that the beginning of premolt can be observed microscopically before the white line condition is observed. Preliminary tests on hormone treatment of intermolt crabs show that low doses (100 ng/crab) decrease the time until the onset of premolt without deleterious effects. In a related study, we have found that the use of seawater with low calcium levels slows the hardening process in soft shell crabs. The future application of these findings to commercial crab shedding operations will be discussed.

(15) **AN UPDATE OF RESEARCH ON VESSEL-LEVEL STANDARDS FOR
GREEN HEADLESS SHRIMP**

Debra Ellis, Ranzell Nickelson II and Larry Wyatt
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201 East Holleman
College Station, Texas 77840

Although the per capita consumption of shrimp has steadily increased over the past three decades, growing markets in raw headless, raw peeled, and cooked peeled shrimp have created concern over the quality of the domestic shrimp supply. An increasing supply of high quality imported shrimp has captured much of the U.S. market, sometimes at higher prices, which the domestic supply could obtain if their quality were competitive.

A program has been outlined to evaluate shrimp quality at the vessel level. This would provide an immediate means to produce an incentive to shrimpers to bring in high quality shrimp. Catches evaluated as poor could be bought at a lower than average price discouraging such practices and, it is hoped, resulting in an improved domestic quality trend.

This research project is evaluating domestic shrimp quality in cooperation with members of the shrimp industry (Gulf Shrimp Roundtable) to establish the validity of a proposed evaluation program and to determine where the parameters for quality classification would be most appropriately set. Both physical and freshness quality are taken into consideration and are measured by sorting the percent unusables and pH, respectively. Industry cooperators, (three in Florida, one in Alabama and four in Texas) are or will be providing quality control technicians trained in the evaluation procedures.

More than 1500 unit samples from the Texas cooperators have been obtained. Analysis of data will be presented to ascertain the appropriateness of the evaluation program and to obtain opinions from the industry members.

(16) **EFFECTS OF POST-HARVEST HANDLING ON THE
QUALITY OF MACROBRACHIUM ROSENBERGII**

Linda S. Papadopoulos and Gunnar Finne
Seafood Technology Section
Animal Science Department
Texas A&M University
College Station, Texas 77843

Prawns, Macrobrachium rosenbergii, harvested from freshwater ponds were quick-killed in an ice-slurry. The prawns were subdivided in two lots one of which was placed in ice while the other was put in frozen storage as either "tails" or whole prawns. At regular intervals during the storage period prawns were evaluated for texture by a trained sensory panel using an Instron Universal Testing Machine equipped with a Kramer shear compression cell. Sections were also collected from prawn samples for electron microscope analysis to determine tissue deterioration at the ultracellular level.

(17) **A PROCEDURE TO MAINTAIN QUALITY
OF STONE CRAB (MENIPPE MERCENARIA) CLAWS ICED PRIOR TO COOKING**

Jenny L. Simonson
Florida Department of Natural Resources
St. Petersburg, Florida 33701

Only claws are harvested in the Florida stone crab (Menippe mercenaria) fishery; declawed crabs are released alive to regenerate claws and reproduce. Icing raw claws prior to cooking causes meat to stick to shells, reducing product value, so crabs are frequently maintained whole onboard vessels and declawed at day's end to eliminate the need for icing. This procedure increases crab mortality and minimizes potential benefits of a renewable resource. Results of this study indicate that if iced raw claws are frozen for at least 10 h after cooking, product quality comparable to that of non-iced claws is maintained.

(18) **FDA SHELLFISH SANITATION MISSION, AUSTRALIA AND NEW ZEALAND**

Thomas L. Herrington
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The Mission to Australia, November 16 to December 18, 1984, was performed at the request of the Commonwealth Department of Primary Industry for the purpose of developing a Memorandum of Understanding (MOU) concerning the sanitary control of shellfish. A draft MOU was reviewed and revised to conform with format and content of existing shellfish MOU's. The Mission found that sanitary control in the State of Tasmania was satisfactory, but no other Australian State had developed adequate controls. The Mission discussed shellfish controls with Commonwealth and State officials and members of the shellfish industry. Travel in Tasmania and New South Wales observed shellfish controls and mariculture of oysters. It is anticipated that an MOU with Australia will be finalized as a result of the Mission's findings.

The Mission evaluated the New Zealand Shellfish Sanitary Control Program in accordance with the 1980 MOU signed with the Ministry of Agriculture and Fisheries (MAF). Discussions were held with numerous federal officials representing regulatory control over processing plants, shellfish farms, growing areas and shipping practices. Observations were made at representative oyster, mussel and clam growing areas, mariculture farms and plant facilities. The New Zealand program was found to be in general compliance with the existing MOU. The Mission provided MAF with recommendations for improving its control program.

(19)

**USE OF FOOD GRADE PHOSPHATES
TO BENEFIT THE SOUTHERN SHRIMP PROCESSING INDUSTRY**

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Experiments were conducted to assess the action of phosphate compounds on weight gain in fresh-dipped shrimp and weight retention in frozen/thawed shrimp. Experiments were designed using short duration dip periods and city water supplies such as would be used in commercial operation of a shrimp packing plant. The objective of the study was to determine optimum mixtures of phosphate solutions for treatment of peeled shrimp to prevent excessive over-packing of boxed shrimp for freezing caused by drip loss. The basic benefit of the project for the southern shrimp industry would be to decrease the amount of product used in over-packing in order to meet net weight declarations.

(20)

**HYDROLYTIC AND ENZYMIC DEGRADATION OF ADDED
CONDENSED PHOSPHATES IN SHRIMP HOMOGENATES
HELD AT DIFFERENT TEMPERATURES**

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The stability of linear condensed phosphates in shrimp was determined by measuring the rates of hydrolysis of these phosphates under both enzymatic and non-enzymatic conditions. Fresh white shrimp (Penaeus setiferus), homogenized and treated with 1% (w/w) each of the pyro and triphosphates, were held at 35, 25, 10 and 5C. Non-enzymatic hydrolysis data were obtained by heat inactivation of the enzyme prior to treatment. By using the thin-layer chromatographic technique developed for this study, the extent of hydrolysis of tri- and pyrophosphates was studied at regular time intervals. This method permits an accurate determination of each phosphate component quantitatively at any stage of the reaction. The hydrolysis data obtained for pyro- and triphosphates is presently used to establish rate constants and the order of the reactions.

(21)

**MICROBIOLOGY OF MULLET HARVESTED
FROM A BRACKISH-WATER SITE**

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Mullet is the number one quantity finfish harvested in Florida; however, nothing is known about its normal flora. In order to obtain these data, mullet were harvested from a brackish-water site in Suwanee, Florida at three different sampling times and analyzed for total and fecal coliforms, Salmonella, and aerobic plate counts with identification of the isolates. The four most common genera found were Corynebacterium (22%), Bacillus (17%), Staphylococcus and Pseudomonas (8%) with Corynebacterium being the only genus isolated at all three sampling times. Coliform counts and aerobic plate counts were generally low, but Salmonella was isolated from one sample during December.

(22)

**LOW DOSE GAMMA IRRADIATION OF VIBRIO CHOLERAE
IN CRABS (CALLINECTES SAPIDUS)**

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The effect of low dose gamma irradiation on Vibrio cholerae in sterile and nonsterile fresh crabmeat homogenates stored for 21 days at 0C, 4C and 8C was studied. In sterile and nonsterile fresh crabmeat homogenates at 0C, 4C, and -8C there was a 5 log cycle reduction and a 3 log cycle reduction respectively in the number of Vibrio cholerae immediately after irradiation at 25 Krad on day 0. No Vibrio cholerae were recovered immediately after irradiation at 50 or 100 Krad on day 0.

(23)

**USE OF A LIQUID CHROMATOGRAPHIC TECHNIQUE FOR
DETECTING AND MONITORING THE ACCUMULATION OF
CIGUATOXIN-LIKE TOXINS IN FISH TISSUE**

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Seafood toxins, such as ciguatoxin, compromise human health through exposure of consumers to contaminated finfish. Due largely to the increased distribution of valuable reef fishes, ciguatera may currently be the leading cause of non-bacterial food poisoning in the United States. In addition to consideration of human health, the threat of exposure to ciguatoxic fish results in economic losses in the commercial and recreational exploitation of seafood. Aspects of developing a safety program for preventing toxic fish from entering commerce include developing improved techniques for monitoring ciguatoxin as well as having a better understanding of how fish become ciguatoxic.

A high pressure liquid chromatographic technique was developed to detect ciguatoxin and related toxin(s). The method features in-line, post-column derivatization and fluorescence detection and is the first chemical method capable of quantitatively measuring ciguatoxin or ciguatoxin-like toxins in concentrations <1 mouse unit of toxicity.

Using this procedure, uptake of algal-produced toxin by the black sea bass, Centropristis striata was studied in an attempt to demonstrate the food chain hypothesis for ciguatoxin accumulation in fish. Higher concentrations of toxin were detected in fish tissue when fish were exposed to whole algal cells, either gavaged or injected interperitoneally, rather than when toxin was presented as algal extract. Regardless of the route of exposure to toxic material, visceral tissue had the greatest toxicity.

Chromatographic separations of algal and fish extracts using the chromatographic technique indicated the presence of only a single toxin, presumably the algal toxin. This result suggests that ciguatoxin is not produced within infected fish, but must be ingested from an algal source.

(24)

DEPURATION OF CLAMS IN FLORIDA

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The Florida Department of Natural Resources has enacted policies which support and encourage the controlled purification of shellfish. These management policies are directed toward increasing hard clam (Mercenaria spp.) production through the responsible utilization of a resource which would otherwise be lost. Policies supporting depuration activity have also impacted public harvesting areas by reducing fishing pressure in open areas.

It was estimated that approximately 165 million hard clams were harvested in 1984 for a total dockside value of \$7.26 million. During 1984, approximately four million hard clams were processed at five depuration facilities located in Brevard County. More than 12 million clams were depurated during the first quarter of 1985.

It is important for the shellfish control agency to work closely with the shellfish industry with regard to the need for adequate regulation of depuration. Since few shellfish regulatory agencies are staffed and funded to effectively monitor depuration, the industry must be willing to support regulatory and enforcement activities.

(25) **FACTORS AFFECTING THE DEPURATION OF CHEMICAL CONTAMINANTS BY
MOLLUSCAN SHELLFISH**

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Degradation of the quality of the estuarine habitats has resulted in closures of shellfish growing waters because of chemical burdens in the biota. Concentrations of cadmium, zinc, arsenic, tin and other inorganic as well as organic contaminants in shellfish occasionally approach recommended maximal dietary intakes. These renewable marine resources may be recaptured into commerce if institutional factors (i.e., laws and regulations, establishment of chemical acceptance criteria) are overcome and if suitable processes for removal of these contaminants are developed. Early studies evaluated the effects of relaying to poorly characterized environments. Results of these studies led to the generally held belief that depuration or relaying for removal of chemical contaminants is impractical.

Controlled evaluations of the rates of elimination of cadmium, zinc, copper, iron, and magnesium by juvenile eastern oysters have been conducted in our Charleston Laboratory. Results thus far suggest important environmental factors affecting the elimination of chemical contaminants by oysters include: salinity; temperature; and organic chelator concentrations. Approximately 20 percent of environmentally-acquired cadmium was eliminated by 28 days when only one environmental factor was optimized. A large scale study is currently underway to evaluate the combined effects of the "best" environmental conditions on the elimination of cadmium, zinc, copper, arsenic, selenium, and tin by adult and juvenile: eastern oysters; Pacific oysters; softshell clams; and hardshell clams.

(27) **CONTROLLED CHALLENGES OF SULFITE-SENSITIVE ASTHMATICS
WITH SULFITED SHRIMP AND OTHER FOODS**

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Ingestion of sulfites can provoke bronchospasm in sulfite-sensitive asthmatics (SSA), but the role of sulfited foods in eliciting episodes of asthma in SSA has not been clearly defined. Clinical challenge procedures usually involve challenges with sulfite in capsules or acidic beverages such as lemonade or citric acid. Sulfited food challenges would be quite different because sulfites are very reactive chemicals. No evidence exists that SSA react to the bound forms of sulfite that predominate in most foods.

A total of 243 asthmatics have been screened for sulfite sensitivity by a single-blind challenge with capsules and beverages containing sulfites. A positive response was a 20% decrease in forced expiratory volume in one second (FEV1), a common measure of lung function that can be readily measured by spirometry. Single-blind positive reactions were confirmed by double-blind trials using sucrose as the placebo and the regular sulfite challenge procedure on separate days. Six confirmed SSA were identified in this manner.

The six SSa were subjected to challenges with 5 sulfited foods: lettuce, dried apricots, white grape juice, dehydrated potatoes, and shrimp. Lettuce challenges were performed double-blind, while open-challenges were conducted with the other foods. Four patients failed to react to any of the sulfited foods indicating that they may have been false positive responders in the original single-blind and double-blind trials. The other two subjects reacted to challenges with lettuce, dried apricots, and white grape juice. Shrimp and dehydrated potatoes did not elicit reactions in these two patients. The shrimp were sulfited after peeling our laboratory to contain approximately 100 ppm total S02 as determined by the Monier-Williams method after cooking. Patients consumed 50, 100 and 200 g of the cooked shrimp at 30 min intervals followed by monitoring of their lung function just before the next dose. The 200 g dose was selected as an upper limit for human consumption of shrimp in a single meal. The 100 ppm residue level was selected because it is the legally allowed upper limit in raw shrimp to meet federal guidelines for good manufacturing practices.

We conclude that sulfited foods can provoke bronchospasm in SSA, but not all sulfited foods elicit these reactions. Foods having less than 100 ppm total S02 as consumed did not elicit reactions in our two patients, while foods having more than 200 ppm total S02 did provoke reactions.

(28) **OMEGA-3 FATTY ACIDS: WHY ALL THE SUDDEN ATTENTION?**

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Omega-3 fatty acids are polyunsaturated fatty acids characterized by the fact that the first carbon-carbon double bond begins at the third carbon from the methyl-terminal end of the carbon chain. Eicosapentanoic (EPA) and docosahexanoic (DHA) are two omega-3 fatty acids derived from fish oil. EPA has been shown to decrease triglycerides in the serum of normal and hypertriglyceridemic humans. EPA, through its role in prostaglandin metabolism, is also capable of causing delayed blood-clotting time. Both actions are thought to have an effect on ischemic heart disease but scope and nature of these effects are far from elucidated.

(29) **NMFS FISH OIL RESEARCH AIDS FISHING INDUSTRY AND CONSUMERS**

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Numerous studies in the last decade have focused particular attention on two fatty acids found in all seafoods, the polyunsaturated fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), and their relative effects on the human cardiovascular system. More recent studies have shown that these two fatty acids, known as n-3 fatty acids because of their chemical structure, may also effect the immune system. Large amounts of DHA have been detected in brain, retina and human milk, suggesting that n-3 fatty acids may be essential components of the diet. With current concern for good health and nutrition, it is reasonable to expect an increase in the amount of seafood in the American diet, with a resulting increase in the economic value of seafood and seafood products, if sufficient information were available on the nutritional value and wholesomeness of these products. A general overview of current and projected projects at the Charleston Laboratory of the National Marine Fisheries Service (NMFS) designed to assist the industry in realizing this potential will be presented. Some of these activities have been devoted to the determination and collation of information on the composition, safety, and uses of fish oils, including those of latent species. The data bases in which this information is stored will be described. In support of the National Institutes of Health (NIH)/NMFS initiative to demonstrate that fish oils, or their component fatty acids, EPA and DHA, are valuable therapeutic agents in treatment of cardiovascular and other diseases, preparations are being made to provide refined menhaden oils and concentration of n-3 fatty acids to NIH approved investigators for use in human clinical trials, animal feeding studies and basic biochemical investigations.

(30) **OMEGA-3 FATTY ACIDS AND FISH OILS: IS ALL THE NEWS GOOD?**

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It is inevitable that consumption of fish and various fish oils will increase as a result of the recent reports on the beneficial effects of the omega-3 fatty acids in these products. FDA has at least two areas of concern. First, will our general risk assessments based on per capita consumption of 13 lbs. of fish per year have to be revised? Second, what contaminants are likely to appear in fish oil products marketed in health food stores and supermarkets? The actual health claims of such products will not be addressed during this presentation. The focus of this paper will be on lipid soluble pesticides and industrial chemicals likely to appear in fish oil concentrates. These substances are readily absorbed by aquatic species and are accumulated in some parts of the fish body. Most of these compounds are distributed in fatty tissues that are not usually consumed and thus would not be a human hazard. On the other hand, these tissues are one source of fish oil supplements. These oils are likely to require special clean-up procedures to assure they do not contain harmful levels of chemicals which may be toxic.

(31) **PARASITES AND PUBLIC HEALTH: IS SEAFOOD SAFE?**

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Serious human disease may result from ingesting seafood products infected with certain parasites. Over fifty species of helminthic parasites have been implicated as producing zoonotic infections resulting from eating raw seafoods. While the majority of these parasitic infections occur outside of the United States, some human cases have been reported within our borders. One of the most carefully studied diseases induced a larval nematode is anisakiasis. Humans are infected when they ingest a larval anisakid nematode along with some raw or other inadequately cooked seafoods. The larva may then penetrate into or through the stomach or intestinal wall. In recent years, the number of new cases of anisakiasis in the U.S. has increased. This increase is probably associated with our society's changing dietary habits. Raw seafoods, such as served at sushi bars, are increasing our chances of encountering this disease. The current state of knowledge concerning this disease and preventative measures will be discussed.

(33) **PROCESSING OF MENHADEN FOR CONVENTIONAL FOOD PRODUCTS, MINCED INTERMEDIATES AND SURIMI**

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Both Gulf and Atlantic menhaden have good potential for human food products if appropriate harvesting, holding, processing and preservation procedures are carried out. Processing studies at the Charleston Laboratory of the Southeast Fisheries Center and some of the resulting demonstration products are described in this paper. Smoked and canned menhaden fillets are a very acceptable product. Menhaden also have potential uses in fish sausages and as an ingredient in hot dogs. Recent emphasis has been on minced intermediate products and/or surimi. Processing requirements for these products are described. A typical yield of strained, washing menhaden mince is 18%. This can be separated during straining into approximately 11% light fraction and 7% dark fraction.