

Abstracts

Monday, February 19th

SEAFOOD PROCESSING SESSION I

S01 Improved Ohmic Cooker for Surimi Gel Preparation JAE W. PARK, Ey J. Kang, Zachary Reed, Craig Holt, and Don Graves¹

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Pacific whiting surimi contains thermo-activated proteolytic enzymes that degrade myofibrillar proteins, resulting in soft to mushy gels. In the production-driven surimi industry, Pacific whiting is not the only problematic surimi. Virtually all surimi possess thermo-activated proteolytic enzymes although at varying amounts. Enzyme inhibitors and fast cooking are remedies to overcome texture softness. Protein additives function as an alternative substrate and minimize fish protein degradation during slow cooking. In fast cooking, temperature quickly rises above the enzyme active zone (50-65C) and reaches above 70C to inactivate proteolytic enzymes. OSU Seafood Lab developed the ohmic gel cooker in the 1990s and demonstrated Pacific whiting surimi could be effectively tested without the use of enzyme inhibitors. However, resulting gels (2 cm id) were not like gels (3 cm id) used currently by the surimi industry. Our objectives were to develop a new ohmic cooker that will homogeneously heat 3 cm gels and to compare various surimi gels heated ohmically with gels heated conventionally. Various grades of surimi were obtained and subjected to two different cooking methods: Water bath (90C for 30 min) and Ohmic heating (200-250 volt to reach 80C). All surimi pastes were prepared with 2% salt and 78% moisture. Two protein additives (egg white or whey protein concentrate) were added to evaluate enzyme inhibition effect on surimi gels. At 200 volts, the ending temperature, 80C, was achieved in 45-50 seconds, while 30-35 seconds at 250 volts. Holding time effect after temperature reached 80C was also measured. A ring-shaped translucent exterior surface, indicating incomplete cooking, was diminished as holding time extended. The effect of voltage gradient on gel texture was not significant. Ohmic gels were superior to gels cooked in conventional water bath regardless of enzyme inhibitors and could therefore be effectively used in the surimi industry for gel cooking.

S02 Refining of Sardine Oil: Effect on Chemical Quality and n-3 PUFA profile

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Marine oils contain n-3 polyunsaturated fatty acids (PUFA), particularly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), which are important to human nutrition, and diseases prevention. These PUFA are synthesized mainly by uni- and multicellular marine (phytoplankton and algae) and incorporated into lipids of aquatic species through the food chain. Therefore, oil from fish processing plants may contain significant quantities of these nutritional components. In order to improve the quality avoiding the alteration of n-3 PUFA, crude fish oil must be correctly refined. Changes in the chemical quality, fatty acids and tocopherols composition during refining of sardine (*Sardinops sagax caeruleus*) oil were evaluated. The refining of oil was carried out in three stages: alkali-refining, clay-bleaching and steam-deodorizing. Results show that refining process significantly improved ($p < 0.05$) the chemical quality of the oil diminishing the peroxides (10.00 to 0.81 mEq/kg), *p*-anisidine value (3.67 to 1.63 mmol/Kg), conjugated dienes (0.65 to 0.40%), free fatty acids (0.21 to 0.05% as oleic acid) and increasing oxidative stability (10.39 to 17.55 h Rancimat). The refining conditions increased the EPA+DHA (14.93 to 18.80%), and did not altered the tocopherols content (25 ppm) obtaining a refined sardine oil that complied with the chemical quality recommendations for edible marine oils.

S03 Nutritional Properties of protein and oil from Halibut (*Hippoglossus stenolepis*) heads P.J. BECHTEL¹ and A.C.M. Oliveira²

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During 2005 the harvest of halibut in Alaska was approximately 26,000 t. Heads are the major processing by-product and 4,200 t was produced in 2005. The objective of this study was to characterize the nutritional properties of protein and oil from halibut heads. Heads were obtained a commercial processor in Kodiak, Alaska. Heads weighting 3.6 to 5.0 kg were immediately ground and samples held in an ultra freezer until analyzed. Analysis included proximate composition, amino acid analysis, mineral analysis, fatty acid and lipid classes, determination of the content of cholesterol and volatile amines, and SDS electrophoresis of proteins. Average proximate composition of halibut heads was 7.2% lipid, 15.2% protein, and 3.1% ash. Cholesterol content was 70 mg/100g of tissue. As a percentage of total amino acids on a weight basis the values for lysine, threonine and hydroxyproline were 6.8%, 3.9% and 2.5%, respectively. Triacylglycerides in halibut head samples averaged 97.5%. Oil from halibut heads was 21.5% PUFA and contained 12.1% DHA and 8.0% EPA. Halibut heads area good source of high quality protein and

oil rich in rich omega-3 fatty acids. Comparisons to nutritional properties of by-products from other cold water marine species will be included.

S04 Gasification of Salmon Harvesting Waste ROWLAND, S. L., C. K. Bower, and C. A. Mireles DeWitt

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The purpose of this research is to judge the feasibility of gasification for the disposal of waste streams generated through salmon harvesting. Gasification is the process of converting carbonaceous materials into combustible “syngas” in a high temperature (above 700° C), oxygen deficient environment. Syngas can fuel engines which recycles energy from waste products. Salmon waste streams are too wet to undergo pyrolysis and combustion. Ground salmon whole fish, heads, viscera, or frames were therefore “dried” by mixing with wood pellets to a final moisture content of 20%. Gasification tests were performed in a small-scale, fixed-bed, updraft gasifier. After an initial start-up period, the gasifier was loaded with 1.5 kg of biomass. Temperature was recorded at six points in the gasifier. Syngas was collected during the short steady-state period during each gasifier run and analyzed. Percentages of each type of gas in the syngas were used to calculate syngas heating value. Bomb calorimetry determined maximum heating value for the raw biomass. Comparing heating values shows the efficiency of gasification. Though research of gasification as a means of salmon waste disposal and energy production is ongoing, it can be concluded that relatively low moisture content mixtures of waste with wood is gasifiable.

S05 The Effects of Processing Methods and Storage on Cadmium Levels in Pacific Oysters (*Crassostrea gigas*) ROSALEE S. RASMUSSEN and Michael T. Morrissey

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The effects of processing and storage on cadmium (Cd) levels in Pacific oysters (*Crassostrea gigas*) were examined. Oysters were analyzed for Cd at various points in the processing line, including: shucked (S), shucked and drained (SD), and shucked, drained, washed and jar-packed (S-WJ). The effects of high pressure processing (HPP) followed by washing and jar-packing were also examined. Jar-packed oysters from groups S-WJ and HPP were stored under refrigeration and analyzed at days 0, 5 and 10. Some processing methods had significant effects on oyster Cd levels. Draining nectar from the oysters resulted in significant increases in Cd concentrations, followed by significant decreases due to washing and jar-packing. HPP-treated oysters that were washed and jar-packed showed further decreases in Cd. Ten days of jar-packed storage resulted in a gradual decrease in Cd for both the HPP (from 1.08 to 0.82 ppm) and the S-WJ groups (from 1.42 to 0.88 ppm). Total tissue Cd levels decreased significantly during storage of Group S-WJ oysters, while tissue weights increased significantly. These findings suggest that changes in Cd concentration may due to a combination of a release of Cd by the oyster tissue and a dilution of the available Cd due to water uptake.

S06 Gel-Forming Ability of a Giant Squid (*Dosidicus gigas*) Protein Concentrate Obtained by Acid Dissolution and Isoelectric Precipitation JUAN A. CORTÉS, Ruiz, Ramón Pacheco, Aguilar, María E. Lugo, Sánchez, María G. Carvallo, Ruiz, Guillermina García, Sánchez,

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It was produced a protein concentrate from giant squid by an alternate process to the surimi technology (control), that consist on the acidic dissolution of the squid mantle proteins and its subsequent isoelectric precipitation. A control concentrate, obtained through washing with water, was named “neuter protein concentrate” (NPC), while the concentrate obtained by acidic dissolution was named “acidic protein concentrate” (APC). The concentrates functional-technologic quality was characterized on the solubility basis of its protein fractions and its gel-forming ability. The protein recovery ($p \geq 0.05$) was 76.8% (± 7.8) and 77.2% (± 7.0) to NPC and APC, respectively. However, the nature of their protein fractions was different. To the NPC, more than 90% were soluble proteins in μ of 0.05 and 0.5, while that to APC, more than 50% were soluble in alkali and around of the 40% soluble in μ of 0.05 and 0.5. The protein composition of the APC was favorable to its functional-technological quality, due to with this concentrate was obtained grade AA gels and values greater ($p < 0.05$) in the parameters of gel-forming ability (gel strength, fracture, elasticity and cohesiveness). Giant squid is a raw material convenient to elaborate functional protein concentrates through the alternate process.

S07 Physicochemical and functional changes in giant squid (*Dosidicus gigas*) mantle muscle during iced storage. JUAN C. RAMÍREZ-SUÁREZ, Luis R. Ibarra-León, Ramón Pacheco-Aguilar, Maria E. Lugo-Sánchez, Gisela Carvallo-Ruiz, Guillermina García-Sánchez

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Gulf of California possesses a great variety of important commercial species such as giant squid (*Dosidicus gigas*); but not much information about its conservation after catch has been done. Therefore, this work evaluated physicochemical and functional changes its mantle muscle experimented during iced storage for up to 15 days. Changes in pH, protein solubility (PS), and SDS-PAGE in muscle proteins as well as TPA (hardness, elasticity and cohesiveness), WHC, and color of gels were evaluated. Proximate analysis showed a huge variation in chemical composition due to fishing season and/or specimens physiological stage. pH as well as PS tended to slightly diminish ($p > 0.05$) towards end of storage. SDS-PAGE of muscle proteins demonstrated no drastic changes in myosin fresh muscle. TPA as well as WHC of gels showed a tendency to decrease towards the end of storage. However, sampling variability caused no significant differences ($p > 0.05$) as effect of storage. Gel color showed a tendency towards yellowish hues. Iced storage

proved to be a good method to preserve physicochemical and functional properties of mantle muscle for at least 15 days. Nevertheless, fishing season and/or specimens physiological stage should be taken into account if this muscle wants to be used for gel-type products.

S08 Functional properties of mantle and fin proteins of jumbo squid *Dosidicus gigas*
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Solubility, foaming capacity, foam stability and gelling properties of squid *Dosidicus gigas* mantle and fin were evaluated at different pH and NaCl concentrations. Muscle fibers and protein fractions were compared. Samples were kept at 0 °C during transportation and then stored at -30 °C for 8 months. Freezing damage in tissues was observed by histology. The solubility curve of both tissues exhibited similar shape and the lowest solubility point moved from pH 6 to lower values with higher salt concentration (0, 0.2, 0.4 M of NaCl). The highest solubility at all the salt concentrations was found at extreme alkali pH values. At acidic pH, the solubility decreased opposite to salt concentration. At pH 5 the solubility had the same value for all the salt concentrations tested. Foaming capacity curves had similar shape to solubility curves. The strength of fin gels was higher ($P \leq 0.05$) than for mantle gels. In the folding test the highest score (value of 5) was obtained in gels of both tissues. Muscle fibers arrangement and protein fractionation were useful to explain the different properties observed between fin and mantle of the giant squid. These results support the hypothesis that gelling additives are unnecessary when adequate post-harvest conditions are maintained.

S09 Sustainability in the giant squid's industry of the Mexican northwest: actual stage and challenges JUAN SAÚL SÁNCHEZ HERNÁNDEZ

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A technique-economic investigation was carried out that allowed to diagnose the state that keeps the operation from the giant squid industry of the Mexican Northwest with an approach of sustainable industry. The operation of 17 installed giant squid plants in Baja California Sur, Sonora and Sinaloa in technical aspects was analyzed: administration and organization for the production, quality and good practices of manufacture, processing and commercialization. In consideration of the theoretical currents of weak sustainability and strong sustainability, the analysis of these results allows to identify a nonsustainable industry in the conditions of their present operation. This industry is integrated by companies that could tend towards a scheme of weak sustainability, looking for the economic benefit more than environmental and the social one; and in an evolution stage more outpost, the companies could as a whole be oriented towards the ecotechnological production (production in a scheme of strong sustainability). In both senses is crucial the

roll that the different instances of government related to the fishing in Mexico assume to impel policies and programs of promotion that stimulate these directions of the industry.

POSTER SESSION I

P01 The Lipids in Pacific Cod (*Gadus macrocephalus*) Liver Oils A.C.M. OLIVEIRA¹ and P.J. Bechtel²

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Cod liver oil (LO) is an important dietary supplement. In Alaska, yearly catches of Pacific Cod (PC) average 225,000 t generating 100,000 t of byproducts. Although underutilized, PC livers contain large amount of lipids. The objective of this study was to characterize the LO's from PC. Five males (MA) and six female (FM) PC were obtained at a processor in Kodiak (Jan. 2005). Protein, moisture, ash and lipid content were determined using AOAC methods. Cholesterol, lipid classes and fatty acids analyses were conducted for all extracted LO's. Data was statistically analyzed ($P < 0.05$).

Liver weights were higher in FM (152.2 g) fish than in MA (63.5 g). Lipid content was not significantly different between MA (43.7%) and FM livers. Cholesterol content for MA livers and FM livers were 1.1g / 100 g oil and 0.95g/ 100 g oil, respectively. Triacylglycerides in FM and MA LO's averaged 96.7% and 94.3%, respectively. Phospholipids (PL) were less than 3% and free fatty acids below 1.5% for all extracted LO's. Fatty acid profiles were similar with omega-3's averaging 30%. Livers from Pacific cod can be separated from the other viscera components during processing and used for production of fish oil rich in omega-3 fatty acids.

P02 Joint actions targeted towards preserving the safety of seafood and aquaculture products LEOBARDO MONTOYA R., Ma. Cristina Chávez S., Adrián Gámez A. y Ma. Eugenia Ménez R.

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The aquaculture industry has growth considerably due to the increase in the demand of good quality protein at affordable prices. However, there has been an increasing concern about the risks of consuming these products.

Statistics by the industrialized countries reveal the increase of diseases due to the consumption of products of aquatic origin. As a consequence, educational programs have been implemented to improve food safety education, water supply, food processing technologies and hygiene standards. On the other hand, in the developing countries where these products are produced and widely consumed, less action to guarantee food safety are put in action. Therefore, food safety measures are urgently needed.

The present paper summarizes the actions taken on food safety for aquaculture products by SENASICA, Aquatic Health Committees and CIAD such as: the preparation of manuals to identify food safety risks, the implementation of good management practices at farm level and food primary processing plants (fish, mollusks and shrimp), running courses, develop awareness through outreach programs and verification and certification of farms applying food safety procedures.

P03 Characterization of the Metabolic Route of Adenosine Monophosphate Degradation from jumbo squid mantle (*Dosidicus gigas*) from Gulf of California
MÁRQUEZ-RÍOS E., Pacheco-Aguilar R., Lugo-Sánchez ME., García-Sánchez G. and Carvallo-Ruiz MG.

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In this study the ATP concentration in jumbo squid flying mantle decreased from 6.54 $\mu\text{mol/g}$ to 0.41 $\mu\text{mol/g}$ after 24 h of storage in ice. AMP deaminase showed a isoelectric point of 5.76, a native MW of 180 kDa, and 87 kDa subunits. pH and temperature optimal were 6.0 and 35 °C respectively. ATP activated the enzyme at concentrations superior to 2 mM, and ADP from 0 to 2 mM range. AMP deaminase presented a sigmoidal kinetic with a K_m of 13 mM, and a catalytic efficiency of 267.69 [(mol/L)-1s-1]. The enzyme 5'-nucleotidase showed an isoelectric point of 3.6-3.8, a native MW of 107 kDa, and 33 kDa subunits. pH and temperature optimal were 4.5 and 50 °C, respectively. ATP activated the enzyme in the whole study range (0-4 mM), whereas ADP activate it to concentrations bigger than 0.4 mM. The enzyme showed a hyperbolic kinetic with a K_m of 1.49, and a catalytic efficiency of 356.62 [(mol/L)-1s-1]. Its efficiency was 1.33 times major that the obtained by AMP deaminase. Our results suppose a major AMP's degradation in squid mantle across the enzyme 5'-nucleotidase to form adenosine, that is to say, the degradation is by Ado route.

P04 The mitochondrial ATP-synthase from shrimp: cDNA sequences from subunits ATPc y ATP6, and analysis of both genes expression. MUHLIA-ALMAZAN, A., Martínez-Cruz, O., Valencia-G. C., Yepiz-Plascencia, G. and García-Carreño, F.

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Shrimp culture is an important economic resource in Mexico, however, studies about their basic biological and physiological processes, as ATP synthesis by oxidative phosphorylation, are scarce. Mitochondria, as the main site of ATP production in animal cells, requires the coordinated expression of multiple genes encoded in two physically separated genomes, nuclear and mitochondrial. In crustacean species, ATP production and consumption are closely related to the molting cycle, an endogenous physiological process with high energy demand. This research is focused on the ATP synthase from

shrimp, including identification and characterization of two ATP-synthase subunits transcripts: ATP-synthase subunit C, and ATP-synthase subunit 6, coded by the nucleus and by the mitochondria, respectively. Semi-quantitative evaluation of mRNA levels for both genes on shrimp at different molt stages is also being used to try to understand gene expression regulation for the mitochondrial ATP-synthase subunits. The complete nucleotide sequence of ATPc and ATP6 cDNAs are 770 and 765 bp, respectively and have 80 to 85% identity to the respective homologs from other crustacean species. We detected different mRNA levels of each transcript in different shrimp tissues, related to tissue function, and small changes on transcript levels in organisms in different molt stages.

P05 Analysis of Carp Hydrolysate Amanda Rosell, ADAM C. OTTLEY, and Richard O. Kellems

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Enzymatic hydrolysates prepared from common carp (*Cyprinus carpio*) from Utah Lake were analyzed to determine dry matter compositional characteristics. Analyses were as follows: Crude Protein, 57.8% (SD 11.7); Crude Fat, 21.4% (SD 7.5); and Ash, 9.7% (SD 3.0). Mineral composition was determined to be: P, 1.67% (SD .943); Ca, 1.42% (SD .483); K, 0.89% (SD .167); S, 0.60% (SD .095); Na, 0.34% (SD .074); Mg, 0.12% (SD .017); Zn, 278.27ppm (SD 78.99); Fe, 210.35ppm (SD 94.95); Cu, 4.59ppm (SD 2.81); and Mn, 2.58ppm (SD .935). The Amino acid profile was: Tryp 0.53%, Cyst 0.48%, Meth 1.64%, Asp 5.36%, Thre 2.66%, Ser 0.99%, Glut 8.71%, Pro 3.13 %, Gly 4.77%, Ala 4.28%, Val 2.93%, Isol 2.59%, Leu 4.56%, Tyro 1.81%, Phen 2.36%, Lys 4.44%, His 1.41%, and Arg 3.84 %. Heavy metal and organic chemical contaminants were determined from composite samples of carp fillet and offal. Only the total PCB levels were found to be elevated of all the heavy metals and organic chemical contaminants evaluated. Total PCBs were 0.0478 mg/kg in the fillet and 0.139 mg/kg in the offal, both of which exceed the EPA cancer screening value (0.02 mg/kg). The offal also exceeded the non-cancer screening value (0.08 mg/kg).

P06 Citric Acid as Pretreatment of Lion's Paw Scallop (*Nodipecten subnodosus*) previous to drying MÁRQUEZ-RÍOS E., Pacheco-Aguilar R., Lugo-Sánchez ME., García-Sánchez G. and Carvallo-Ruiz MG.

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Lion's Paw Scallop were dried to 50, 60 and 70°C using as previous pretreatment immersion in citric acid to pH 3 by zero (control), one and three hours. Immersion in acid solution reduced pH from 6.20 to 5.99 and 5.88 in scallop subject to immersion by one and three hr respectively, it affect directly the drying times. To 50 °C drying times were 22, 10 and 8.5 hr, to 60 °C were 15, 9.5 and 8 hr whereas to 70 °C were 13, 8 y 6 hr for control, 1 y 3 hr of acid immersion respectively. Drying times were reduced considerably in scallop immersed in acid solution for each of the used temperatures. The drying

temperature had not a significant effect ($p \geq 0.05$) on color and texture, whereas the pretreatment had a significant effect ($p < 0.05$), where scallop control presented a major hardness and dark coloration more intense than those immersed in acid ($p < 0.05$). The water activity was diminish with an increase in drying temperature increasing in scallop immersed in acid ($p < 0.05$). The immersion in acid solution as pre-treatment in drying scallop is a good option for decrease the drying times therefore the process costs, moreover the product present a better color due the acid solution reduce Maillard reactions.

P07 Digestive Lípases in the whiteleg shrimp *Litopenaeus vannamei*
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Lipases are physiologically important because they digest fats into fatty acids for absorption across a cell membrane and transform triglycerides into more polarized molecules. In this study, we investigated the effect of starvation as a stimulant to the digestive system for increasing digestive lipase activity in the whiteleg shrimp *Litopenaeus vannamei*. The group of starved organisms was sampled at regular intervals for 120 hours and compared with a continuously fed group. Midgut gland extracts from *L. vannamei* were evaluated for protein by the Bradford method and lipase activity by using beta-naphthylcaprylate as substrate and measured spectrophotometry. The liberation of long chain fatty acids from a triolein emulsion was measured by titrating in pH-stat at pH 8. The molecular mass of this enzyme was obtained by SDS-PAGE electrophoresis. The gene expression for lipase was evaluated by RT-PCR at each interval of the starvation period to explain changes in lipase activity. We found that starvation is a stimulant that affects digestive lipase activity. Studies of starved organism, in combination with tools of molecular biology, is a helpful approach for understanding regulatory mechanisms in the digestive system of marine species, which may be beneficial for production in aquafarming.

P08 Recovery of functional protein from jumbo squid *Dosidicus gigas* muscle by acid and alkaline solubilization HUGO PALAFOX-CARLOS, Fernando L. García-Carreño*

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Jumbo squid (*Dosidicus gigas*) is a fishery on the Pacific coast of Mexico without processing and producing low revenue. New products would increase revenue of the fishery. Two procedures for processing frozen and unfrozen giant squid muscle to obtain protein isolates with useful properties are described. They are based on solubilization, isoelectric precipitation, and recovery of muscle protein. Squid muscle proteins were extracted using acid and alkaline solubilization. About 85% of the muscle proteins were dissolved at pH 2-2.5 and 11-11.5, of which 80% and 89% was recovered after

precipitation at pH 5.5. The recovered protein was about 70% of raw material. Also, foaming capacity, foaming stability, emulsion-forming capacity, and emulsion stability were evaluated. This study demonstrated that processing under acid and alkali conditions is a practical approach for recovering large quantities of the jumbo squid muscle protein that have attractive functional properties, specifically, the myofibrillar protein. The acid and alkali processes eliminated impurities, such as membranes, skin, and connective tissue, yet about 85% of the water is was recovered. There were no statistical differences between either of the pH recovery methods.

P09 Texture changes in raw and cooked meat of whiteleg shrimp (*Litopenaeus vannamei*) during storage on ice DÍAZ-TENORIO, L. M., García-Carreño, F. L. and Pacheco-Aguilar, R.

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To preserve its delicate taste and unique texture, decapods (shrimp, crabs, and lobster) are prepared raw or cooked in many dishes around the world. Whiteleg shrimp *Litopenaeus vannamei* is a desirable species in aquaculture production; it is one of the most widely traded shrimp species, second only to *Penaeus monodon*. We studied changes in texture during ice storage of raw and boiled shrimp. All parameters showed significant differences resulting from storage. Higher values of hardness, shear force, and fracturability were observed in boiled shrimp. Significant changes in hardness and water-holding capacity occurred in raw meat, and shear force and water-holding capacity in boiled meat. Significant correlations were present in microscopic analysis and shear force in raw and cooked samples. As in other crustaceans, mushiness occurred in boiled meat after long storage at low temperatures. Based on characteristics of textural and appearance, the best meat quality was maintained for about 2.5 d; after this time, unappealing changes in appearance and texture developed until final shelf-life (18.5 d). A better knowledge of the effects of chilling on texture of shrimp meat would provide producers, retailers, and processors a more efficient way to market this product.

P10 Effect of storage on Jumbo Squid Proteins GABRIELA DE LA FUENTE-BETANCOURT, Fernando García-Carreño*, Julio H. Córdova-Murueta

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Jumbo squid is a marine resource that is not processed or sold as a raw material. To take advantage of this low-cost Mexican fishery product, new processes will need to be developed. Before this can be done, protein properties as well as how the contents are affected by storage must be studied. Effects of storage on ice of jumbo squid mantle with its fin on the gelling capacity and changes in protein fractions and functional properties were assessed. Most characteristics of texture in gels were not significantly changed during storage. On average, these were: strength (65.07 ± 4.71 N); elasticity ($68.14 \pm$

5.3%), fracturability (52.97 ± 1.28 N), and cohesiveness ($36.6 \pm 0.1\%$). Solubility of protein increased more than 40%. Whippability increased during storage (0°C) for 16 days from the initial 81% to 162%, as did foam stability from the initial 73% to 94%. Results suggest that iced squid mantle protein is a suitable ingredient for food products where these certain functional properties are desirable.

P11 Effect of a natural antioxidant on lipid oxidation and histological changes in frozen cultured white shrimp (*Litopenaeus vannamei*) VALENCIA PEREZ ADRIANA ZULEMA, Soto-Valdez Herlinda and Ezquerria-Brauer Josafat Marina

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The effectiveness of a natural antioxidant to retard autoxidation and muscle fiber damage of frozen cultured white shrimp (*Litopenaeus vannamei*) was evaluated. Antioxidant was mixed with lecithin before applied to shrimp. Antioxidant concentrations of 0 (LE), 200 mg/Kg lipid (ANTX) and 2g/kg lipid (10ANTX) were added to deheaded shrimp. Shrimp without lecithin was used as control (CO). Quality changes were determined by phospholipase A2 activity, determinations of thiobarbituric acid reactive substances (TBARS) and histological observations. Analyses were carried out immediately after preparation of samples and during 32 d storage at -8°C. Phospholipase A2 activity did not change during storage, however TBARS increased and muscle fiber damage were detected, mainly in LE and CO. Antioxidant resulted in better quality in relation to TBARS and muscle fibers. The best treatment was 10ANTX shrimps. The results suggested that commercial addition of antioxidant might delay lipid oxidation and tissue damage to deheaded cultured white shrimp.

P12 Freshness and spoilage indices for farmed whiteleg shrimp (*Litopenaeus vannamei*) DÍAZ-TENORIO, L. M., García-Carreño, F. L*. and Pacheco-Aguilar, R.

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Trends in food marketing indicate that the finer points of eating, display, status, exotic products, and even higher costs now play an important role in the processing and marketing of seafood. The biology of the seafood organism strongly affects the post-mortem chemical reactions, and for this reason, each commercial species must be studied individually. Knowledge about post-mortem biochemistry is useful for establishing the best parameters for measuring freshness and spoilage and defining the best conditions of management to meet consumer satisfaction and safety policies. This study describes and evaluates post-mortem changes in muscle characteristics of whiteleg shrimp (*Litopenaeus vannamei*) during storage at 0 °C. Rigor mortis in shrimp muscle begins 5 hours after death and is completed at 30 h after death. Resolution of rigor mortis was not observed, confirming low proteolytic activity in shrimp muscle. Lixiviation of low-molecular weight compounds was observed, suggesting a loss in sensorial quality. For farmed whiteleg shrimp, K-value or the increase in the amount of hypoxanthine is recommended

for measuring freshness. The concentration of trimethylamine is better than total volatile bases as a spoilage index.

P13 Solubility and thermal gelling of Jumbo squid proteins GABRIELA DE LA FUENTE-BETANCOURT¹, Fernando García-Carreño*¹, Julio H. Córdova-Murueta¹, Lugo Sánchez Ma. Elena²

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Solubility of jumbo squid (*Dosidicus gigas*) muscle proteins at several ionic strengths (0 to 1.0), pH (2 to 13), and gelling capacity were evaluated. Protein recovery was >90% at pH 9-12. Folding score was 5 on all gels. Strength was higher for thermal gels prepared from squid fin (50.2 ± 1.2 N) than that prepared from mantle (23.4 ± 2.5 N). There was no significant difference in gel strengths from previously-frozen (46.4 ± 7.5 N) and never-frozen (43 ± 5.5 N) samples. Moisture, water-drip, and water-holding capacity were evaluated on thermal gels; values of these parameters showed significant differences between previously-frozen and never-frozen samples. Color of squid gels was evaluated; results suggest that squid mantle can be used as a colorless protein ingredient and adding squid fin provided a bright pink to a brilliant red color. Solubility and gel-forming capacity of the proteins from mantle and fin suggest that these properties can provide additional value to this resource.

P14 Chemical and Biological Properties of Chitosan from Shrimp Waste: Obtention and Physical Chemical Characterization, Fungistatic and Insect Repellent Activities MARTÍNEZ-CAMACHO, A.P.¹, Cota-Arriola, O.¹, Moreno-Villa, F.A.¹, Cortez-Rocha, M.O.¹, Castillo-Ortega, M.M.¹, Castillo-Yañez, F.J.¹, Shirai, K.² y Plascencia-Jatomea, M.¹

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Chitosan is a versatile biopolymer obtained from alkaline hydrolysis of chitin. It is biodegradable, non-toxic, biocompatible and it also has been reported that has antimicrobial properties. The objective of this work was to obtain chitosan from shrimp waste and to evaluate its fungistatic activity against *Aspergillus niger*; repellent activity against the insect *Rhyzopertha dominica*; its mechanical properties and chemical characterization. Chitin was obtained by chemical and biological methods. The obtained chitins were transformed into chitosan by homogeneous and heterogeneous alkaline deacetylation. Chitosans were analyzed for molecular weight, deacetylation degree, ash and protein content, fungistatic properties and insect repellency. Chitosans molecular weight ranged from 200-400 mPa.s, high deacetylation degree (>80%), and the ash content ranged from 0.04 to 1.4%. Chitosan biofilms exhibited better insect repellency compared to commercial films (cellophane and polyethylene). The high viscosity

chitosan (HVC) significantly inhibited the fungal growth and the spore germination. The medium viscosity chitosan (MVC) had the lowest estimated value of inhibitory concentration (CC_{50}) (2.82 g/L) for spore germination, while the HVC the lowest CC_{50} for radial growth (0.613 g/L). These results indicate that MVC is the best to delay the *A. niger* germination spore, while the HVC is more active on the apical growth phase. Only 55% of Cherry tomatoes in which chitosan was applied were infected compared to acetic acid control and water control, 91 and 100%, respectively. In conclusion, besides the viscosity and molecular weight, the effect of chitosan depends of the fungus growth phase.

P15 Proteolytic activity in viscera of several marine species from Kino Bay in the Gulf of California CARDENAS-LOPEZ, J. L., Leal- Velez, N.E. and Barreto-Barrios, V. B.

Departamento de Investigación y Posgrado en Alimentos. Universidad de Sonora, Hermosillo, Son. México

Several marine species from the mid region of the Gulf of California were captured in Kino Bay along the 2005-2006 season. A crude extract was made from the viscera and the proteolytic activity was measured using azocasein substrate at different pH values. Higher specific activity was found in Pen shell (*Pinna rugosa*) and Red clam “Almeja chocolata” (*Megapitaria aurantiaca*) at pH 4, Grouper (*Epinephelus*) and Bonefish (*Albula vulpes*) at pH 8 during winter season; Striped mullet (*Mugil cephalus*) at pH 8 during spring season; Sierra fish (*Sierra concolor*) at pH 8 and Jumbo squid (*Dosidicus gigas*) at pH 6 during autumn season. Activity was also monitored using a zymogram incorporating 0.1% casein into an SDS electrophoresis gel. Bands showing several proteases in some cases were detected in the crude extracts. Studies are under way to identify and isolate those proteases that could impact the quality of the species of interest.

P16 Effect of different levels of *Aloe vera* on the metabolic rate of juvenile tilapia (*Oreochromis niloticus*) RIVAS-VEGA, MARTHA ELISA, Miranda-Baeza, Anselmo, Simental-Trinidad, Jorge Arturo and Sandoval-Muy, María Idalia

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Aloe vera is a high antioxidant capacity vegetable, and can be an excellent additive in aquaculture feeds. In the present study, the effect of *A. vera* on the metabolic rate was evaluated. Four experimental diets (33 % protein) were elaborated; they contained 0, 1, 2 and 3 % of *A. vera*. Juvenile tilapias (15.8 g) were acclimated during 24 h in starving at 28 °C, feed was added and the consumed oxygen was measured during four hours. Post-prandial metabolic rate was calculated. A closed respirometer was used. A significant effect was founded ($p < 0.05$) by the increment of *A. vera* in the diet. Post-prandial metabolic rate was increased from 180 mg/kg per h without *A. vera* to 240 mg/kg per h with 3 % of *A. vera* in the diet. Rosas *et al.* (2000) have related the post-prandial metabolic rate with the energy expense of the organisms during the digestion processes

and absorption of the foods, probably the increase in the metabolic rate founded in the present study was due to the increased of polysaccharides in the diet.

P17 Seasonal Distribution of Cyanobacteria in Khamir Port, Persian gulf KOREHI, H¹., Farahani, F¹., Nasrolahi, A., Mazaheri, M²., Nejatkhah Manavi, P².

1. Iranian Academic Center for Education, Culture and Research, teacher training Branch, Tehran, Iran.
2. Department of Marine Biology, Islamic Azad University, North Tehran Branch, Tehran, Iran

Khamir port is one of the most important mangrove ecosystems in the Persian Gulf. Seasonal changes in cyanobacteria distribution and physico-chemical factors affecting these parameters were investigated in this study. Nutrients, temperature, salinity, pH and dissolved oxygen were measured monthly as comparative environmental factors. A broad-scale survey of cyanobacteria abundance and genus composition in khamir Port was conducted monthly in 2003-2004. Three stations were selected: one near mangrove ecosystem, one near the sea and another between this two. There were no significant differences between physico-chemical factors in column water stations. All physico-chemical data except salinity were highest in June, while the lowest measured in February. Cell density of cyanobacteria was maximum in August, whereas minimum was seen in November. Some genera such as: *Synechococcus*, *Chroococcus*, *Oscillatoria* and *spirulina* were observed during the study. Results showed that concentration of cyanobacteria were influenced by variation of salinity. However, cyanobacteria lost their dominant position while salinity decreased.

P18 Kinetic characterization, expression and molecular modeling of chitinase from Pacific white shrimp *Litopenaeus vannamei*

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We describe the purification and characterization of a chitinase from the hepatopancreas of the white shrimp, *Litopenaeus vannamei*. The enzyme has a molecular mass of 50 kDa

and pI 4.7, similar to the values calculated from the cDNA deduced amino acid sequence. *L. vannamei* chitinase was stable at pH 5.0 to 8.0 and to NaCl concentrations from 0-1 M, and presented an acidic pH-optimum (pH 5.5–6.0) and maximum activity at 0.45-0.6 M NaCl. Steady-state kinetics were obtained using the fluorescent substrate analog 4-methylumbelliferyl- β -D-N,N'-triacetylchitotrioside. The Michaelis-Menten constant was $K_m=165 \mu\text{M}$ and $V_{max}=0.59 \text{ mmol/min/ml}$ at pH 6.0 and 25°C, with a marginal effect of salt concentration on the kinetic parameters. Molecular mass and isoelectric point indicates similarity to chitinase 3 from *P. japonicus*. Molecular modeling indicates the presence of a hydrophobic cavity at the substrate binding site. The mRNA was detected by RT-PCR in hepatopancreas but not in muscle, pleopods or gills, suggesting a role in food digestion.

Tuesday, February 20th

AQUACULTURE SESSION

S10 The Oyster Culture, *Crassostrea gigas*, in the Northwestern Coast of Mexico: Preliminary results on Pathology CASTRO-LONGORIA, R¹, J. M. Grijalva-Chon¹, L. Bringas-Alvarado¹, R. H. Barraza-Guardado¹, M. A. López-Torres¹, Navarro-García¹ Ma. del C. Garza-Aguirre¹ and J. Ramos-Paredes

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The shellfish production in the Northwestern coasts of Mexico is mainly based up on the exotic oyster, *Crassostrea gigas*. The production of this species had dramatically decreased in the last decade in the coasts of Sonora. Also, the fishery crops of *C. gigas* have fluctuated depending on the total seeding that ranging from 150,000-4,000,000 per culture cycle/producer. High mortalities have been variable from sites and years and reached maximum of 90% besides of the efficient management of some fishermen. In this work we present advances of those research areas where the Committee of Interdisciplinary Research on Bivalve Mollusks in Sonora, have considered important to obtain information to establish the mortalities causes to increase production. The research is focused on pathogens declared by OIE for bivalve mollusks. Preliminary results indicated by histological analysis in the soft tissues the existence of protozoa in several sporulative phases in all oyster culture sites during 2005-2006.

S11 The Reproductive Cycle of the Crab Fishery Resource, *Callinectes bellicosus* (Stimpson, 1859) from The Gulf of California. CASTRO-LONGORIA, R. ¹, J. Ramos-Paredes¹ and G. Montemayor-López², J. G. Jimenez-Rodríguez²

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The swimming crabs, *Callinectes bellicosus* (Stimpson, 1859), *Callinectes arcuatus* (Ordway, 1863) and *Callinectes toxotes* (Ordway, 1863) are important fishery resources in the Gulf of California. In the last years, the three species had supported significant increase in their catches. *C. bellicosus* is by far the most important due to its higher sizes. The importance of this species was evidenced because the earlier catches in 1982 registered 462 t increasing to 5,652 t, in the 2000's. This food fishery resource has turned on an important economic activity in the Gulf of California because the catches are all year round. The management plans for the species can be based on the reproductive season that has established in the present work. It was taken monthly samplings, from December 2001 to November of 2002, from the artisanal coastal fishery crab catches to analyze live organisms that were dissected to obtain gonads and analyzed by histological techniques. Males and females of 131.7 mm \pm 1.98 and 116.7 mm \pm 0.9 (N=556) of lateral spine depicted that maturity is initiated from February to reach maximal activity in July, 60% mature organisms, and a second from August to September (70%). An effective management plan to this species must take account these temporal patterns of reproduction.

S12 Nitrogen budget in an integrated system of shrimp culture and a biofilter using two densities of black clam, *Chione fluctifraga* LUIS R. MARTÍNEZ CÓRDOVA y Tamara Bernal Jaspeado

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An experimental study was carried out in the facilities of Dictus, University of Sonora, at Bahía Kino, Sonora, México, to evaluate the nitrogen budget in an integrated system of shrimp culture plus a biofilter, using the black clam, *Chione fluctifraga* at two densities (12 and 25 organisms/m²). The different species of nitrogen increased significantly through the shrimp culture system, but diminished after to pass the biofilter. The system resulted adequate to remove some forms of nitrogen, however it was not attributable to the clam, which although tolerated the biofilter conditions, was not effective to that purpose, at least at the densities and sizes used in the study.

SEAFOOD CHEMISTRY AND BIOCHEMISTRY SESSION I

S13 Molecular characterization of the Monterey sardine trypsin (*Sardinops sagax caerulea*) MARTHA FELIX-LOPEZ*, Javier Castillo-Yañez[#], Karina Garcia-Orozco*, Ramon Pacheco-Aguilar*, Gloria Yepiz-Plascencia*, Rogerio Sotelo-Mundo*[§]

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We have characterized some molecular features of sardine trypsin in an effort to get a more complete understanding of trypsin mechanism and function. RNA was isolated from pyloric caeca, and mRNA was synthesized using a reverse transcription system. An internal fragment was amplified using degenerate primers designed after analysis of conserved trypsin sequences from several fishes. Later a RACE (Rapid Amplification of cDNA extremes) was used to obtain the 3' extreme of the trypsin gene. A three-dimensional molecular model was constructed using the deduced amino acid sequence and it was compared with the secondary structure content obtained experimentally at the Brookhaven National Laboratory synchrotron using a high UV intensity spectropolarimeter. Amino acid composition and sequence deduced from the cDNA is consistent with cold-adapted trypsins. The catalytic triad residues were found invariant and were properly positioned in the structural model. These results show that molecular approaches are key to understand digestive and proteolytic processes in sardine by comparison to other well studied species such as salmon and codfish.

S14 Characterization of a Phenoloxidase-Like Enzyme Derived from *Litopenaeus vanammei* Hemocyanin ABDIEL KENI COTA-RUIZ and Fernando L. García-Carreño*

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Melanosis is a major concern in prolonging the shelf life of crustaceans. The discoloration appears to depend on endogenous polyphenol oxidases located in hemocytes; however, a more abundant protein, hemocyanin, may be involved. The conversion of hemocyanin, an oxygen carrier/storage protein into phenoloxidase was investigated. Hemocyanin from plasma of whiteleg shrimp (*Litopenaeus vanammei*) was purified and characterized as a potent inducer of melanosis during storage. This protein was converted into the phenoloxidase enzyme using chemical and enzymatic trypsin and chymotrypsin activators. Treatment with the chemical SDS was the more powerful converter. Using preparative electrophoresis, pure 6-mer and 12-mer aggregates was obtained, with the latter aggregate the only one with phenoloxidase activity. This demonstrated that the activity depends on the way subunits are aggregated. The phenoloxidase enzyme derived from hemocyanin has more affinity for diphenolic substrates than monophenolic ones. The isolated hemocyanin was stable when frozen and thawed at -20 °C. Additionally, the amount of potential phenoloxidase derived from hemocyanin suggests that this protein is the main inducer of black spots in shrimp that are frozen and then thawed.

S15 Acid and alkaline digestive proteinases in three species of penaeids from the Pacific coast of Mexico MARÍA DE LOS ANGELES NAVARRETE DEL TORO, Fernando García-Carreño*, Julio Córdova Murueta

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Three shrimp species (*Litopenaeus vannamei*, *L. stylirostris*, and *Farfantepenaeus californiensis*) of the Pacific coast of Mexico have major economic interest either by fishery or aquafarming. These were studied to better understand their digestive proteinases, using biochemical tools to identify the class and type of proteinase activity. Substrate SDS-PAGE zymograms of these species showed that the zymograms are species-specific and may be used for identification of the species or, because of particular isoforms of the enzymes, to characterize populations. The three species had proteinase activity at alkaline and acid pH and some proteinases were inhibited by class and type-specific inhibitors showing a share of serine and aspartic proteinases. Some enzymes were identified as trypsin and chymotrypsin and some are suspected cathepsins belonging to the aspartic proteinases. We suspect that further studies will show that aspartic proteinases have a function in hydrolyzing peptide bonds in food proteins, provided the pH of the gastric juice and digestive gland is 4.7-6.0 and 5.8-6.8. At these acidities, the enzymes have activity and, because the secretion of the digestive gland is holocrine and intracellular cathepsins are secreted to the lumen to reach the proventriculus in the gastric chamber, its mix with food initiates the first steps of digestion.

SEAFOOD CHEMISTRY AND BIOCHEMISTRY SESSION II

S16 Aspartic proteinases in gastric fluid of European lobster *Homarus gammarus* PAULINA TAMEZ-HIDALGO¹, F. L. García-Carreño^{1,*}, R. Saborowski²

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Marine organisms have highly specialized biochemical adaptations as part of their response to environmental conditions. The great diversity of digestive enzymes reflects this situation. In this study, we isolated and characterized the major acid proteinase in the gastric fluid of adult European lobsters (*Homarus gammarus*). Proteinolytic activity under acid conditions was determined by hemoglobin digestion; the highest activity occurred at pH 3.5. The activity was more than threefold higher in the gastric fluid (11.0 ± 4.0 U·mg⁻¹) than in midgut gland extracts (3.5 ± 1.1 U·mg⁻¹). These enzymes seem to be released from cells of the midgut gland and remain as active forms in the gastric fluid, where they constitute a significant share of proteinolytic activity. Gastric fluid of lobsters is pH 4.7, lower than the gastric pH of other crustaceans. Electrophoresis of gastric fluid under reducing conditions showed six bands with activity between 12 and 48 kDa. The enzyme was purified and concentrated 243-fold. The enzyme is a monomer with a molecular

weight ca 23,500. It is inhibited by pepstatin A and diazoacetyl norleucin methyl ester (DAN). This first approach indicates that this enzyme belong to the family of aspartic proteinases.

S17 Gametogenic development of the Geoduck clam *Panopea globosa* (Bivalvia: Hiatellidae) in the central Gulf of California EUGENIO ALBERTO ARAGÓN-NORIEGA¹, Edna María Arámbula-Pujol², Alma Rosa García-Juárez^{1,3}, Rosalio Maldonado-Amparo⁴

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This study describes some morphometric relationships and gametogenic development of the geoduck clam *Panopea globosa* (Dall 1898) from a population in the east central Gulf of California. Nearly ten clams were collected monthly during a year (October 2004-October 2005), and were measured and weighed to obtain morphometric relationships. Standard histological analysis and measurements of oocyte diameters were used to describe the timing of gametogenic development and spawning. Morphometric results showed not a clearly relationship when shell length was used as independent variable. On the other hand when total weight was used as independent variable, a linear relationship was observed with gonad, meat and shell weights. Five reproductive phases were identified and related with in situ temperature and seawater surface temperatures from the Comprehensive Oceanic and Atmospheric Data Set. Cytological characteristics of the gonad and averages of oocyte diameters for the different reproduction phases were similar to other geoduck clams in New Zealand and Canada. Gametogenesis begins in autumn and gamete development was linked to lower temperatures, reaching the highest reproductive output during December (18 °C). One spawning was induced when seawater temperature increased between January and February. We found that *P. globosa* spawned at comparable temperatures as *P. zelandica* in the southern hemisphere, but the reproductive strategy of the California geoduck clam seemed closer to *P. abrupta* of the northern hemisphere because spawning occurred in association with increased seawater temperature. Results are the first description of gametogenesis in *P. globosa* and represents the basis for future studies on the biology, ecology, and fishing potential of this geoduck clam.

S18 Chemical Composition of Giant Red Sea Cucumbers Commercially Harvested in Alaska A.C.M. OLIVEIRA¹, P.J. Bechtel² and Scott Smiley¹

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The Alaskan commercial dive fishery for the giant red sea cucumber *Parastichopus californicus* averages ~830 t/yr. Muscle from the sea cucumber is exported to Asia, where wholesale prices average US\$ 9 / kg. The objective of this research was to initially characterize the chemistry of muscles and body wall of *P. californicus* from Kodiak waters. Fifteen sea cucumbers (4.4 kg) were delivered live to the FITC pilot plant and processed immediately. The animal's anterior end was removed, the body was slit lengthwise, the viscera removed and the muscles separated from the body wall. The muscles (1 kg) and body walls (3.4 kg) were analyzed in triplicate for mineral content, proximate composition, amino acid and fatty acid content using standard AOAC methods. Proximate analysis showed muscle was 84.5% moisture, 11.8% protein, 1.9% ash, 0.7% glycogen and 0.3% lipids. Amino acid analysis detected large differences between the muscles and body wall. The hydroxyproline, proline and glycine content were higher in the body wall than the muscle, consistent with the presence of a significant connective tissue compartment in the body wall samples. Conversely, muscle protein had a higher content of lysine, arginine and histidine indicating its greater nutritional value compared with body wall.

S19 Post-mortem melanosis in *Litopenaeus vannamei*: a molecular approach
GRACIA A. GÓMEZ-ANDURO, Julio H. Cordova-Murueta, Jesús N. Gutiérrez-Rivera, Fernando L. García-Carreño*

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Melanosis in shrimp is a brown discoloration resulting from accumulation of melanin. It is an indicator of post-mortem deterioration. Melanin is produced by the prophenol oxidase system (PPO) that includes activation of zymogen by a serine proteinase. However, the small amount of PPO available suggests that other pathways are involved, namely the hemocyanin, an abundant protein that may be converted to phenoloxidase. Preliminary observations showed different melanosis rates among specimens. The goal of this research is to evaluate melanosis rates among different individuals. Evaluation was based on tests over 17 days of ice storage of three trypsin phenotypes (I, II, and III). Differential Display (DD) was used to analyze gene expression related to melanization. Hemocyanin and chymotrypsin mRNAs were quantified by real-time PCR (RT-PCR). The results showed that shrimp of trypsin phenotype III had a lower rate of melanosis than phenotypes I and II. DD analysis showed 9 bands that were differentially expressed. RT-PCR data did not show differences in the amount of hemocyanin mRNA, regardless

of the rate of melanization and more chymotrypsin mRNA in low melanization shrimp. In summary, melanin production is related to individual factors that have yet to be determined.

POSTER SESSION II

P19 Postmortem changes in the muscle quality of cazon fish (*Mustelus lunulatus*) during storage in ice MARINA CANIZALES-DÁVILA^{S1}, Francisco Javier Castillo-Yáñez¹, María Elena Lugo-Sánchez², Enrique Marquez-Ríos², Ramón Pacheco-Aguilar², Victor Manuel Ocaño-Higuera^{1*}

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Quality characteristics of cazon fish (*Mustelus lunulatus*) were evaluated during an 18-day period of storage in ice by monitoring the biochemical, chemical and physical parameters. K-value, pH, trimethylamine-nitrogen (TMA-N), total volatile bases (TVB-N), water holding capacity (WHC), color and texture changes were monitored. The K value increased linearly ($r^2=0.967$) from an initial value of 1.0% to 57.01% at day 18. Likewise, a significant increase ($p < 0.05$) in TVB-N, TMA-N and pH was observed at the end of the storage period. In contrast, texture and color were not affected. Overall results indicated that good quality of cazon fish was maintained at least during the first 15 days of storage at 0°C. From day 15 onwards, the characteristic odor was lost, but no putrid odor was detected even at day 18.

P20 Short-term starvation induces expression of cytochrome c oxidase (COI, COII, COIII) in juvenile shrimp *Litopenaeus vannamei* PEREGRINO-URIARTE, ALMA BEATRIZ; Anduro-Corona, Iván; Sánchez-Paz, J. Arturo; Muhlia-Almazán, Adriana T. y Yepiz-Plascencia Gloria M.

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Crustaceans go through periods of natural and obligated starvation during molting and therefore, must use their energy reserves to synthesize ATP. The bulk of ATP is produced in mitochondria by electron transport and oxidative phosphorylation. The cytochrome c oxidase complex is a component of the electron transport system. Since hepatopancreas is an energy storage organ with high metabolic activity, we studied the expression of subunits I, II and III of cytochrome c oxidase, under starvation for up to 120 h, -similar to the period of molting,- using quantitative real time RT-PCR. Expression of the *16SrRNA* gene was included as a potential constitutive gene. Independent analysis of each gene revealed a significant induction at 24 h and then a reduction to the initial level that was maintained until the end of the experiment. Feeding of shrimp that had been starved for 96 h, resulted in rapid and high induction of all the genes. When the *16SrRNA* was used as constitutive gene for normalization, the starvation effect was basically unnoticed, since the trend of all the genes transcripts levels was very similar, in agreement to the polycistronic transcription mechanism of mitochondrial genes.

P21 Comparative Omega-3 and Omega-6 fatty acids profile in pure and refined sardine oil, and commercial capsules by GC-MS. MARTINEZ-ROBINSON K, Hernandez-Martínez J, Goycoolea-Valencia F.M., Higuera-Ciapara I., Lizardi-Mendoza J., Felix-Valenzuela L., Campa-Mada A.C. & Toledo-Guillén A.

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Omega-3 and Omega-6 fatty acids are fundamentally found in fish, particularly in salmon and sardine. These acids contribute with several benefits to the human health. It has been reported the prevention of some immunological diseases as well as cardiovascular diseases by reducing triglycerides and cholesterol levels. Some authors affirm that they help in the development of the brain in the fetus. Due to these benefits, it is important the recommended daily intake of the omega fatty acids. It explains the increasing of the manufacture of capsules with salmon and fish oil. The present study shows a comparative fatty acids profile in pure and refined sardine oil, and commercial capsules from 12 different trademarks. This profile was analyzed by Gas Chromatography-Mass Spectrometry. The results showed that the main Omega-3 and -6 (myristic acid, palmitic acid, palmitoleic acid, oleic acid, linoleic acid, EPA and DHA) were present in all the samples. Commercial capsules and refined sardine oil presented higher concentration of DHA, whereas palmitic acid predominated in pure sardine oil. The highest concentration of all the analyzed fatty acids were found in the refined sardine oil.

P22 Effect of aflatoxin B1 on farmed white shrimp (*Litopenaeus vannamei*) muscle proteins GARCÍA-MORALES, M. H., Cárdenas-López, J. L. and Ezquerro-Brauer, J. M.

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The effect of injecting aflatoxin B1 (AFB1) to the muscle of farmed white shrimp was evaluated by histological analysis, electrophoresis, differential scanning calorimetry (DSC) and firmness. Four tanks containing 5 specimens of shrimp were kept at 27-30°C, 35% salinity and pH 6.8-7.2 and once acclimated for 24 h, an intramuscular injection in the 2nd abdominal segment was applied to specimens at 0, 10, 100 and 565 ng of AFB1. Shrimp were removed after death and 24 or 48 h after injection. A fractionation of the proteins was done and histological changes were observed in the muscular structure when injected with the higher doses of AFB1 and 48 h of exposition. SDS electrophoresis showed that the 200 kDa band corresponding to myosin heavy chain was heavily degraded in all the doses of AFB1, but not in that of control. DSC showed that enthalpy for myosin decreased with increased exposition and 100 ng dosage. Even though no changes were evident in firmness at the conditions of the experiment, the protein changes induced by the presence of the aflatoxin could have an effect in longer exposition times or in the conditions of presence in the diet.

P23 The Enzymatic Hydrolysis of Carp (*Cyprinus Carpio*) PHUDEE JOHN HENG, J. Shields, A. Rosell, M Snith and R.O. Kellems

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The study evaluated factors (pH, temp, time) that influenced the enzymatic hydrolysis of common carp (*Cyprinus carpio*) for both intrinsic and extrinsic commercial enzymes systems. Carp used in this project were obtained from Utah Lake. Carp that had been frozen were homogenized prior to treatment with either hydrochloric or phosphoric acid to adjust pH (3, 4, 5, 6) and maintained at different temperatures (40, 50, 60°C) for different periods of time (60 or 90 min). The liquefied hydrolysate was then separated from the bones by screening and hydrolysate yield was determined. Maximum hydrolysate yield (73.9%) for intrinsic enzyme systems was found to be achieved at pH 3 at 40°C for 90 minutes when phosphoric acid was used to adjust pH. The highest hydrolysate yield (71.0%) using hydrochloric acid was achieved at pH 3 at 50°C for 90 min. Maximum hydrolysate yield was achieved at 50°C for hydrochloric acid and 40°C for phosphoric acid. Hydrolysate yield for commercial enzymes were as follows: Corolase (75.7%), Papain (77.7%), Liquipanal (73.9%), Alcalase (87.7%), and Novozym (74.0%). Hydrolysate yield was on average 24.7% higher when commercial enzymes were used.

P24 Helping Fishermen Increase Profits Through Extension LIZ BROWN

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Salmon fishing is the base of the economy for the people of the Bristol Bay region of Southwest Alaska. Decreasing prices and increasing costs have induced fishermen to look at processing and/or marketing their own catch rather than selling to large processors. A series of workshops were held between April, 2004 and June, 2006 to provide information intended to help fishermen decide whether to invest in marketing and processing or continue with the status quo, with each workshop evaluation suggesting the contents of the next.

P25 Study of Arginine Kinase as Allergenic Protein from Pacific White Shrimp (*Litopenaeus vannamei*) AISPURO-HERNANDEZ, E.; Sotelo-Mundo, R. R.; Yepiz-Plascencia, G.; Calderón de la Barca, A. M.; Garcia-Orozco, K.D.

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Shrimp is a seafood known to cause allergic reactions in susceptible individuals through components called allergens. Since shrimp is a valuable seafood traded worldwide, is important to study its safety for consumers. Tropomyosin has been reported as the mayor allergen in crustaceans, but there are other proteins like arginine kinase (AK, EC 2.7.3.3)

that also cause allergic reactions. The enzyme AK is involved in the maintenance of ATP levels in invertebrates, in the form of arginine phosphate. We purified chromatographically and sequenced the AK cDNA from Pacific white shrimp (*Litopenaeus vannamei*), and evaluated its reaction against sera from allergic subjects. The AK cDNA sequence resulted in 1425 bp that coded for 356 amino acids. A 40 kDa protein with specific AK activity was purified using ionic exchange chromatography. AK triptic peptides were characterized by MALDI-TOF mass spectrometry and their sequences matched the deduced cDNA sequence. The AK protein was specifically recognized by IgE in serum from allergic individuals using ELISA. Due to its availability, AK is a novel model to study the IgE-mediated allergenic mechanisms, relating structure and function.

P26 Water, Ice and Direct Contact Surfaces as Sanitary Indicators for Seafood Processing Plants RIVERO L.K, Paredes-Aguilar M.C. y Noriega-Orozco L.

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This study was conducted to verify the official sanitary criteria at seafood processing plants located in the Northwest of Mexico. Water, ice and direct contact surfaces samples were collected at different facilities during several years. Samples were analyzed for mesophilic aerobic total count and total coliforms based on Mexican official methodologies. Results showed an improvement in the cleaning and disinfection procedures since a reduction in bacterial load and increasing number of samples were complying official criteria along time. Similar behavior was observed for the potable water used at the processing facilities; where water samples shown an improvement in the sanitary quality. On the contrary, ice samples did not improve microbiological quality, and total coliforms were above the established official limits. In general, a progress in the sanitary conditions can be assumed; this improvement shows the effort of the processing facilities on the implementation of good manufacturing practices, cleaning and disinfection procedures. Nevertheless, some deficiencies that could affect the end product safety were still detected and reflect that not all the practices were properly conducted.

P27 Enzymatic Esterification of n-3 PUFA from Sardine Oil: Response Surface Analysis NORIEGA-RODRÍGUEZ J.A., Barrón-Hoyos J.M., Medina-Juárez L.A., Ortega-García J. and Gámez-Meza N.

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One of the methodologies widely studied for the preparation of concentrated n-3 polyunsaturated fatty acids (PUFA) products is the enzymatic catalysis, because it is efficiently performed at ordinary pressure, pH, and temperature levels. In this work the enzymatic esterification of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) to glycerol were studied in order to obtain the optimal conditions for the

production of highly enriched n-3 PUFA lipids. A concentrated of n-3 PUFA (80.53%) obtained from sardine oil was used as substrate with the enzyme NV-435 in a free solvent media. Results show that for reach higher esterification degree of n-3 PUFA (99.5%), a molar ratio of 1.3 FFA/glycerol (mol/mol), time 8.3 h and temperature 38°C are required. However depending of product desired this conditions must be modified. To obtain higher triacylglycerols level (55%), 4.5 FFA/glycerol (mol/mol), 10.8 h and 58°C are necessary. Diacylglycerols are preferred formed (35%) with a molar ratio of 0.4 to 1.0 mol AGL/mol glycerol, 6 h and 55°C. The formation of monoacylglycerols was superior when 5.0 FFA/glycerol (mol/mol), 2.0 h and 30°C were used. The different conditions resulted offer the possibility of drive the reaction for the desired product.

P28 Extraction and Fractionation of Lipolytic Enzymes from Viscera of Sardine (*Sardinops sagax caeruleus*) GÁMEZ-MEZA N., Miramontes-Romo P., Alanis-Villa A. and Noriega-Rodríguez J.A.

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Marine enzymes have received much attention during the last 10 years because of their potential usefulness in food processing. In this study lipolytic enzyme from sardine viscera was extracted and fractionated. Fresh sardine specimens (*Sardinops sagax caeruleus*) were obtained from a fish meal factory located in Guaymas, Mexico. Sardine was weighted and eviscerated (0-4°C). The viscera were homogenized with purified ice and phosphate buffer 50 mM, pH 7.0 for 5 min. The homogenates were centrifuged at 6,000 x g for 30 min and 0°C. The supernatant was considered as the crude extract of viscera (CEV), which was fractionated with ammonium sulfate at 20, 30, 40, 50 and 60% saturation. The lipolytic activity of CEV and each fraction was measured by titrimetric assay with 0.01 M NaOH, at different temperatures (25-50°C) of incubation during 30 min. Results show that both CEV and concentrated presented a higher lipolytic activity when Menhaden oil was used as substrate. The optimal conditions (pH 7.0 and 30°C) obtained were lower than microbial lipases reported. Fractionation with ammonium sulfate (50%) increased the lipolytic activity. These results suggest the importance of purification of lipases from sardine viscera to be used in the oleo-chemical industry.

P29 Presence of Organochlorine Pesticidas in Muscle Fish from Sistema Lagunario, Tamaulipas, México RUBÉN SANTIAGO, Kristel Mejía, Rocío M. Uresti, José A. Ramírez

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Organochlorine pesticides (OCPs) are compounds extremely toxics and resistant to photolytic, biological and chemical degradation. These semi-volatile substances can widespread through the atmosphere before deposition occurs. The high lipid-solubility allows them to be bioacumulated through the food chain. The aim of this study was to determine the presence of OCPs in fish muscle of species from Sistema Lagunario in the

south of Tamaulipas, México. Texas cichlid (*Cichlasoma cyanoguttatum*), tilapia (*Oreochromis* sp), carp (*Cyprinus carpio*), black bass (*Micropterus salmoides*) were obtained directly from fishermen. The presence of aldrin, dieldrin, endrin, p,p'DDT, p,p'DDE, p, p'DDD, heptachlor, mirex, α -chlordane, γ -chlordane was determined by lipid extraction with acetone-hexane solution and introduced into C18 and Florisil SPE columns. OCPs presence was quantified by gas chromatography with electron capture detector and the maximum concentration found was reported as ng/g. Texas cichlid had heptachlor at 5.4, α -chlordane at 5.9, p-p'DDD at 5.1, and the other compounds were below 5.4 ng/g. Tilapia had heptachlor at 6.5, γ -chlordane at 23.6, p-p'DDD at 11.9, p-p'DDT at 7.5, and the other compounds were below 9 ng/g. Carp had γ -chlordane at 4.5, endrin at 6.3, p-p'DDD at 5.2, and the other compounds were below 4 ng/g. Black bass had heptachlor at 12.1, γ -chlordane at 32.6, α -chlordane at 17.1, endrin at 11.5, p-p'DDT at 23.7, and the other compounds were below 13 ng/g. The results indicate that there is not ecotoxicological risk by consuming the fish species studied on the basis of the limits reported by the EPA-FDA.

P30 Rheological behavior of wheat dough treated with trypsin from sierra (*Scomberomorus concolor*) pyloric ceca extracts. VALDEZ MELCHOR R.G., Cárdenas-López J.L. and Rouzaud-Sández O.

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In this study, the first goal was to follow the rheological behavior during mixing and proofing stages of wheat dough treated with trypsin isolated from sierra fish pyloric ceca extracts, using two Chopin devices: Alveograph and Rheofermentometer. A second objective was to evaluate the best test to use as function of the added enzyme. Two wheat varieties (RW and AW) and two enzyme dose (0.14 and 0.28 U) were used. The tenacity (P-value) of the RW dough was clearly improved by the incorporation of 0.14 U, but the extensibility decrease. The tenacity decrease had a positive effect on the extensibility of the AW dough with 0.28 U. The protease influence was measured by the proteolytic degradation index. This index increase with the trypsin dose and was greatest in AW dough. The maximum dough development and gas retention during proofing was improved in AW dough but not in RW. According to the fish trypsin action, we can screen their influence on dough by choosing both Alveograph and/or Rheofermentometer and predict an improvement on the finished product.

P31 Effect of a packaging with antioxidant on rancidity development in frozen muscle of Sierra (*Scomberomorus concolor*) TORRES-ARREOLA, WILFRIDO, Soto-Valdez, Herlinda, Cárdenas-López, José Luis and Ezquerria-Brauer, Josafat Marina

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The effect of an active packaging (a low density polyethylene film added with buthyl hidroxytoluene) (AFP) on lipid and protein quality of high-fat-content fish species, Sierra (*Scomberomorus sierra*), during frozen storage (-25°C/120 days) was studied. Sierra fillets packed with a film with no antioxidant were used as control (CFP). This species has a high comercial value and is endemic of the Gulf of California region. Biophysical (electrophoresis, histological analysis, shear force) and chemical (peroxide value, PV; thiobarbituric acid index, TBA; free fatty acids, FFA) analyses were carried out. Fish muscle packed with AFP showed less lipid deterioration than CFP ($p < 0.05$): 3.0 fold on TBA, 2.3 fold on PV, and 1.5 fold on FFA. Histological analysis of sierra fillets packed in AFP showed less tissue damage during frozen storage compared to fillets packed in CFP. Same behavior was observed with shear force and electrophoresis.

P32 Alternative treatment of sardine stick-water prior ultra-filtration to generate better quality effluents CELIA O. GARCÍA-SIFUENTES, Ramón Pacheco-Aguilar, and Gisela Carvallo-Ruiz.

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Sardine reduction process generates pollution and waste of potentially useful solids. In practice, solids recovered from stickwater by evaporation are being incorporated to fishmeal; however, solids can be of nutritional importance, thus adding more value to this by-product. Stickwater was treated by using complementary centrifugations followed by pH adjustment (1.5-TCA or 2.5- HCl and 8.5-NaOH) and ultrafiltration (UF) to recover solids, thus generating a better quality effluent. Before the UF step, the TCA-NaOH treatment removed 43.1±15%, 99.5±0.5%, 81.2±22% and 62.4±22%, while the HCl-NaOH 38±17%, 99±0.1%, 81.0±20% and 66.0±12% of protein, fat, biochemical oxygen demand (BOD₅) and chemical oxygen demand (COD), respectively. Acid and alkaline solid fractions were recovered from TCA-NaOH and HCl-NaOH treatments. Acid fractions presented 76.0±4% and 69.7±8.2% of protein, 12.0±6.2% and 13.9±11% of fat, 7.9±2% and 8.2±1.2% of ash for each treatment respectively, while alkaline fractions presented 16.9±3.1% and 19.1±3.8 of protein, 2.9±1.9% and 3.3±1.8% of fat, 75.4±2.6% and 72.3±5.3% of ash respectively. UF (1kDa MWCO) resulted in 99% removal of BOD₅ and 90.2% of COD. The results suggest that the evaluated treatments could be used as a feasible technological alternative for stick-water treatment, thus generating better quality effluents and reduce significantly the pollution produced by the sardine fishmeal industry.

P33 Hydrolysis of wheat flour proteins by trypsin from sierra (*Scomberomorus sierra*) and commercial porcine. Breadmaking quality parameters. S. GUTIÉRREZ-BARCELÓ, J.L. Cárdenas-López, J.M. Ezquerro-Brauer. O. Rouzaud-Sáñez.

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Enzymes from marine sources for the preparation of cereal products, are currently investigated in our laboratory as an alternative application. In this study, were used two doses of trypsin isolated from sierra (*Scomberomorus sierra*) guts extracts and trypsin porcine as control. Trypsins were evaluated for their hydrolysis capability on the wheat flour proteins from *Triticum durum* (variety "Júpatepeque"), in the bread dough system. The hydrolytic capability was observed in some breadmaking quality parameters, which were measured by specific volume and crumb firmness tests. The specific volume was 2.94cc/g and 2.73cc/g, the crumb firmness was 0.478 kgf and 0.476 kgf, both determinations were for marine and commercial trypsin, respectively. The low doses of trypsin from sierra guts and porcine had the best results in the parameters of quality of bread. These results were comparable between both sources.

P34 The white shrimp (*Litopenaeus vannamei*) phosphofructokinase mRNA: tissue distribution and expression during starvation. SOÑANEZ-ORGANIS, J.G., Sánchez-Paz, J.A. y Yépez-Plascencia, G.

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Glycolysis is a universal route for rapid ATP synthesis in most organisms. It is regulated by Hexokinase (HK), phosphofructokinase (PFK) and pyruvate kinase (PK). Although these enzymes have been studied in vertebrates for many years, in invertebrates as crustaceans, the knowledge is very limited. Since crustaceans go through periods of obligated starvation during molting, they may have particular modes to regulate energy usage by regulating gene expression. We are interested in investigating if PKF responds to starvation, being a particular adaptation to respond to natural and obligated periods of starvation in shrimp. A partial sequence of the PFK gene from *Litopenaeus vannamei* was obtained using a PCR based strategy and PKF expression was detected by RT-PCR in muscle, heart, nervous system, intestine, pleopods, gills, hemocytes and hepatopancreas. Since hepatopancreas is one of the main tissues for energy storage, PFK transcripts were evaluated in shrimp subjected to different starvation times (up to 120 h) using qRT-PCR by real time. PKF transcripts declined initially and then returned to levels similar to the ones in fed shrimp, correlating with the amounts of glucose and glycogen, indicating regulation of PFK expression.

P35 Effect of necrotizing hepatopancreatitis in shrimp muscle texture AVILA VILLA L. A.; Pacheco Aguilar R.; Lugo Sanchez M. E.; Garcia Sanchez G. and Gollas Galván T.

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Necrotizing hepatopancreatitis (NHP) is a disease of penaeid shrimp caused by gram-negative intracellular rickettsial like bacteria (NHPB), which target tissue is the tubular epithelial cells of the hepatopancreas (HP). *Litopenaeus vannamei*, *Litopenaeus setiferus*, *Litopenaeus stylirostris*, *Farfantepenaeus aztecus* y *Farfantepenaeus californiensis* (Lightner, 1996) are NHP affected by NHPB clinical signs of NHP disease include reduced feed intake, empty guts, soft shells, flaccid bodies, black or darkened gills, lethargy and marked atrophy of hepatopancreas. Mortalities can be ranging from 25% to 95% in severely affected ponds (Loy et al., 1996). Even though flaccid bodies are mentioned like characteristic of shrimps with NHPB, there are not scientific data that show this effect. In this work one method of NHP infection was developed. The shrimps were fed with NHP infected hepatopancreas, and samples were taken after several times. Raw and cooked muscle texture parameter were determined in NHP infected shrimps at 4, 8, 15 y 18 days post infection and we did not find significant differences in fracturability, hardness, cohesiveness and springiness. These results are the first report that shows, at least, in the first NHPB infection stage (18 days) the shrimp muscle is not affected.

P36 Seasonal Variation on Biological Development and Chemical Composition of the Oyster *Crassostrea gigas* from the Coastal of Sonora Mexico BRINGAS-ALVARADO, L, R. Castro-Longoria, R. Barraza-G., M. Grijalva-Chon., M. Serna-Félix. and G. Navarro-García

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The oyster *Crassostrea gigas* is widely cultivated and utilized for human consumption along the coastal of Sonora. The oysters were from three representative estuaries of different culture zones: San Jorge in North; Santa Cruz in Center and Santa Barbara in South. The organisms were sampled monthly between April 2005 and June 2006. It was realized biometrical and chemical analysis. In biometrical studies it was measured length, wide and weight. The highest values were from Santa Barbara, but only there was significantly difference in wide and whole weight among three estuaries. The south zone is characterized for its highest biological productivity. Mean percentage and range values of the main chemical components from three zones, were: Proteins 6.43 (4.26-8.52); 6.40 (3.96-9.87); 6.67 (4.07-9.82). Lipids 1.23 (0.76-1.68); 1.12 (0.33-1.55); 1.69 (0.42-1.98).

Ash 3.38 (2.47-4.53); 3.27 (2.88-4.14); 2.44 (1.48-2.98). Carbohydrates 3.91 (1.43-5.76); 4.42 (2.33-6.8); 5.08 (2.82-10.64). Lipids decreased in autumn and increased in spring for center and south zones, while in winter for north zone. Carbohydrates showed an opposite pattern. The lowest levels in protein were in autumn, while the highest were in winter for north, summer for center and spring for south zone. The changes on protein values coincide with gametogenesis and maturation in this specie. Low levels of carbohydrates were coincident with the stage of gametogenesis.

Wednesday, February 21th

CURRENT REGULATORY ISSUES SESSION

Evaluation of the fishing efforts for the assessment of “artisan” fisheries of the state of Sonora O. MARÍA DE LOURDES JUÁREZ ROMERO¹, Ing. Luis Carlos Romo Salazar²

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The state of Sonora has very valuable fishing resources within their shorelines. Main fisheries such as shrimp, sardine and Jumbo squid are an important part of the regional economy, but also there are other smaller fisheries species such as flatfish, sierra, red snapper, pufferfish, sharks, groupers, rayfishes, hake, seabass, and crabs, among others. These small boat or “artisan” fisheries are captured within a very small strip of the coastline. These fisheries are also very important from the social and economic standpoint. It is the interest of the state and federal government to coordinate and regulate the fisheries and aquaculture activities, so that the fishing effort corresponds to the population capacities of these important resources. A project was carried out to determine the biological impact of these smaller fisheries in the state of Sonora and a verification process of the fishery economic units pursuing this activity. It was found that these fisheries capture 87 different species and that the total capture is decreasing from 44,445 tons in 2002 to 28,019 in 2005. The decrease was due to market prices and not from a decrease in the population stocks. One of the species that is in the increase in capture is the cannonball jellyfish. A total of 309 economic units geared towards fishing were visited and their permits, installations and fishing boats were inspected and registered.

The Aquaculture Research Directorate at the National Fisheries Institute (INP)
VÍCTOR LAURENCEZ REYES

Instituto Nacional de la Pesca (INP) *National Fisheries Institute of México*

The sector program of the Ministry of agriculture, livestock, rural development, fisheries and food (Programa Sectorial de la Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación) 2001-2006 from the National Development Plan states that fisheries and aquaculture are national security issues and a very important part of the economic and social development of the country. Studies from the national fisheries institute show that 27% of the fisheries nationwide are in poor condition, 53% at their maximum capacity and only 20% with growth possibilities. Considering this, aquaculture represents a real alternative to enhance the food supply in the country, and also enhance food security, generate currency and regional development. This activity will promote new and permanent jobs. To promote aquaculture it is required that productive efficiency and reduction of the environment impact are reached through proper technology and biologic management. The aquaculture research general direction from the National Fisheries Institute (INP) was created in 1994 with the purpose of directing, evaluating and promoting the scientific and technological research in the field, as well as establish the technical and legal guidelines for the sustainable use of aquatic resources, through Technical Opinions and the elaboration of the National Fisheries and Aquaculture Cartography (CNP). This applies to local and introduced species. It is the public administration office responsible for generating and providing scientific evidence for sustainable development in national aquaculture through the implementation of scientific projects with Annual Operative Programs as well as Federal Scientific Projects applied on this Sector.