

IDENTIFICATION OF A GLUCOSE-6-PHOSPHATE ISOMERASE INVOLVED IN ADAPTATION TO SALT STRESS OF DUNALIELLA SALINA

Liuqing Cui, Yurong Chai, Jie Li, Hongtao Liu, Lei Zhang, Lexun Xue-2010

Journal of Applied Phycology 22(5): 563-568

Abstract:

The unicellular green alga *Dunaliella salina* is a recognized model for studying plant adaptation to high salinity. To isolate some salt-induced proteins at proteomics levels and to identify their expressions at gene levels, algal cells at logarithmic phase cultured in 1.5 and 3.5 M NaCl media were harvested for protein extraction. Solubilized proteins were applied to two-dimensional gel electrophoresis (2-DE) and analyzed by ImageMaster 2D Platinum software. Twenty-one protein spots whose intensities were elevated threefold to 13-fold at 3.5 M NaCl as compared to 1.5 M NaCl were analyzed by matrix-assisted laser desorption/ionization tandem time of flight mass spectrometry. One salt-induced protein isolated from the 2-DE gels was identified as a glucose-6-phosphate isomerase (GPI) from *D. salina* (DsGPI). A full-length cDNA of DsGPI was obtained using rapid amplification of cDNA end technique, and it was shown by heterologous expression to encode a protein with a molecular weight consistent with the protein spot in the 2-DE gels. Real-time quantitative RT-PCR demonstrated that the mRNA of DsGPI was induced up to eightfold ($P < 0.01$) by 2.5 M and 14-fold higher ($P < 0.01$) by 3.5 M NaCl than by 1.5 M NaCl, respectively. It is concluded that the protein isolated through 2-DE is indeed DsGPI and that the DsGPI gene may be involved in adaptation to high salinity.

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EFFECT OF UV STRESS ON THE FATTY ACID AND LIPID CLASS COMPOSITION IN TWO MARINE MICROALGAE PAVLOVA LUTHERI (PAVLOVOPHYCEAE) AND ODONTELLA AURITA (BACILLARIOPHYCEAE)

Freddy Guihéneuf, Manuela Fouqueray, Virginie Mimouni, Lionel Ulmann, Boris Jacquette, Gérard Tremblin-2010

Journal of Applied Phycology 22(5): 629-638

Abstract :

Polyunsaturated fatty acids (PUFAs), especially eicosapentaenoic and docosahexaenoic acids (EPA and DHA), are abundantly synthesized by some phytoplankton species and play a key role in the marine food chain. However, they are generally considered to be sensitive to oxidation by UV radiation (UV-R). In order to investigate the effect of UV-R on the lipid composition of two marine microalgae, *Pavlova lutheri* and *Odontella aurita*, they were exposed to a combination of UVA-R and UVB-R with a total UV-R daily dose of 110 kJ m⁻². Chlorophyll a, photochemical efficiency, and lipid composition were then determined on days 3, 5, and 8 of UV-R exposure. In *P. lutheri*, exposure to UV-R treatment led to a decrease in the proportions of PUFAs, such as EPA and DHA, especially into structural lipids (glycolipids and phospholipids). Our findings reveal a reduction of 20% in EPA levels and 16% in DHA levels, after 8 days of UV-R treatment. In *O. aurita*, exposure to UV-R did not change the fatty acid composition of the total lipids and lipid fractions of the cells. EPA levels remained high (27–28% of total lipids) during the 8 days of treatment. Consequently, the n-3 fatty acid content of *P. lutheri* was altered which highlights the sensitivity of this species to UV-R, whereas the results obtained for *O. aurita* suggest a more UV-R resistance. As a result, in latitude countries with medium UV-R level, outdoor “race-way” culture of *O. aurita* could yield a high-EPA algal biomass, whatever the seasonal variations in UV-R.

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CAROTENOID FLUORESCENCE IN DUNALIELLA SALINA

Dorinde M. M. Kleinegris, Marjon A. van Es, Marcel Janssen, Willem A. Brandenburg, René H. Wijffels-2010

Journal of Applied Phycology 22(5): 645-649,

Abstract:

Dunaliella salina is a halotolerant green alga that is well known for its carotenoid producing capacity. The produced carotenoids are mainly stored in lipid globules. For various research purposes, such as production and extraction kinetics, we would like to determine and/or localise the carotenoid globules in vivo. In this study, we show that the carotenoid-rich globules emit clear green fluorescence, which can be used in, for example, fluorescence microscopy (e.g. CLSM) to obtain pictures of the cells and their carotenoid content.

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DOES A LARGE-SCALE CONTINUOUS ALGAL PRODUCTION SYSTEM PROVIDE A STABLE SUPPLY OF FATTY ACIDS TO BIVALVE HATCHERIES?

Anita Jacobsen, Otto Grahl-Nielsen, Thorolf Magnesen-2010

Journal of Applied Phycology 22(6): 769-777

Abstract:

The variation of fatty acid (FA) content and composition of the microalgal production (*Isochrysis* sp., *Pavlova lutheri* and *Chaetoceros muelleri*) in a continuous large-scale production system (500-L bags) used in hatcheries were analysed. The variation of the FAs was analysed in replicate bags over time for the different species. Total FA content (pg cell⁻¹) increased significantly ($p < 0.05$) in the *P. lutheri* and *C. muelleri* bags over time. The content of the essential FAs (arachidonic acid (ARA), eicosapentaenoic acid (EPA), *n*-6 docosapentaenoic acid (*n*-6 DPA) and docosahexaenoic acid (DHA)) increased over time in all of the species, except for DHA in *Isochrysis* sp. The content of EPA and ARA were highest in *C. muelleri*, whilst *n*-6 DPA and DHA were highest in *Isochrysis* sp. The FA composition in the *C. muelleri* bags showed large variability between bags at the beginning of the experiment, but decreased over time. In contrast, the FA composition of *Isochrysis* sp. and *P. lutheri* did not vary much over time, but larger variability was observed between the replicate bags. The results indicate that, even though the essential polyunsaturated FAs (PUFAs) varied between the different species, the total microalgal production secured a stable and increased supply of all the essential PUFAs to the scallop larvae and spat.

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CHANGES IN RNA, DNA, PROTEIN CONTENTS AND GROWTH OF TURBOT SCOPHTHALMUS MAXIMUS LARVAE AND JUVENILES

X. H. Tong, Q. H. Liu, S. H. Xu, J. Li, Z. Z. Xiao, D. Y. Ma-2010

Journal of Fish Biology 77(3): 512-525

Abstract:

The growth potential of turbot *Scophthalmus maximus* larvae and juveniles was studied using nucleic acid-based indices and protein variables. The experiment was carried out from 4 to 60 days post hatching (dph). A significant increase in instantaneous growth rate during metamorphosis and retarded growth rate during post-metamorphic phase were observed. Ontogenetic patterns of DNA, RNA and protein all showed developmental stage-specific traits. The RNA:DNA ratio decreased up to 12 dph, then increased rapidly till 19 dph and fluctuated until 35 dph followed by a decline to the end. The RNA:DNA ratio was positively correlated with growth rate of juveniles during the post-metamorphic phase, whereas this ratio was not a sensitive indicator of growth during the pre-metamorphic phase and metamorphosis. The protein:DNA ratio showed a similar tendency to the RNA:DNA ratio. Changes of DNA content and protein:DNA ratio revealed that growth of *S. maximus* performed mainly by hyperplasia from 4 to 12 dph and hypertrophy until 21 dph during the pre-metamorphic larval phase.

Growth was dominantly hypertrophical from the early- to mid-metamorphosing phase and hyperplastic thereafter. The results show that the DNA content and protein:DNA ratio can evaluate growth rates of larval and juvenile *S. maximus* on a cellular level.

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SHORT COMMUNICATION

INFLUENCE OF HEAT SHOCK PROTEINS INDUCTION IN DIFFERENT YEAST CELL WALL MUTANTS ON THE PROTECTION AGAINST *VIBRIO CAMPBELLII* INFECTION IN GNOTOBIOTICALLY GROWN *ARTEMIA FRANCISCANA* (KELLOGG)

L. Wang, K Baruah, T Fan, M Yu, P Bossier-2010

Journal of Fish Diseases 33(11): 919–923

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REVIEW

NEW DEVELOPMENTS IN RECIRCULATING AQUACULTURE SYSTEMS IN EUROPE: A PERSPECTIVE ON ENVIRONMENTAL SUSTAINABILITY

C.I.M. Martins, E.H. Eding, M.C.J. Verdegem, L.T.N. Heinsbroek, O. Schneider, J.P. Blancheton, E. Roque d'Orbcastel, J.A.J. Verreth-2010

Aquacultural Engineering 43(3): 83-93

Abstract:

The dual objective of sustainable aquaculture, i.e., to produce food while sustaining natural resources is achieved only when production systems with a minimum ecological impact are used. Recirculating aquaculture systems (RASs) provide opportunities to reduce water usage and to improve waste management and nutrient recycling. RAS makes intensive fish production compatible with environmental sustainability. This review aims to summarize the most recent developments within RAS that have contributed to the environmental sustainability of the European aquaculture sector. The review first shows the ongoing expansion of RAS production by species and country in Europe. Life cycle analysis showed that feed, fish production and waste and energy are the principal components explaining the ecological impact of RAS. Ongoing developments in RAS show two trends focusing on: (1) technical improvements within the recirculation loop and (2) recycling of nutrients through integrated farming. Both trends contributed to improvements in the environmental sustainability of RAS. Developments within the recirculation loop that are reviewed are the introduction of denitrification reactors, sludge thickening technologies and the use of ozone. New approaches towards integrated systems include the incorporation of wetlands and algal controlled systems in RAS. Finally, the review identifies the key research priorities that will contribute to the future reduction of the ecological impact of RAS. Possible future breakthroughs in the fields of waste production and removal might further enhance the sustainability of fish production in RAS.

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A CASE REPORT ON THE DISTENDED GUT SYNDROME (DGS) IN CULTURED LARVAE OF ATLANTIC COD (*GADUS MORHUA*)

Yuko Kamisaka, Ann-Elise Olderbakk Jordal, Rolf Brudvik Edvardsen, Harald Kryvi, Erling Otterlei, Ivar Rønnestad-2010

Aquaculture 309(1-4): 38-48

Abstract:

Production of juvenile Atlantic cod (*Gadus morhua*) in Norway has made progress during the past few years; however, high mortality in the larval stage is still one of the bottlenecks in commercial mass production. “Distended gut syndrome (DGS)” is often seen before and during phases of high mortality in the larval stage. The syndrome, which may affect various larval stages, is characterized by low

activity and reduced appetite. The gut lumen becomes opaque, distended and filled with fluid. This study reports an outbreak of DGS in a commercial cod hatchery and employed histology and transcriptomics to characterize differences between DGS-affected larvae and well-performing larvae.

During commercial larval production in autumn 2008, samples were collected regularly from two of the rearing tanks, enabling us to follow a typical outbreak of DGS. During the outbreak of DGS, larvae were sampled from the water surface (floating larvae, with typical DGS symptoms) and from the water column (swimming larvae, apparently unaffected, as an internal control), and they were compared with well-performing larvae from spring 2008 (as an external control).

Histological sections showed extraordinarily many exfoliated epithelial cells in the gut of DGS larvae. There was also hydropic degeneration of hepatocytes in the liver of most of the larvae (from both DGS and internal control). Microarray analysis revealed several genes which were differentially regulated in DGS larvae. A literature search for genes with large differences in expression revealed that the genes which are related to redox balance and inflammation response were affected. The data indicate that oxidative stress is one of the underlying mechanisms of DGS and that the primary problems occur in the liver while secondary effects develop in the gut.

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ALTEROMONAS MACLEODII 0444 AND *NEPTUNOMONAS* SP. 0536, TWO NOVEL PROBIOTICS FOR HATCHERY-REARED GREENSHELL™ MUSSEL LARVAE, *PERNA CANALICULUS*

Aditya Kesarcodi-Watson, Heinrich Kaspar, M. Josie Lategan, Lewis Gibson-2010

Aquaculture 309(1-4): 49-55

Abstract:

Antibiotic management of aquacultured animals, such as Greenshell™ mussel (GSM) larvae, *Perna canaliculus*, is undesirable because of health concerns and political pressures; hence, alternatives are needed. Herein, two novel probiotic bacteria were identified and trialled in a GSM larval rearing hatchery. Sequencing of the 16S rRNA gene and phylogenetic analysis identified the strains as *Alteromonas macleodii* 0444 and *Neptunomonas* sp. 0536. Both probiotics were evaluated separately at the Glenhaven Aquaculture Centre hatchery facility during routine larval rearing and when the larvae were challenged with both a high (10^7 and 10^6 CFU ml⁻¹) and low (10^6 and 10^5 CFU ml⁻¹) pathogenic dose of *Vibrio* sp. DO1 and *V. splendidus* respectively. In all experiments, probiotic application improved larval survival significantly when administered prior to pathogen exposure. Across all experiments, larvae that were exposed to the high and low dosages of pathogens averaged 14% and 36% survival respectively on the fourth day following pathogen exposure. The administration of probiotics prior to pathogen challenge resulted in larval survival of 50% and 66% respectively. Non-inoculated control larvae and larvae administered the probiotic alone demonstrated 67% and 79% survival respectively. *Neptunomonas* sp. 0536 appeared to suppress naturally occurring vibrios in the culture environment of healthy GSM larvae. This is the first report of *A. macleodii* and *Neptunomonas* sp. as probiotic bacteria in a large scale production facility.

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EFFECTS OF PHOTOPERIOD, TEMPERATURE, AND SALINITY ON GROWTH AND SURVIVAL OF OBSCURE PUFFER *TAKIFUGU OBSCURUS* LARVAE

Yonghai Shi, Genyu Zhang, Yazhu Zhu, Jianzhong Liu-2010

Aquaculture 309(1-4): 103-108

Abstract:

The effects of photoperiod, temperature, and salinity on growth and survival of obscure puffer *Takifugu obscurus* larvae were determined from 3 to 19 days after hatching (dah). The results showed that the optimal photoperiod for obscure puffer larvae was under continuous light conditions (24 h light:0 h dark). Increasing daylength resulted in improved larval growth and survival. Larvae cultured under total darkness grew very slowly and even negatively, and all died within 12 days (15 dah). The optimal and

critical high temperatures for obscure puffer larvae were at 22–23 and 32 °C, respectively. The specific growth rates (SGR) of obscure puffer larvae increased with an increase in temperature from 20 to 29 °C, while no corresponding increase in SGR was observed for temperatures from 29 to 32 °C. Larval survival rate significantly decreased when the temperature increased from 23 to 32 °C, and there was a tendency for a low survival rate at 20 °C. A high salinity (25‰) resulted in reduced larval growth and survival probabilities. The highest survival and specific growth rates were both predicted to occur at 8‰ to 10‰ based on quadratic equations. High SGR (5.71–6.14% d⁻¹) and survival rates (> 90%) were found within a wide salinity range (0–20‰). The optimal and suitable salinity ranges of larviculture were 8–10‰ and 0–20‰, respectively. Therefore, obscure puffer larvae can feasibly be cultured in brackish water (0–20‰) existing in majority of coastal areas.

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EFFECTS OF DIFFERENT DIETARY MICROALGAE ON SURVIVAL, GROWTH, SETTLEMENT AND FATTY ACID COMPOSITION OF BLUE MUSSEL (*MYTILUS GALLOPROVINCIALIS*) LARVAE

Amanda K. Pettersen, Giovanni M. Turchini, Samad Jahangard, Brett A. Ingram, Craig D.H. Sherman-2010

Aquaculture 309(1-4): 115-124

Abstract:

The diatom *Chaetoceros calcitrans* is a major component of many bivalve hatcheries, yet it is expensive and notoriously difficult to culture on a commercial scale. In an attempt to reduce dependence on the diatom *C. calcitrans*, mussel larvae (*Mytilus galloprovincialis*) were subjected to feeding experiments which altered levels of the diatom under controlled hatchery conditions. Growth, survival and settlement success of mussel larvae were determined in response to five mixed algal diets in which the relative contributions of *C. calcitrans* was varied over the experimental period (30 days). Fatty acid profiles of the larvae and algal diets were also assessed. The exclusion of *C. calcitrans* from the diet had no significant differences on larval growth and only minor differences in total fatty acid content were found between treatments. Fatty acid analysis revealed that larval survival was strongly influenced by the proportions of dietary docosahexaenoic acid (DHA), while settlement was positively correlated with higher ratios of the n-3 long-chained polyunsaturated fatty acid (n-3 LC-PUFA) (namely, DHA and eicosapentaenoic acid, EPA), to the n-6 LC-PUFA (arachidonic acid, ARA). Despite similar relative and absolute n-3 LC-PUFA levels in the larvae under different dietary treatments, the larvae receiving high levels of *C. calcitrans* performed significantly better in terms of survival and settlement success. These results indicate that the (DHA + EPA)/ARA ratio is a key factor in determining larval performance, rather than the total amount of these fatty acids.

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DIETARY TAURINE SUPPLEMENTATION ENHANCES METAMORPHOSIS AND GROWTH POTENTIAL OF *SOLEA SENEGALENSIS* LARVAE

Wilson Pinto, Luís Figueira, Laura Ribeiro, Manuel Yúfera, Maria Teresa Dinis, Cláudia Aragão-2010

Aquaculture 309(1-4): 159-164

Abstract:

The effect of dietary taurine supplementation on growth performance, metamorphosis success and amino acid metabolism of Senegalese sole (*Solea senegalensis*) larvae was investigated. These parameters were assessed in larvae fed control and taurine supplemented microcapsules during the pelagic phase. Subsequently, a similar evaluation was carried out in newly settled larvae fed upon *Artemia*, in order to verify the effect of earlier dietary taurine supplementation in larvae reared under improved feeding conditions. Results showed that dietary taurine supplementation did not affect larval growth performance and metamorphosis during the pelagic phase. However, by the end of the trial, Senegalese sole previously fed taurine supplemented microcapsules had a significantly higher growth performance and metamorphosis completion success than larvae fed control microcapsules. These

differences were likely related to the improvement of feeding conditions upon settlement, which probably helped revealing the positive effects of earlier dietary taurine supplementation on Senegalese sole performance. Additionally, Senegalese sole may have benefited from taurine antioxidant properties during metamorphosis, since larval antioxidant defences may saturate at this stage. Furthermore, results from metabolic trials have shown that dietary taurine supplementation significantly increased amino acid retention in Senegalese sole larvae when a concomitant increase of taurine body levels was found. Therefore, an increase in larval growth potential and metamorphosis success was observed under dietary taurine supplementation and these results may help understanding why dietary taurine supplementation has been reported to simultaneously increase taurine body levels and growth performance in other fish species, leading to a better comprehension on the role of taurine during fish development.

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LIPID REQUIREMENTS OF THE SCALLOP PECTEN MAXIMUS (L.) DURING LARVAL AND POST-LARVAL DEVELOPMENT IN RELATION TO ADDITION OF RHODOMONAS SALINA IN DIET

Renée Gagné, Réjean Tremblay, Fabrice Pernet, Philippe Miner, Jean-François Samain, Frédéric Olivier-2010

Aquaculture 309(1-4): 212-221

Abstract:

The main objective of this study was to evaluate the effect of the addition of *Rhodomonas salina* in the diet of *Pecten maximus* on growth, survival and metamorphosis success in relation to biochemical content. Food quality is an essential factor in the success of larval, post-larval and juvenile development. A diet rich in polyunsaturated fatty acids present an advantage for growth, survival and metamorphosis success. Larvae and post-larvae fed with the diet containing *R. salina* showed a higher accumulation of arachidonic acid (20:4n-6) and generally a lower concentration of docosahexaenoic acid (22:6n-3). Addition of *R. salina* in diet was related with higher level of eicosapentaenoic acid (20:5n-3) in larval stages, but lower level in post-larvae. Addition of *R. salina* seemed to be advantageous during larval stages by a higher accumulation of triacylglycerol associated with an earlier appearance of metamorphosis. The composition of sterol observed in larvae fed with an addition of *R. salina* showed a high level of brassicasterol. Advantage of the preferential accumulation of brassicasterol with the addition of *R. salina* is not clear but other studies suggest that brassicasterol can replace cholesterol in some functions. Our results suggest that addition of *R. salina* at larval stages could be advantageous in the aquaculture hatchery by a more rapid passage of *P. maximus* in the nursery.

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EFFECT OF ELEVATED WINTER-SPRING WATER TEMPERATURE ON SEXUAL MATURATION IN PHOTOPERIOD MANIPULATED STOCKS OF RAINBOW TROUT (*ONCORHYNCHUS MYKISS*)

Ryan J. Wilkinson, Ryan Longland, Hannah Woolcott, Mark J.R. Porter-2010

Aquaculture 309(1-4): 236-244

Abstract:

The use of artificial lighting on salmonids has successfully reduced levels of early sexual maturation, however variable results between seasons have been observed. Therefore, this work investigated the impact of photoperiod and winter-spring water temperature on maturation in populations of female rainbow trout. Fish were maintained in tanks (from April 2006 to May 2007) under two photoperiod regimes—(1) simulated natural annual photoperiod cycle (41°S) and (2) approximately 5 week advanced annual photoperiod cycle. Two temperature treatments were also employed—(1) simulated natural annual temperature cycle (8–18 °C) and (2) simulated natural annual temperature cycle with elevated mean winter-spring water temperatures (maximum 5 °C elevation). In photoperiod advanced

fish, elevated water temperature resulted in a significant increase in maturation rate ($39.8 \pm 3.3\%$ and $17.5 \pm 5.3\%$ for the elevated temperature and natural temperature group, respectively). Maturation rates in fish held under natural photoperiod conditions were significantly higher irrespective of water temperature ($79.4 \pm 6.6\%$ and $73.3 \pm 0.1\%$ for the elevated temperature and natural temperature group, respectively). In addition, gonadosomatic index was significantly higher in photoperiod advanced fish, irrespective of water temperature, at the conclusion of the experiment, with 32% of these fish undergoing ovulation and significantly reduced plasma levels of 17 β -estradiol just prior to ovulation. Significantly greater wet weight, condition factor, specific growth rate and plasma insulin-like growth factor-I were measured in PIT-tagged fish which went on to mature at the conclusion of the experiment compared to those which remained immature. This study demonstrates that elevated winter–spring water temperature results in increased rates of maturation in photoperiod-manipulated stocks of rainbow trout and has important implications for application of artificial lighting on commercial farms which may experience variation in water temperature from year to year.

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SHORT COMMUNICATION

SPERM–EGG INCOMPATIBILITY IN INTER-SPECIFIC INSEMINATIONS OF *PENAEUS (LITOPENAEUS) OCCIDENTALIS*, *P. (LITOPENAEUS) STYLIROSTRIS* AND *P. (LITOPENAEUS) VANNAMEI*

Karol Ulate, Jorge Alfaro-Montoya-2010

Aquaculture 309(1-4): 290-292

Abstract:

Artificial inseminations using sperm masses were applied to intra-specific crosses of *Penaeus (Litopenaeus) occidentalis*, as validation of the technique. Reciprocal, inter-specific crosses of *P. occidentalis* and *P. (Litopenaeus) stylirostris* were performed; complementary, inseminations of both species were also accomplished with sperm masses of *P. (Litopenaeus) vannamei*. Intra-specific inseminations generated viable spawns with 54.2% of normal embryos; on the contrary, inter-specific spawns were all unfertile, with a high rate of eggs showing abnormal intracellular corpuscles. Based on recent discoveries about sperm maturation/capacitation, a new approach to study inter-specific sperm–egg compatibility in the sub-genus *Litopenaeus* is discussed.

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SHORT COMMUNICATION

SPERMATOZOA OF SHARPSNOUT SEA BREAM (*DIPLODUS PUNTAZZO*) AND EUROPEAN SEA BASS (*DICENTRARCHUS LABRAX*) EXPRESS OPIOID RECEPTORS

G. Aiudi, F.A. Bucci, A. De Sandro Salvati, A.C. Guaricci, M. Albrizio-2010

Aquaculture 309(1-4) : 293-296

Abstract:

Endogenous opioid peptides (EOP) are molecules affecting many biological functions influencing productive and reproductive performance. They increase in stress conditions and interact with specific opioidergic receptors (OR): delta, kappa and mu. Several studies in other animal species suggest that they can also affect sperm cell motility. In fish the ionic external environment modulates the increase of intracellular calcium ion that is required to activate sperm motility after spawning. In mammals OR are functionally associated to calcium channels and in fishes calcium is highly required for fish sperm activation.

In this study the presence of OR on spermatozoa of two Perciform fish, the sharpsnout seabream (*Diplodus puntazzo*, family *Sparidae*) and the European sea bass (*Dicentrarchus labrax*, family *Moronidae*) was investigated; the two species were chosen for their importance in Mediterranean aquaculture. The analysis by indirect immunofluorescence evidenced the presence of OR on sperm cells of these fishes. Delta, kappa and mu opioid receptors appeared differently localized on the surface of

the sperm cells of sharpsnout seabream and European sea bass. Opioidergic receptors on fish spermatozoa could be a new target for reducing stress associated to captivity reproduction in fish farms by EOP antagonists.

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SPAWNING FREQUENCY OF BROOD DAMS AND SIRES IN A MARINE FISH STOCK-ENHANCEMENT HATCHERY

J. R. Gold, M. A. Renshaw, E. Saillant, R. R. Vega-2010

Journal of Fish Biology 77(4): 1030–1040

Abstract:

Parentage analysis, employing five hypervariable microsatellite markers, was used to follow spawning patterns of red drum *Sciaenops ocellatus* broodfish in two spawning tanks through most of a calendar year in a marine fish hatchery dedicated to stock enhancement. Five of six dams and all four sires spawned at least once during the year. Variation in dam and sire spawning incidence and in number of progeny produced per dam and per sire translated into reduced genetic effective size (N_e) per spawn by 40·6% in one tank and 50·8% in the other.

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PROVIDING A COMMON DIET TO DIFFERENT MARINE DECAPODS DOES NOT STANDARDIZE THE FATTY ACID PROFILES OF THEIR LARVAE: A WARNING SIGN FOR EXPERIMENTATION USING INVERTEBRATE LARVAE PRODUCED IN CAPTIVITY

Ricardo Calado, Tânia Pimentel, Daniel F. R. Cleary, Gisela Dionísio, Cristóvão Nunes, Teresa Lopes da Silva, Maria Teresa Dinis, Alberto Reis-2010

Marine Biology 157(11): 2427-2434

Abstract:

Larval decapods are commonly produced in captivity and employed in experiments to evaluate interspecific physiological and biochemical differences. Currently, it is still unknown if different decapod species provided a common diet and exposed to identical abiotic conditions produce newly hatched larvae (NHL) with similar fatty acid (FA) profiles. This study analyzed the FA composition of NHL from five marine shrimp species (*Lysmata amboinensis*, *L. boggei*, *L. debelius*, *L. seticaudata* and *Rhynchocinetes durbanensis*) fed a common diet and stocked at constant temperature. FA profiles of NHL differed significantly within and among genera. NHL from species unable to molt from zoea I to zoea II in the absence of food (*L. amboinensis*, *L. debelius* and *R. durbanensis*) displayed the lowest FA contents. Researchers must be aware that providing a common diet to different species, even if closely related, may not standardize the FA profile of NHL produced in captivity.

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COMPARING THE EFFECT OF ELEVATED PCO₂ AND TEMPERATURE ON THE FERTILIZATION AND EARLY DEVELOPMENT OF TWO SPECIES OF OYSTERS

Laura M. Parker, Pauline M. Ross, Wayne A. O'Connor-2010

Marine Biology 157(11) 2435-2452

Abstract:

This study compared the synergistic effects of elevated pCO₂ and temperature on the early life history stages of two ecologically and economically important oysters: the Sydney rock oyster, *Saccostrea glomerata* and the Pacific oyster, *Crassostrea gigas*. Gametes, embryos, larvae and spat were exposed to four pCO₂ (375, 600, 750, 1,000 µatm) and four temperature (18, 22, 26, 30°C) levels. At elevated pCO₂ and suboptimal temperatures, there was a reduction in the fertilization success of gametes, a reduction in the development of embryos and size of larvae and spat and an increase in abnormal

morphology of larvae. These effects varied between species and fertilization treatments with *S. glomerata* having greater sensitivity than *C. gigas*. In the absence of adaptation, *C. gigas* may become the more dominant species along the south-eastern coast of Australia, recruiting into estuaries currently dominated by the native *S. glomerata*.

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MORPHOLOGICAL DEVELOPMENT, ORGANOGENESIS AND SOMATIC GROWTH OF HATCHERY-REARED NIGOROBUNA CARASSIUS AURATUS GRANDOCULIS

Koh-Ichi Fujiwara-2010

Nippon Suisan Gakkaishi 76 (5) : 894-904

Abstract :

The morphological development, organogenesis and somatic growth of hatchery-reared *nigorobuna Carassius auratus grandoculis* from newly-hatched larvae to early stage of juveniles were investigated in order to obtain basic data for determining the effective size at release for the stock enhancement program in Lake Biwa. As a result, generally the completion of the fin rays, scales and skeleton, and rapid development of the skeletal muscles and organs for digestion, respiration, circulation, hematogenesis, excretion and sensory perception were observed at the juvenile stage of approximately 16 mm in standard length (SL), leading to an improved ability to survive under natural environmental conditions. It was concluded that this developmental stage (ca. 16 mm SL) is a criterion for determining the effective size at release.

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A REVIEW ON THE POTENTIAL OF TRIPLOID TENCH FOR AQUACULTURE

Martin Flajšhans, David Gela, Martin Kocour, Hana Buchtová, Marek Rodina, Martin Pšenička, Vojtěch Kašpar, Veronika Piačková, Eliška Sudová, Otomar Linhart, H. Buchtova -2010

Reviews in Fish Biology and Fisheries 20(3): 317-329

Abstract:

Performance and physiological traits and health of spontaneous and induced triploid tench are reviewed. Triploidy is best induced with cold shock; with triploids exhibiting 13.5–51.5% better weight gain, 2.69–3.94% higher slaughtering value, 20–60% lower gonadosomatic index, 0.9–4.5% higher dry matter in flesh and up to 107% more flesh fat than diploids, if farmed until post sexual maturity. Triploids exhibit more abdominal fat and less polyunsaturated fatty acids of the n-3 and n-6 groups in the flesh. Triploid females are sterile, while triploid males may produce aneuploid spermatozoa with varying DNA content (1–1.9n) which may initiate development of embryos. Triploids have milder seasonal dynamics in their erythrocyte profile than the diploids. Thinner diffusion distance in gills of triploids than in diploids is interpreted as adaptation to lower aerobic capacity. Triploids show neither stronger tendencies to anatomic malformations, nor have bigger affinity to parasitic diseases than the diploids. Production of triploid tench could be an economically interesting method of farming to higher marketable weight, bringing a relatively high product quality.

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THE EFFECT OF TANNIN CONCENTRATION AND EGG UNSTICKING TIME ON THE HATCHING SUCCESS OF TENCH TINCA TINCA (L.) LARVAE

Roman Kujawa, Dariusz Kucharczyk, Andrzej Mamcarz-2010

Reviews in Fish Biology and Fisheries 20(3): 339-343

Abstract:

The influence of dose and time of eggs exposure in tannin solution on tench embryonic development, survival of embryos and percentage of larvae hatched were studied. The eggs obtained under controlled conditions from 11 tench females were fertilized with semen from 7 males and then rinsed for 1 h in

Woynarovich solution (40 g urea, 30 g NaCl per 10 dm³ of water). Random samples (50 cm³) of the fertilised eggs were placed into three tannin solutions 0.05, 0.1 or 0.15% for 30, 60 or 90 s, then they were transferred to Weiss jars where incubation at 25°C took place. Tannin solution of 0.05% for 30–90 s or 0.1% for 30 s allowed effective unsticking of eggs and resulted in a very high per cent of hatched larvae. Extending the eggs rinsing time to 60 s in 0.10 and 0.15% solutions resulted in a high mortality of embryos during hatching because of hardened egg capsule.

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TOXICITY OF DIAZINON 60 EC FOR EMBRYOS AND LARVAE OF TENCH, *TINCA TINCA* (L.)

Jana Máchová, Miroslav Prokeš, Milan Peňáz, Vlastimil Baruš, Hana Kroupová-2010

Reviews in Fish Biology and Fisheries 20(3): 409-415

Abstract:

The effects of Diazinon 60 EC (organophosphate insecticide, active substance diazinon) on mortality, growth rate, early ontogenetic rate, and occurrence of malformations was studied in embryos and larvae of tench, *Tinca tinca* (L.). The exposure of fish to 0, 10, 100, 1,000, and 3,000 µg dm⁻³ of Diazinon 60 EC was initiated 24 h after fertilization of eggs and concluded 32 days later. At the highest concentration tested (3,000 µg dm⁻³), total mortality was observed within the first 15 days of exposure. A concentration of 1,000 µg dm⁻³ caused high incidence of malformations, decrease in growth rate and ontogenetic development slowed down. A concentration of 100 µg dm⁻³ mildly decreased growth rate, but at 10 µg dm³ no changes compared to the control were observed. Thus, Diazinon 60 EC at the concentration of 10 µg dm⁻³ is not dangerous for the embryos and larvae of tench.

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CADMIUM AND COPPER TOXICITY TO TENCH *TINCA TINCA* (L.) LARVAE AFTER A SHORT-TERM EXPOSURE

Justyna Sikorska, Jacek Wolnicki-2010

Reviews in Fish Biology and Fisheries 20(3): 417-423

Abstract:

At the onset of swimbladder inflation, *Tinca tinca* larvae were exposed for 24 h to cadmium or copper at 0.0 (control concentration), 0.1, 0.2 and 0.3 mg dm⁻³ at 22°C. From then larvae were reared at 25°C for 9 days in un-supplemented water. Both metals resulted in a significantly reduced growth, survival, and retarded swimbladder inflation in a dose-response manner. The highest Cd and Cu concentration delayed the onset of exogenous feeding (live artemia nauplii) for 2 or 1 days, respectively, comparing to the control concentration. Our results demonstrate a highly toxic effect of Cd and Cu in the studied period of larval ontogeny, when fish seem especially sensitive. Although, at low concentrations and long exposure period, Cu is considered more toxic to fish than Cd, our study revealed the reverse effect for first-feeding larvae of both metals at high concentrations and short exposure.

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