

COMBINED EFFECTS OF DIET AND STOCKING DENSITY ON GROWTH AND BIOCHEMICAL COMPOSITION OF SPAT OF THE CORTEZ OYSTER *CRASSOSTREA CORTEZIENSIS* AT THE HATCHERY

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Aquaculture 284(1-4): 98-105

Abstract:

The interactive effects of diet and stocking density on growth and biochemical composition of hatchery-reared *Crassostrea corteziensis* spat were investigated. Specimens were maintained for 21 days in upwelling chambers with continuous flow-through of seawater containing feed. The diets were: (1) A 1:1 combination of the microalgae *Isochrysis galbana* and *Chaetoceros mulleri*, (2) A 50/50 mixture of the two microalgae and cornstarch, and (3) A 50/50 mixture of the two microalgae and wheat flour. Experimental densities of specimens per upwelling cylinder were: low (5714), medium (11,428), and high (17,142). Changes in growth of spat (shell height, total wet weight, and total volume) and biochemical composition of the meat (carbohydrates, proteins, and lipids) were measured. The diet of microalgae (firstly) and microalgae with cornstarch (secondly) led to faster growth of spat under low stocking density conditions. In contrast, spat grew significantly less in shell height, wet weight, and total volume at medium and high density when fed the microalgae/wheat flour diet. Highest protein, carbohydrate, and lipid content occurred with the diet containing only microalgae, regardless of density. Glycogen content did not vary significantly between diets 1 and 2. Our results confirm that microalgae continue to be the main food source for meeting nutritional needs of *C. corteziensis* spat. However, it is feasible to replace microalgae by < 50% with some smaller proportion of cornstarch without significantly affecting the nutritional balance of the diet or the biochemical composition of spat.

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EVALUATION OF WAX SPRAY BEADS FOR DELIVERY OF LOW-MOLECULAR WEIGHT, WATER-SOLUBLE NUTRIENTS AND ANTIBIOTICS TO ARTEMIA

C. Langdon, A. Nordgreen, M. Hawkyard, K. Hamre-2008

Aquaculture 284(1-4): 151-158

Abstract:

Culture of the early larval stages of many marine fish species is often characterized by high larval mortality and poor growth. Comparison of the nutritional composition of cultured live prey, such as species of rotifers and *Artemia*, with that of "natural" prey species, such as copepods, indicates possible deficiencies in essential micronutrients that could explain the poor performance of larvae fed on these cultured foods. Enrichment of live prey species by feeding them on artificial diets is difficult due to high leakage losses from microparticles in aqueous suspension. In this study, wax spray beads (WSB) consisting of bees wax, with or without a 5% w/w extract of a synthetic marine phospholipid (mPHL), were evaluated for their potential for delivery of water-soluble micronutrients and the antibiotic oxytetracycline (OTC) to *Artemia*. The micronutrient mix consisted of amino acids, vitamins and trace minerals and was based on the nutritional composition of copepods. Leaching experiments indicated that nitrogen (N) retention of WSB containing the micronutrient mix rapidly declined in the first 5 to 10 min of suspension in seawater; however, subsequent N losses over a 2 h period occurred at much lower rates, resulting in overall N retention efficiencies of 44% and 24% for WSB prepared with either 100% wax or 95% wax/5% mPHL, respectively. Substantial losses of labile micronutrients, such as vitamin A, vitamin E, astaxanthin, selenium, vitamin C and thiamin, occurred during WSB preparation. Furthermore, production of peroxidation products and losses of astaxanthin were greater with beads containing 5% mPHL compared with beads prepared with 100% bees wax. *Artemia* ingested and broke down riboflavin-containing WSB prepared with 100% bees wax and liberated riboflavin was observed in their digestive systems. *Artemia* fed OTC-containing WSB prepared with 100% bees wax retained OTC after purging their guts of ingested WSB. WSB

may be useful in delivering water-soluble substances to *Artemia* as well as other marine suspension feeders capable of breaking down these beads by mechanical or enzymatic processes. The advantage of using wax as the lipid carrier, compared with phospholipid and triacylglycerol lipid types, is that it is relatively inert and will less likely react with incorporated materials to produce peroxides or result in excessive contributions to the lipid nutrition of the target organism.

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EFFECT OF LYSINE AND TYROSINE SUPPLEMENTATION IN THE AMINO ACID METABOLISM OF *DIPLodus SARGUS* LARVAE FED ROTIFERS

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Aquaculture 284(1-4): 180-184

Abstract:

Dietary amino acid imbalances are likely to happen when fish larvae are fed live food. This can lead to reduced growth as well as decreased larval quality. The tube-feeding technique can be used to assess the effect of free amino acid supplementation at short term and determine whether a given amino acid is deficient in the diet. In this study supplementation of lysine and tyrosine were tested in *Diplodus sargus* larvae fed rotifers in order to determine its effect on the metabolism of these amino acids. Supplementation was done using rotifers enriched with liposomes boosted with free amino acids. Single crystalline ¹⁴C amino acids as well as a mixture of ¹⁴C amino acids were used as tracers to compare results of individual amino acid metabolism with the average of all amino acids. The results showed low absorption efficiencies for both tyrosine and lysine when compared to the average of all amino acids. A lower relative ¹⁴C retention was found when *D. sargus* larvae were fed tyrosine enriched rotifers and tube-fed ¹⁴C tyrosine, indicating that tyrosine was not a limiting amino acid. On the other hand, lysine supplementation had a similar retention percentage in the treatments with and without lysine supplementation. Based on the tube-feeding studies with lysine and tyrosine supplemented rotifers neither lysine nor tyrosine affected protein synthesis in a way to indicate that these amino acids are insufficient in *D. sargus* larvae fed rotifers.

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ROTIFERS ENRICHED WITH IODINE AND SELENIUM INCREASE SURVIVAL IN ATLANTIC COD (*GADUS MORHUA*) LARVAE

Kristin Hamre, Ted A. Mollan, Øystein Sæle, Børre Erstad-2008

Aquaculture 284(1-4): 190-195

Abstract:

In the present study, rotifers were enriched with iodine and selenium up to the levels found in the most abundant organisms in the natural diet of fish larvae, i.e. copepods. Cod larvae fed iodine and selenium enriched rotifers had slightly lower growth than control larvae, but the survival increased by 32%. There was an increase in selenium concentration, but not in iodine concentration, in the larvae in response to feeding the selenium and iodine enriched rotifers. The glutathione peroxidase (GPx) activity in the larvae was not significantly different between the groups, but an insignificant trend of increase of 19% was observed ($P = 0.11$). Outer ring deiodinase (ORD) activity was not affected by the treatments. An increase in thyroid hormones was indicated but not statistically proved. In conclusion, it is recommended to enrich rotifers used for marine fish larval culture with iodine and selenium. The data are too weak to conclude whether iodine, selenium or both were deficient in the control rotifers used in the present study.

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THE USE OF THE MEDITERRANEAN CALANOID COPEPOD *CENTROPAGES TYPICUS* IN YELLOWTAIL CLOWNFISH (*AMPHIPRION CLARKII*) LARVICULTURE

I. Olivotto, I. Buttino, M. Borroni, C.C. Piccinetti, M.G. Malzone, O. Carnevali-2008
Aquaculture 284(1-4): 211-216

Abstract:

In the present study we demonstrated the efficiency of the Mediterranean calanoid copepod *Centropages typicus* as live prey in *Amphiprion clarkii* larviculture. After hatching, larvae were divided into two experimental groups as follows: group A (control) fed rotifers followed by *Artemia* nauplii and group B fed *C. typicus* nauplii and copepodites. On day 11 post-hatch, larvae fed *C. typicus* showed better survival and growth compared to those fed a standard rotifer/*Artemia* diet (90 ± 2 vs $43 \pm 2\%$; 6.6 ± 0.2 vs 6.0 ± 0.2 mm; 5.8 ± 0.3 vs 4.5 ± 0.3 mg, respectively). At a molecular level, a significant increase of insulin-like growth factors I and II (IGF I and IGF II) gene expression and a significant decrease of myostatin (MSTN) gene expression were evidenced in group B larvae fed copepods. Considering these results, *C. typicus* may be recommended as a valuable life prey for *A. clarkii* larviculture.

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CRYOPRESERVATION OF SPOTTED HALIBUT (*VERASPER VARIEGATUS*) SPERM

Y.S. Tian, S.L. Chen, X.S. Ji, J.M. Zhai, L.J. Sun, C. Chen, P.Z. Su-2008

Aquaculture 284(1-4): 268-271

Abstract:

Spotted halibut (*Verasper variegatus*) is now regarded as being endangered in China because of its continuous decline in the last three decades. Preservation and protection of its genetic resources were demanded in order to protect this rare fish species. In this project, cryopreservation technique for sperm of spotted halibut was developed. The effects of various extenders and cryoprotectants on motility of frozen–thawed sperm were examined. The motility of frozen–thawed sperm in TS-2 was higher than that in ASW and MPRS ($p < 0.05$) and was not significantly different from that of fresh sperm ($p > 0.05$). While the motility of frozen–thawed sperm cryopreserved with 13.3% EG (ethylene glycol), 13.3% glycerol, 13.3% MeOH (methanol) and 13.3% DMF (dimethylformamide) was less than 5%, no significant differences were observed in the motility between fresh sperm and frozen–thawed sperm cryopreserved with 13.3% DMSO (dimethyl sulfoxide), 13.3% PG (propylene glycol) ($p > 0.05$). Using the above method, we cryopreserved spotted halibut semen with extender TS-2 and 13.3% DMSO or 13.3% PG. As a result, the fertilization rate ($34.52 \pm 10.92\%$) and hatching rate ($23.53 \pm 11.80\%$) of frozen–thawed sperm were not significantly different from that of fresh sperm ($p > 0.05$). Motility and time delay in the activation of frozen–thawed sperm activated by artificial seawater at different salinity were different. Low salinity (low osmolality) could delay the activation of frozen–thawed sperm. The highest motility was observed with artificial seawater of 30‰ ($p < 0.05$). The most suitable temperature of seawater to activate spotted halibut frozen sperm was determined to be 18 °C ($p < 0.05$). However, temperature of seawater has no significant effect on time delay in the activation of frozen–thawed sperm ($p > 0.05$).

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HATCHERY BROODSTOCK CONDITIONING OF THE BLUE MUSSEL *MYTILUS EDULIS* (LINNAEUS, 1758). PART II. NEW FORMULATED FEEDS OFFER NEW PERSPECTIVES TO COMMERCIAL HATCHERIES

Nancy Marie Nevejan, Anna Elisabeth Pronker, Frank Peene-2008

Aquaculture International 16(6): 483-495

Abstract:

Five diets were compared for their efficiency at maturing the gonads of the blue mussel, *Mytilus edulis*. The diets consisted of a 1:1:1 mixture of *Isochrysis galbana* (T-Iso), *Pavlova lutheri*, and *Chaetoceros calcitrans* given at concentrations of 2.4×10^{11} cells day⁻¹ for the positive control treatment (PF) and 3.0×10^{10} cells day⁻¹ (=1/8) for the negative control treatment (NF). The other

three treatments, MB10+, MyStock+, and Frippak+, consisted of the NF diet supplemented with one of the micro-encapsulated diets MB10 (mixture of dried algae), MyStock (formulated diet), and FRiPPAK® Fresh #1 CAR (larval shrimp diet) at a level of 0.2% of the live weight (LW). Treatments PF, MB10+, and MyStock+ led to high percentages of spawning animals (80, 78, and 85%, respectively) and large numbers of eggs (on average 3.0×10^6 eggs female⁻¹). Females given the NF and Frippak+ treatments produced only half the number of eggs per female, and only 17 and 6%, respectively, of the animals spawned. A high hatching rate was observed for all treatments, 71% for the pure algae diets PF and NF and more than 80% for the micro-encapsulated diets. The larvae resulting from the NF treatment were smaller, with 41% of D-larvae measuring less than 90 µm, whereas with the other treatments only 5–11% belonged to that size category. The four most important fatty acids found in mussel eggs were 16:0, 16:1(n-7), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA); these represented at least 50% of the fatty acids in all treatments. The high DHA content of MB10 and MyStock was not reflected in the fatty acid composition of the eggs whereas the high concentration of linoleic acid in MyStock was. To our knowledge, this is the first time that mussels are successfully conditioned with formulated feeds.

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TRANSPOSITIONAL FEEDING RHYTHM OF LOACH MISGURNUS ANGUILLICAUDATUS FROM LARVAE TO JUVENILES AND ITS ONTOGENESIS UNDER ARTIFICIAL REARING CONDITIONS

Youji Wang, Menghong Hu, Weimin Wang, Ling Cao, Yi Yang, Biping Lü, Rongrong Yao-2008
Journal Aquaculture International 16(6): 539-549

Abstract:

The diel feeding rhythm and ontogenesis during early life stage of loach *Misgurnus anguillicaudatus* were investigated under experimental conditions (light: L 06:00–18:00, D 18:00–06:00 h). Morphological and behavioral developments of loach from newly hatched to 40 days after hatching were observed. Larvae were able to prey on daphnia 3–4 days after hatching at $23 \pm 0.5^\circ\text{C}$. As the larvae grew, they showed an increasing feeding capacity and a distinct feeding rhythm. Feeding intensity and incidence for day-4 larvae were highest at 10:00 and 16:00 h. The highest levels of feeding intensity for day-12 larvae occurred at 08:00, 12:00, and 18:00 h as did feeding incidence. By day 20, when the larvae metamorphosed, the highest levels of feeding intensity occurred at 06:00, 18:00, and 24:00 h and were concurrent with the highest feeding incidence. After metamorphosis, feeding capacity had again increased considerably and, in contrast to the earlier stages before day 20, feeding intensity for day-30 juveniles peaked at 05:00 and 20:00 h, about 1–2 h after the maximum feeding incidence. The feeding rhythm of loach juveniles at day 40 was almost the same as the day-30 juveniles. The estimated maximum daily feeding rates were 43.1%, 33.4%, 19.0%, 12.8%, and 5.8% of body weight on days 4, 12, 20, 30, and 40, respectively. Thus, loach was found to have different feeding rhythms in the pre- and post-metamorphosis stages, with the highest feeding activity in daytime during the larval planktonic stage before metamorphosis, and intensely nocturnal feeding behavior during the juvenile benthic stage after metamorphosis.

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SUITABLE METHODS FOR CRYOPRESERVATION OF SEMEN FROM ATLANTIC HALIBUT, HIPPOGLOSSUS HIPPOGLOSSUS L.

Igor Babiak, Sylvie Bolla, Oddvar Ottesen-2008
Journal Aquaculture International 16(6): 561-572

Abstract:

Decrease in the quality and quantity of Atlantic halibut, *Hippoglossus hippoglossus* L., semen towards the end of the reproductive season hampers production of good-quality embryos. Therefore, cryopreservation of spermatozoa is a method showing potential to facilitate controlled reproduction in

Atlantic halibut. The present study aimed at establishing the appropriate cryopreservation procedure. We tested 20 extenders composed of four various diluents and five cryoprotectants (DMSO, DMA, methanol, propylene glycol, and glycerol) to determine the best extender. Then, we examined cryopreservation quality using various methods of loading and various volumes of cryopreserved samples. In most of the tested variants, sperm diluted with an extender showed high motility after 24-h incubation despite the high osmotic pressure of the extender. Modified turbot extender (MTE) was the best of the tested diluents, securing the highest post-thaw motility ($P < 0.05$), and DMSO, DMA, and methanol were the best cryoprotectants ($P < 0.05$). There was no significant effect of 15-min equilibration of semen in MTE-based extenders prior to freezing on post-thaw motility ($P > 0.05$). MTE-based extender was chosen as the most suitable. Semen cryopreserved in straws, Eppendorfs or Ziploc bags in volumes ranging from 0.25 to 20 ml showed similar high fertilization ability. Survival of larvae produced with the cryopreserved sperm did not differ from controls produced with freshly collected sperm. Motility 3 h after thawing was high but depended on the type of cryoprotectant and the volume of cryopreserved sperm ($P < 0.05$). The developed cryopreservation procedure has been applied at our Atlantic halibut breeding station for seed production.

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UNDERSTANDING COMMUNITY PERCEPTIONS OF AQUACULTURE: LESSONS FROM AUSTRALIA

Nicole A. Mazur, Allan L. Curtis-2008

Journal Aquaculture International 16(6): 601-621

Abstract:

Aquaculture is a growing and high-value industry that depends on access to and wise use of shared inland, coastal and marine resources. Varied stakeholders and communities are very interested in these public resources, and there has been conflict about how the aquaculture industry uses them. Prior to the research discussed in this article, there have been few large-scale studies of community perceptions of aquaculture. Our research drew upon an extensive literature review, stakeholder interviews and a survey mailed to the public in two regional case studies in Australia: the Eyre Peninsula in the state of South Australia and Port Phillip Bay in the state of Victoria. The data revealed some public support for aquaculture's socioeconomic benefits and strong interest in minimizing the risk of its environmental impacts. There were mixed opinions about the trustworthiness of governments' aquaculture decisions and actions. Some industry sectors attracted greater trust and lower perceived environmental risks. The importance and credibility of different information sources varied. There was strong support for improved dialogue among governments, the aquaculture industry and communities. Key differences between the regions included levels of awareness of and knowledge about aquaculture. Our research is consistent with literature on risk communication and perception that suggests that conflict and subsequent costs to industry and the community can be overcome or mitigated if government and industry understand, acknowledge and respond to community perceptions of the industry.

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INDUCTION OF DIPLOID GYNOGENESIS IN TURBOT SCOPHTHALMUS MAXIMUS WITH LEFT-EYED FLOUNDER PARALICHTHYS OLIVACEUS SPERM

Jian-He Xu, Feng You, Wei Sun, Bin-Lun Yan, Pei-Jun Zhang, Bi-Xiang Jing-2008

Journal Aquaculture International 16(6): 623-634

Abstract:

Turbot *Scophthalmus maximus* exhibits sexually dimorphic growth, with females growing faster and reaching larger adult sizes than males. Thus, development of techniques for preferentially producing females is necessary to optimize production of these species. In this paper, gynogenetic diploids of turbot were induced by activating egg development with ultraviolet (UV)-irradiated left-eyed flounder *Paralichthys olivaceus* sperm combined with cold shock to prevent extrusion of the second polar

body. The results of UV irradiation experiments showed that survival, motility, and duration of activity of *P. olivaceus* sperm generally decreased with increase in UV dose. The typical Hertwig's effect was observed after fertilized turbot eggs with UV-irradiated *P. olivaceus* sperm and the optimal UV dose for gynogenetic haploid production was 36,000 erg mm⁻². At 15°C, appropriate timing of cold shock for retention of the second polar body in turbot eggs was at 6 min after fertilization. Results of different combinations of two shock temperatures (1 or 3°C) and four shock durations (15, 25, 35 or 45 min) at 6 min after fertilization demonstrated that shock of 25 min at 1°C gave the highest production of diploid gynogens (39.58% relative to its diploid control). The results of this study reveal that the use of UV-irradiated *P. olivaceus* sperm for activation of turbot eggs and cold shock for polar body retention is an effective method to produce gynogenetic offspring. (Huaihai Institute of Technology, Key Laboratory of Marine Biotechnology of Jiangsu Province, Lianyungang, 222005, China; email of Feng You: youfeng@ms.qdio.ac.cn)

CRYOPRESERVATION OF SILVER BARB PUNTIUS GONIONOTUS (BLEEKER) SPERMATOZOA: EFFECT OF EXTENDER COMPOSITION, CRYOPROTECTIVE AGENTS AND FREEZING RATE ON THEIR POSTTHAWING FERTILIZATION ABILITY

Padmanav Routray, Surjya Narayan Dash, Chidananda Dash, Priyabrat Swain, Sampad Kumar Sarkar, Niranjan Sarangi-2008

Aquaculture Research 39(15):1597 – 1605

Abstract:

The effects of extender composition, cryoprotectant concentration and freezing and thawing on the fertilization efficiency of cryopreserved spermatozoa of *Puntius gonionotus* were evaluated. Computer-aided motility analysis of semen was conducted to check the suitability of spermatozoa for cryopreservation after mixing with different extenders and cryoprotective agents (CPAs). Extender-4 with an osmolality 260 mOsmol kg⁻¹ and pH 7.6 was used for the cryopreservation study. Among the CPAs, dimethyl sulphoxide (DMSO) was least toxic and more than 60% fertilization was achieved when used at 1.4 M at 0 °C for 10 and 30 min, whereas the toxicity of all CPAs to spermatozoa was evident when tested at 30 °C. Semen frozen at -16 °C min⁻¹ with 1.4 M DMSO showed 70% fertilization, which was significantly higher ($P < 0.05$) than other freezing rates. Samples thawed at 35 °C water showed a fertilization rate comparable with that of fresh semen. Computer-assisted semen analysis of fresh and frozen semen after thawing showed variations in different types of motility in spermatozoa and in their class. There was no significant difference in motility before or after cryopreservation; however, significant differences could be observed in the average path velocity (VAP), straight line velocity (VSL) and curve linear velocity (VCL). Semen of silver barb could be cryopreserved with extender-4 by addition of 1.4 M DMSO to a final cryopreservation medium (MED 2) cooled at a rate of -16 °C min⁻¹, stored in liquid nitrogen (-196 °C) and utilized after thawing at 35±2 °C.

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OPTIMAL DIETARY LIPID LEVEL FOR LARGE YELLOW CROAKER (PSEUDOSCIAENA CROCEA) LARVAE

Q.H. Ai, J.Z. Zhao, K.S. Mai, W. Xu, B.P. Tan, H.M. Ma, Z.G. Liufu-2008

Aquaculture Nutrition 14 (6):515 – 522

Abstract:

A 30-day feeding experiment was conducted in blue tanks (70 × 50 × 60 cm, water volume 180 L) to determine the effects of dietary lipid levels on the survival, growth and body composition of large yellow croaker (*Pseudosciaena crocea*) larvae (12 days after hatchery, with initial average weight 1.93 ± 0.11 mg). Five practical microdiets, containing 83 g kg⁻¹ (Diet 1), 126 g kg⁻¹ (Diet 2), 164 g kg⁻¹ (Diet 3), 204 g kg⁻¹ (Diet 4) and 248 g kg⁻¹ lipid (Diet 5), were formulated. Live feeds (*Artemia sinicia* nauplii and live copepods) were used as the control diet (Diet 6). Each diet was randomly assigned to triplicate groups of tanks, and each tank was stocked with 3500 larvae. During the experiment, water temperature was maintained at 23(±1) °C, pH 8.0 (±0.2) and salinity 25 (±2) g L⁻¹.

The results showed that dietary lipid significantly influenced the survival and growth of large yellow croaker larvae. Survival increased with the increase of dietary lipid from 83 to 164 g kg⁻¹, and then decreased. The survival of larvae fed the diet with 83 g kg⁻¹ lipid (16.1%) was significantly lower than that of larvae fed other diets. However, the survival in larvae fed the diet with 16.4 g kg⁻¹ lipid was the highest compared with other artificial microdiets. Specific growth rate (SGR) significantly increased with increasing dietary lipid level from 83 to 164 g kg⁻¹ ($P < 0.05$), and then decreased. The SGR in larvae fed the diet with 164 g kg⁻¹ lipid (10.0% per day) was comparable with 204 g kg⁻¹ lipid (9.6% per day), but were significantly higher than other microdiets ($P < 0.05$). On the basis of survival and SGR, the optimum dietary lipid level was estimated to be 172 and 177 g kg⁻¹ of diet using second-order polynomial regression analysis respectively.

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CONTRIBUTION OF MICROORGANISMS TO THE BIOFILM NUTRITIONAL QUALITY: PROTEIN AND LIPID CONTENTS

C. Fernandes da Silva, E. Ballester, J. Monserrat, L. Geracitano, W. Wasielesky Jr, P.C. Abreu-2008
Aquaculture Nutrition 14 (6):507 – 514

Abstract:

The nutritional quality of biofilm, a microbial community associated to an organic matrix, was evaluated in artificial substrate (polyethylene screen) in net cages during 30 days in the Patos Lagoon estuary, Southern Brazil. During this period, samples of biofilm were collected each 5 days for analysis of chlorophyll a, microorganisms abundance, dry weight, protein and lipid contents. During the study, chlorophyll a varied from 0.38 to 2.75 $\mu\text{g cm}^{-2}$; dry weight between 7.16 and 17.63 mg cm^{-2} ; protein content from 0.43 to 1.76 mg cm^{-2} and lipid concentration between 1.21 and 4.23 mg cm^{-2} . The variation of lipid in the biofilm was closely related to the abundance of free heterotrophic bacteria ($34.25\text{--}56.54 \times 10^6 \text{ cells cm}^{-2}$), filamentous cyanobacteria ($7.5\text{--}15.9 \times 10^6 \text{ filaments cm}^{-2}$), flagellates ($6.92\text{--}12.89 \times 10^6 \text{ cells cm}^{-2}$) and mainly nematodes ($29\text{--}1,414 \text{ organisms cm}^{-2}$), while protein content varied similarly to the abundance of unicellular centric diatoms ($52.10\text{--}179.81 \times 10^3 \text{ cells cm}^{-2}$), and nematodes. This information will allow a better management of food supply to raised aquatic organism with the utilization of natural productivity in the culture systems, with considerable decrease in production costs.

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A COMPARISON OF FATTY ACID COMPOSITION AND QUALITY ASPECTS OF EGGS AND LARVAE FROM CULTURED AND WILD BROODSTOCK OF COMMON SOLE (SOLEA SOLEA L.)

I. Lund, S.J. Steinfeldt, K.I. Suhr, B.W. Hansen-2008

Aquaculture Nutrition 14 (6): 544 – 555

Abstract:

Eggs from a F1 cultured broodstock of sole were compared with eggs from wild-caught breeders throughout one spawning season, to evaluate if egg quality may be affected by culture-related conditions. Fourteen batches of eggs from cultured broodstock and 17 batches from wild-caught sole were compared with respect to fatty acid (FA) composition, egg size, fertilization rate and hatching rate. Based on a multivariate analysis of the FA profiles, it was possible to discriminate between culture and wild inheritance. Eggs from cultured broodstock had high levels of C20:1(n-9), C18:2(n-6) and C18:3(n-3), whereas eggs from wild fish had high levels of C16:1(n-7), C20:4(n-6) and C20:5(n-3). Differences in FA profiles were most likely related to dietary differences. Fertilization and hatching rates were generally low and lowest in eggs from cultured broodstock, but not related to FA composition. Larval growth of one batch from each group was compared. Larval growth was not correlated to broodstock origin, FA composition or egg or larval size. However, larval survival was significantly lower for larvae from cultured broodstock.

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DEVELOPMENT OF DIGESTIVE ENZYME ACTIVITY IN LARVAE OF SPOTTED SAND BASS *PARALABRAX MACULATOFASCIATUS*. 1. BIOCHEMICAL ANALYSIS

C. A. Alvarez-González, F. J. Moyano-López, R. Civera-Cerecedo, V. Carrasco-Chávez, J. L. Ortiz-Galindo, S. Dumas-2008

Journal Fish Physiology and Biochemistry 34(4): 373-384

Abstract:

Spotted sand bass *Paralabrax maculatofasciatus* is a potential aquaculture species in Northwest Mexico. In the last few years it has been possible to close its life cycle and to develop larviculture technology at on pilot scale using live food, however survival values are low (11%) and improvements in growth and survival requires the study of the morpho-physiological development during the initial ontogeny. In this research digestive activity of several enzymes were evaluated in larvae, from hatching to 30 days after hatching (dah), and in live prey (rotifers and *Artemia*), by use of biochemical and electrophoretic techniques. This paper, is the first of two parts, and covers only the biochemical analysis. All digestive enzyme activities were detected from mouth opening; however the, maximum activities varied among different digestive enzymes. For alkaline protease and trypsin the maximum activities were detected from 12 to 18 dah. Acid protease activity was observed from day 12 onwards. The other digestive enzymes appear between days 4 and 18 after hatching, with marked fluctuations. These activities indicate the beginning of the juvenile stage and the maturation of the digestive system, in agreement with changes that occur during morpho-physiological development and food changes from rotifers to *Artemia*. All enzymatic activities were detected in rotifers and *Artemia*, and their contribution to enhancement the digestion capacity of the larvae appears to be low, but cannot be minimised. We concluded that the enzymatic equipment of *P. maculatofasciatus* larvae is similar to that of other marine fish species, that it becomes complete between days 12 and 18 after hatching, and that it is totally efficient up to 25 dah.

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THE CHANGES IN THE BIOCHEMICAL COMPOSITIONS AND ENZYMATIC ACTIVITIES OF ROTIFER (*BRACHIONUS PLICATILIS* , MÜLLER) AND ARTEMIA DURING THE ENRICHMENT AND STARVATION PERIODS

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Abstract:

The changes in the biochemical compositions and enzymatic activities of rotifer (*Brachionus plicatilis*) and *Artemia*, enriched and stored at 4°C temperature, were determined. The total starvation period was 16 h and samples were taken at the end of the 8th and 16th hours. In present study, the rotifer and nauplii catabolized a large proportion of the protein during the enrichment period. Lipid contents of both live preys increased during the enrichment period and decreased in nauplii and metanauplii throughout the starvation period but lipid content of the rotifer remained relatively constant during the starvation period. The changes observed in the amino acid compositions of *Artemia* and the rotifer were statistically significant ($P < 0.05$). The conspicuous decline the essential amino acid (EAA) and nonessential amino acid (NEAA) content of the rotifer was observed during the enrichment period. However, the essential amino acid (EAA) and nonessential amino acid (NEAA) contents of *Artemia* nauplii increased during the enrichment period. The unenriched and enriched rotifers contained more monounsaturated fatty acid (MUFAs) than polyunsaturated fatty acid (PUFAs) and saturated fatty acids (SFA). However, *Artemia* contained more PUFAs than MUFAs and SFA during the experimental period. A sharp increase in the amounts of docosahexaenoic acid (DHA) during the enrichment of the rotifer and *Artemia* nauplii was observed. However, the amount of DHA throughout the starvation period decreased in *Artemia* metanauplii but not in *Artemia* nauplii.

Significant differences in tryptic, leucine aminopeptidase N (LAP), and alkaline phosphatase (AP) enzyme activities of Artemia and rotifer were observed during the enrichment and starvation period ($P < 0.05$). The digestive enzymes derived from live food to fish larvae provided the highest contribution at the end of the enrichment period. In conclusion, the results of the study provide important contributions to determine the most suitable live food offering time for marine fish larvae. Rotifer should be offered to fish larvae at the end of the enrichment period, Artemia nauplii just after hatching and before being stored at 4°C, and Artemia metanauplii at the end of the enrichment and throughout the starvation period.

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