

INFORMATION OF INTEREST

Fish for Africa: International Center for Aquaculture and Fisheries Research and Development in Africa

Proceedings of the Global Trade Conference on Aquaculture, 29–31 May 2007, Qingdao, China; Arthur & Nierentz (eds), FAO FISHERIES PROCEEDINGS nr 9, 271 pp. (2007)

Southern Bluefin Tuna Aquaculture Subprogram website

The Aquafeed.com Newsletter: free e-zine for aquafeed professionals

Asian Fisheries Science: Vol 20, number 1 2 3 4

Asian Fisheries Science: Fisheries Society Year Book 2007

CHEMICAL ESTIMATION OF PHOSPHORUS RELEASED FROM HYPERSALINE POND SEDIMENTS USED FOR BRINE SHRIMP ARTEMIA FRANCISCANA PRODUCTION IN THE MEKONG DELTA

Chau Minh Khoi, Vo Thi Guong, Margriet Drouillon, Pieter Pypers, Roel Merckx-2008
Aquaculture 274(2-4): 275-280

Abstract:

Artemia production in the Mekong Delta of Vietnam occurs in hypersaline conditions and depends on adequate algal growth. In turn, algal proliferation mostly depends on mineral nutrients derived from pond bottom sediment. This study was carried out to evaluate chemically rapid procedures reliable to estimate the capacity of the sediment in supplying available phosphorous (P) in hypersaline Artemia ponds. To this end, sediments were sampled from Artemia ponds and artificially submerged by Instant Ocean at 70 g L⁻¹ salinity. The amounts of dissolved reactive P (DRP) and unreactive P (DUP) released from the sediments were analyzed during 4-day submergence. Linear and exponential regression analyses were employed to determine the correlation between the amounts of DRP released over submergence and the concentrations of P extracted by Olsen method and by shaking the soil slurry for 24 h. The results showed that the concentrations of DRP and DUP in hypersaline conditions (EC \approx 97 dS m⁻¹) were on average 1.5 to 3 fold higher than those in less saline conditions (EC \approx 11–23 dS m⁻¹) (P < 0.001). During the early stage of submergence, the amount of DRP released from sediment after 4 days was linearly correlated with Olsen-P content in the sediment (R² = 0.64, P < 0.001), while its relationship with DRP present in the saline extracts after a 24-h equilibration followed a logarithmic pattern (R² = 0.84, P < 0.001). The results from this study revealed that Olsen-P and/or DRP measurements after a 24-h equilibration allow predicting the availability of P in the conditions prevailing in Artemia cultivation.

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THE USE OF HARPACTICOID COPEPODS AS LIVE PREY FOR AMPHIPRION CLARKII LARVICULTURE: EFFECTS ON LARVAL SURVIVAL AND GROWTH

I. Olivotto, F. Capriotti, I. Buttino, A.M. Avella,, V. Vitiello, F. Maradonna, O. Carnevali-2008

Aquaculture 274(2-4): 347-352

Abstract:

The aim of this study was to evaluate the potential use of the harpacticoid copepod *Tisbe* spp as prey in *Amphiprion clarkii* larviculture. After hatching, *A. clarkii* larvae were divided in four experimental groups for feeding studies as follows: group A (control group) fed rotifers (*Brachionus plicatilis*) followed by *Artemia* nauplii; group B fed a mixed diet of rotifers and *Tisbe* spp nauplii followed by a combination of *A. nauplii* and *Tisbe* spp copepodites/copepods; group C fed copepod nauplii solely followed by *Tisbe* spp copepodites and copepods; group D fed rotifers followed by *Tisbe* spp copepodites and copepods. In this study we observed a positive effect of feeding *Tisbe* spp copepods in *A. clarkii* larviculture as a supplement live food to the traditional diet based on rotifers and *A. nauplii*. In group B larvae, fed a combination of rotifers/*Tisbe* spp nauplii followed by a combination of *A. nauplii*/*Tisbe* spp copepodites-adults, a significant increase of IGF II and IGF I gene expression and a significant decrease of myostatin gene expression was evidenced by Real Time PCR compared to the other experimental groups. In this same group we also observed the best results in terms of growth (total length and weight) and survival.

In conclusion, the harpacticoid copepod *Tisbe* spp may be considered a suitable live prey for marine fish larvae larviculture when used as a supplement to the traditional diet based on rotifers and *A. nauplii*.

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BIOCHEMICAL COMPOSITION OF COPEPODS FOR EVALUATION OF FEED QUALITY IN PRODUCTION OF JUVENILE MARINE FISH

Terje van der Meeren, Rolf Erik Olsen, Kristin Hamre, Hans Jørgen Fyhn-2008

Aquaculture 274(2-4): 375-397

Abstract:

To increase current knowledge on the nutritional value of natural prey organisms, the biochemical components of mainly three copepods (*Acartia grani*, *Centropages hamatus*, and *Eurytemora affinis*) from a marine pond system were analysed once a week from spring until late fall, over two years. The analysed components were total lipid, lipid class composition, total lipid fatty acid composition, free amino acids, total protein, protein-bound amino acids, pigment (astaxanthin and β -carotene), and vitamins (A, thiamine, riboflavin, C, D3, and E). Copepod dry weight (DW), dry matter (% of wet weight), and ash content (% of DW) were also determined. The data are unique due to the homogenous content of copepods in the samples and the long time span of sampling. The copepods were characterised by moderate levels of lipids (6.9–22.5% of DW), with polar lipids accounting for 37.9 to 70.2% of the total lipid. The most abundant fatty acids in total lipid (as % of total lipid) were 16:0 (palmitic acid, 10.8–17.1%), 20:5n-3 (EPA, 8.3–24.6%), and 22:6n-3 (DHA, 13.9–42.3%). The amount of 20:4n-6 (ARA) was generally low (0–2.6%), giving an EPA/ARA range between 7.5 and 49.5. The DHA/EPA ratio was between 1.0 and 4.9. Free amino acids (FAA) constituted between 4.3 and 8.9% of copepod DW, and varied with salinity. Glycine, taurine, and arginine dominated FAA, and the fraction of indispensable amino acids varied between 15.5 and 26.8%. Protein, as back-calculated from the protein-bound amino acids (PAA), amounted to 32.7–53.6% of copepod DW, and contained a stable fraction of indispensable amino acids (37.3–43.2% of PAA). Glutamine/glutamic acid, asparagine/aspartic acid, leucine, alanine, and glycine were the most abundant PAA. Astaxanthin was abundant in the copepods (413–1422 $\mu\text{g/g}$ DW), while β -carotene was not found. High but variable concentrations of vitamin C (38–1232 $\mu\text{g/g}$ DW) and vitamin E (23–209 $\mu\text{g/g}$ DW) were found, while vitamin A and D3 occurred in trace amounts or were not detected. Detectable levels were found for both thiamine (3.5–46.0 $\mu\text{g/g}$ DW) and riboflavin (23.2–35.7 $\mu\text{g/g}$ DW). The data may generate an important base for improvement of live feed enrichment emulsions or formulated feeds used during larval and early juvenile stages in marine fish culture.

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EVALUATION OF PARTIAL REPLACEMENT OF LIVE AND FRESH FEEDS WITH A FORMULATED DIET AND THE INFLUENCE OF WEANING PANULIRUS ORNATUS PHYLLOSOMATA ONTO A FORMULATED DIET DURING EARLY ONTOGENY

Matthew D. Johnston, Danielle J. Johnston, Clive M. Jones-2008

Aquaculture International 16(1)

Abstract:

We have evaluated the potential of a formulated diet as a replacement for live and fresh feeds for 7-day post-hatch *Panulirus ornatus* phyllosomata and also investigated the effect of conditioning phyllosomata for 14–21 days on live feeds prior to weaning onto a 100% formulated diet. In the first trial, the highest survival (>55%) was consistently shown by phyllosomata fed a diet consisting of a 50% combination of *Artemia* nauplii and 50% Greenshell mussel, followed by phyllosomata fed 50% *Artemia* nauplii and 50% formulated diet and, thirdly, by those receiving 100% *Artemia* nauplii. The second trial assessed the replacement of on-grown *Artemia* with proportions of formulated diet and Greenshell mussel that differed from those used in trial 1. Phyllosomata fed a 75% combination of formulated diet and 25% on-grown *Artemia* and 50% on-grown *Artemia* and 50% Greenshell mussel consistently showed the highest survival (>75%). Combinations of Greenshell mussel and formulated diet resulted in significantly ($P < 0.05$) reduced survival. In trial 3, phyllosomata were conditioned for 14, 18 or 21 days on *Artemia* nauplii prior to weaning onto a 100% formulated diet, which resulted in survival rates that were negatively related to the duration of feeding *Artemia* nauplii. In the final trial, phyllosomata were conditioned for 14 days on live on-grown *Artemia* prior to weaning onto one of three formulated diets (one diet with 44% CP and two diets with 50%). Phyllosomata fed a 44% CP diet consistently showed the highest survival (>35%) among all treatments, while those fed a 50%-squid CP diet showed a significant ($P < 0.05$) increase in mortality at day 24. The results of these trials demonstrate that hatcheries can potentially replace 75% of live on-grown *Artemia* with a formulated diet 7 days after hatch. The poor performance associated with feeding combinations of Greenshell mussel and formulated diet, and 100% formulated diet as well as conditioning phyllosomata for 14–21 days on live feeds prior to weaning onto a formulated diet highlights the importance of providing *Artemia* to stimulate feeding.

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FIRST RESULTS ON SPAWNING, LARVAL REARING AND GROWTH OF THE WEDGE SOLE (*DICOLOGLOSSA CUNEATA*) IN CAPTIVITY, A CANDIDATE SPECIES FOR AQUACULTURE

Marcelino Herrera, Ismael Hachero, Montserrat Rosano, José Francisco Ferrer, José Manuel Márquez, José Ignacio Navas-2008

Aquaculture International 16(1)

Abstract:

The wedge sole is a target species in the fisheries of the Gulf of Cadiz (Spain). Having reared them to commercial size, we have studied reproduction and breeding in captivity of the wedge sole in this work here. The breeders adapt easily to captivity, and they can spawn in less than 1 year in captivity. The relative fecundity is relatively high, $1.06\text{--}2.33 \cdot 10^6$ eggs kg^{-1} per spawning season (mean 1.6 ± 0.1). Larval SGR is high, $7.2 \pm 0.2\%$ day^{-1} (range 5.8–9.1), similar to other cultured flatfish species. In 1 year, some individuals reach market size and can release eggs, registering SGRs of 1.39–1.66% day^{-1} (mean 1.56 ± 0.01). This species

presents some very different characteristics with respect to other farmed flatfishes (turbot, halibut and Senegal sole, mainly), so that it is necessary to develop new techniques to optimise its cultivation. In the present work, the first results are presented on the biology of the wedge sole in captivity.

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EXPERIMENTAL EVALUATION OF A COMPOSTED SEAWEED EXTRACT AS MICROALGAL CULTURE MEDIA

Daniela Alvarado, Esperanza Buitrago, María Solé, Khenia Frontado-2008

Aquaculture International 16(1)

Abstract:

An organic culture media based on a composted liquid seaweed extract was developed and tested for growth of *Chaetoceros muelleri*. The extract was evaluated at two concentrations and then compared with two commercial media: Walne and agricultural fertilizer (AF). The concentrations of nitrogen and phosphorous differed between the two commercial media and the seaweed extract; however, growth of *Chaetoceros muelleri* was similar. The successful culture of *Chaetoceros muelleri* in composted liquid seaweed extract suggests the feasibility of and potential use for this natural, organic fertilizer in aquaculture. The seaweed extract is simple to obtain and inexpensive.

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EVALUATIONS OF LACTIC ACID BACTERIA AS PROBIOTICS FOR JUVENILE SEABASS LATES CALCARIFER

Sirirat Rengpipat, Thosaporn Rueangruklikhit, Somkiat Piyatiratitivorakul-2008

Aquaculture Research 39(2): 134–143

Abstract:

Lactic acid bacteria (LAB) were isolated from adult, wild-caught and farmed seabass (*Lates calcarifer*) intestines for evaluation as possible probiotics using the well agar diffusion method. Five LAB isolates (designated as LAB-1–5) were found to inhibit *Aeromonas hydrophila*, a known seabass pathogen. Median lethal concentrations (LC₅₀) of *A. hydrophila* on juvenile seabass were measured in aquaria. Median lethal concentration values of 7.76, 7.47 and 7.26 log₁₀ CFU mL⁻¹ for 72, 96 and 120 h, respectively, were found. Juvenile seabass (0.6±0.2 g) were cultured in aquaria and fed individual LAB-1–5 fortified feeds with 7 log₁₀ CFU g⁻¹ LAB. Seabass fed LAB-4 fortified feed had significantly greater growth (P<0.05) than fish fed other feeds. Seabass fed LAB-4 also had greater survival, but this was non-significant (P<0.05). Challenge tests of LAB-4 fed seabass with *A. hydrophila* at 7 log₁₀CFU mL⁻¹ yielded significantly greater survival compared with control seabass (P<0.05). *Aeromonas hydrophila* infections in seabass were confirmed by observing disease manifestation and by immunohistochemistry techniques. LAB-4 was preliminarily identified using lactic acid analysis, biochemical and physical characteristics. It was further identified using 16S rDNA sequencing. LAB-4 was identified as *Weissella confusa* (identity of 99%). GenBank accession number for the 16S rDNA sequence for LAB-4 was AB023241.

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EGG QUALITY DETERMINATION BASED ON THE SHAPE OF THE LIPID VESICLE IN COMMON DENTEX, DENTEX DENTEX

Franz Lahnsteiner, Gemma Giménez, Estévez Alicia-2008

Aquaculture Research 39(2): 144–149

Abstract:

The shape of the lipid vesicle (the ratio between the maximal and the minimal diameter and the shape coefficient) of the eggs of *Diplodus puntazzo* and *Sparus aurata* is correlated with larval survival rate (%) and can be used as an egg quality marker as reported previously by Lahnsteiner and Patarnello (2005). In the present study, this method for egg quality determination has also been validated for common dentex, *Dentex dentex*, after introducing several modifications in the calculation and evaluation procedure in order to obtain higher sensitivity. In the present study, it could be demonstrated that the shape of the lipid vesicle is not only correlated with the hatching rate but also with the survival rate of 1, 2 and 3 days post hatch larvae and therefore it can also be used as an indicator of larval viability at early stages of development.

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SHORT COMMUNICATION

SPERM VELOCITY INFLUENCE PATERNITY IN THE ATLANTIC COD (*GADUS MORHUA* L.)

Geir Rudolfson, Lars Figenschou, Ivar Folstad, Oddmund Kleven-2008

Aquaculture Research 39(2): 212–216

(Department of Evolution and Ecology, Institute of Biology, University of Tromsø, Tromsø, Norway; email of G Rudolfson: geir.rudolfson@ib.uit.no)

EFFECTS OF DIETARY HIGHLY UNSATURATED FATTY ACIDS AND ASTAXANTHIN ON THE FECUNDITY AND LIPID CONTENT OF POND-REARED *PENAEUS MONODON* (FABRICIUS) BROODSTOCK

Jian-Hua Huang, Shi-Gui Jiang, Hei-Zhao Lin, Fa-Lin Zhou, Le Ye-2008

Aquaculture Research 39(3): 240–251

Abstract:

Five diets that contained fresh squid meat as the basic constituent and were supplemented with different amounts of highly unsaturated fatty acids (HUFA) and astaxanthin were fed to pond-reared *Penaeus monodon* broodstock. Diet A was sole squid meat. Diets B and C were supplemented with astaxanthin 50 and 100 mg kg⁻¹ respectively. Diets D and E were supplemented with HUFA 5 and 10 g kg⁻¹ and astaxanthin 50 mg kg⁻¹ respectively. The result showed that the group fed diet E had the best reproductive performance in all experimental groups. It had a higher proportion of spawns (71.5%), spawning rate (0.047), a shorter latency period (7.7±0.3 d), higher absolute fecundity (× 10³) (361.6±5.5) and egg production/female (× 10³) (597.0±18.0) than all the other experimental groups. The fatty acid composition in broodstock diets strongly affected the tissue and fecundity of broodstock. Good correlations between the content of 20:4n-6 in eggs and the fecundity (r²=0.6109) and egg production (r²=0.9876) of broodstock were found. On the other hand, 22:6n-3 and DHA/EPA ratio was negatively correlated with the fecundity of broodstock (r²=0.5362, 0.8702 respectively). The result also showed that the balance between n-3 and n-6 fatty acid families, total polyunsaturated fatty acids and total saturated fatty acid and 20:5n-3 (EPA) and 22:6n-3 (DHA) may play vital roles in maturation and reproductive performance of *P. monodon* broodstock.

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ANTIPREDATOR RESPONSES TO OVERHEAD FRIGHT STIMULI IN HATCHERY-REARED AND WILD EUROPEAN SEA BASS (*DICENTRARCHUS LABRAX* L.) JUVENILES

Stefano Malavasi, Vyron Georgalas, Danilo Mainardi, Patrizia Torricelli-2008

Aquaculture Research 39(3): 276–282

Abstract:

In this study, shoals of hatchery-reared and wild sea bass juveniles (*Dicentrarchus labrax* L.) were tested for differences in their antipredator responses towards a visual (shadow) and a mechanical (dummy bill) overhead stimulus. Two behavioural variables – distance from the bottom and freezing duration – were measured during post-stimulus phases of each test and compared between wild and hatchery-reared shoals, composed of 10 juveniles each. The results showed that in both hatchery-reared and wild juveniles, stimulus exposure elicited a significant decrease in the mean shoal distance from the bottom. Similarly, individuals from both groups engaged a freezing reaction, but the mean freezing duration was significantly higher in wild- than in hatchery-reared juveniles. Results are discussed in the light of their relevance for the enhancement of restocking programmes.

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COPULATION BEHAVIOUR OF *NEPTUNEA ARTHRITICA*: BASELINE CONSIDERATIONS ON BROODSTOCKS AS THE FIRST STEP FOR SEED PRODUCTION TECHNOLOGY DEVELOPMENT Aquaculture Research

Richard M Miranda, Roberto C Lombardo, Seiji Goshima-2008

Aquaculture Research 39(3): 283–290

Abstract:

Copulation trials under three different scenarios were performed aiming to study the copulation behaviour of *Neptunea arthritica* and determine whether broodstock maintenance is required for artificial seed production. *Neptunea arthritica* showed polygamy, copulating at least three times with different partners. From all males and females used in this study, 43% of them copulated at least once. Female whelks showed rejection behaviour, which generated significant difference in copulation time between rejected (13.7±10.7 min) and non-rejected (49.7±44.7 min) males. The effect of body size on copula duration appeared to be superficial, while its effect on accumulative copulas played an important role as an indicator of copulation capacity because whelks varied in size. After first copula, males showed a contrasting tendency to mate copulated females over non-copulated females ($\chi^2=6.23$, d.f.=1, $P=0.01$). Broodstock maintenance as the first step in seed production is possible but considering low mating percentage and female rejection, it would be not economically reasonable due to the considerable number of whelks required and related logistical factors.

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SHORT PAPER

A METHOD FOR THE MICROINJECTION INTO NATURALLY SPAWNED EGGS OF MARINE FISH, ESPECIALLY CULTURED PACIFIC BLUEFIN TUNA *THUNNUS ORIENTALIS*

Satoshi Otani, Manabu Ohara, Shigeru Miyashita, Toru Kobayashi-2008

Fisheries Science 74(1): 208–210

(Department of Fisheries, Faculty of Agriculture, Kinki University, Nakamachi, Nara 631-8505, Japan; email of Toru Kobayashi: kobayasi@nara.kindai.ac.jp)

EFFECTS OF DIFFERENT DIETS ON THE REPRODUCTION AND NAUPLIAR DEVELOPMENT OF THE COPEPOD ACARTIA BIFILOSA

Jie Li, Song Sun, Chao-lun Li, Zhan Zhang, Xin-ming Pu-2008

Journal of Experimental Marine Biology and Ecology 355(2): 95-102

Abstract:

The influence of diatoms on the reproduction and naupliar development of *Acartia bifilosa* was investigated under laboratory conditions, comparing initial in situ values and laboratory-food treatments. Egg production by *A. bifilosa* was significantly reduced by one diatom diet (*Phaeodactylum tricornutum*: Pt) and by two non-diatom diets (*Platymonas subordiformis*: Ps and *Nannochloropsis oculata*: No). It was less affected by the other diatom diet (*Skeletonema costatum*: Sc) or by two mixed-food treatments (D-mix and DG-mix), composed of two diatoms (Pt, Sc) and four species (Pt, Sc, Ps and No), respectively. The negative effect of Pt was eliminated when adult copepods were offered mixed-food diets. There were no significant differences between the hatching success values observed in filtered seawater and in algal exudates, indicating that diatoms did not produce active dissolved toxic substances under the different food concentrations tested. The mortality rate of nauplii was higher with Pt than the other diets, suggesting that this diatom species had a negative effect on egg production, hatching success and naupliar survival simultaneously. Compared to other diets, No and Pt were not beneficial food sources for reproduction and for female and larval survival.

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LARVAL RECRUITMENT OF THE BLUE MUSSEL MYTILUS EDULIS: THE EFFECT OF FLOW AND ALGAE

Sergey Dobretsov, Martin Wahl-2008

Journal of Experimental Marine Biology and Ecology 355(2): 137-144

Abstract:

The mussel *Mytilus edulis* settlement and distribution was studied on plastic panels with manipulated flow regime (faired, bluff, split and angled) with or without water soluble metabolites of the green alga *Cladophora rupestris*. The panels were exposed vertically on a device (hydrovane) that ensures their constant orientation in the current during the peak of larval settlement at 1 m depth. In order to investigate larval distribution on the panels, half of them were coated with a silicone vacuum grease that prevents larvae from de-attachment. This grease was not toxic and did not attract or repel larvae. Low densities of larvae on the un-greased plates compared to the greased ones suggested that some of larvae left the substratum. The blue mussel larvae initially settled in regions of reduced shear velocity and then redistribute to the regions of high shear velocity. The presence of the alga increased the density of blue mussel larvae and changed their distribution on the panels. Overall, our results demonstrated that larval recruitment of *M. edulis* is an active process affected both by boundary-layer hydrodynamics and algal waterborne compounds.

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A HERPES-LIKE VIRUS INFECTING CRASSOSTREA GIGAS AND RUDITAPES PHILIPPINARUM LARVAE IN FRANCE

T. Renault, C. Lipart, I. Arzul-2008

Journal of Fish Diseases 31 (VIRTUAL ISSUE: Thirty Years of Fish Disease Research Page): 369-376

Abstract:

Concomitant sporadic high mortalities were reported in June 1997 among batches of larval Pacific oyster, *Crassostrea gigas*, and Manila clam, *Ruditapes philippinarum*, in a French commercial hatchery. Histological observation showed the presence of cellular abnormalities in affected animals. Electron transmission microscopy revealed the presence of herpes-like virus particles in infected larvae of both bivalve species. Viruses observed in *C. gigas* and *R. philippinarum* are closely related with respect to ultrastructure and morphogenesis. They were detected simultaneously in both bivalve species larvae indicating possible interspecific transmission. Moreover, PCR analysis using oyster herpes-like virus specific primers allowed amplification of fragments of expected sizes for both bivalve species and demonstrated the presence of viral DNA. The PCR products obtained for both bivalve species and digested by restriction enzymes displayed the same patterns. These data suggest that the same herpes-like virus may infect larval oysters and clams.

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EFFECT OF FOOD CONCENTRATION ON PROTEIN AND CARBOHYDRATE PRODUCTION DURING LARVAL DEVELOPMENT OF THE SEA URCHIN *LYTECHINUS VARIEGATUS*

Patricia Miloslavich, John M. Lawrence, Daniela Schiopu, Eduardo Klein-2008

Journal of Shellfish Research 26(4): 1177–1182

Abstract:

Changes in protein and carbohydrate content during larval development of *Lyttechinus variegatus* were measured under two diet conditions, low concentration (600 algal cells ml⁻¹ day⁻¹) and high concentration (6,000 algal cells ml⁻¹ day⁻¹) to determine the larval stage at which these proximate constituents showed significant changes under different conditions of food availability. In terms of morphology, larvae under the high concentration diet developed fully and metamorphosed after 30 days, whereas under the low concentration diet, some larvae developed up to the 4 arm stage, and some ceased to develop at the 8 arm stage. No significant differences were found in the percentage of larval survival up to day 24 with both treatments (high: 77 ± 18%, low: 66 ± 24%). With the high concentration diet, protein and carbohydrate content per larvae remained relatively constant through day 17 after fertilization, through the 8-arm stage, and then significantly increased by day 20 coinciding with the first appearance of the rudiment stage, remaining high by day 24, coinciding with the first appearance of pedicellariae. Despite the morphological differences between the larvae at both treatments, no significant differences were found in the protein and carbohydrate content per larvae up to day 24. During normal development with a high concentration diet, growth of the pluteus larva seems to be primarily an increase in dimension of the feeding structures, the arms, that requires little production. After full feeding capacity is reached at the 8-arm stage, production increases with development of the rudiment and the pedicellariae.

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GROWTH AND SURVIVAL OF SPOTTED SAND BASS LARVAE, *PARALABRAX MACULATOFASCIATUS*, AT TWO EARLY WEANING TIMES

Roberto Civera-Cerecedo, Carlos A. Alvarez-González, Rubén E. García-Gómez, Victor Carrasco-Chávez, José L. Ortiz-Galindo, Martín O. Rosales-Velázquez, Tanos Grayeb-Del Álamo, Francisco J. Moyano-López-2008

Journal of the World Aquaculture Society 39(1): 22-36

Abstract:

Early weaning in spotted sand bass larvae, *Paralabrax maculatofasciatus*, was evaluated, testing a combination of two weaning times, 17 and 22 d after hatching (d.a.h.), and three different microparticulate diets. Protein in diets was mainly from sardine meal and from 15%

squid meal, beef blood meal, or fish protein hydrolysate. Anatomical (standard length), histological (gut development), and biochemical (highly unsaturated fatty acids) parameters were measured in larvae, as well as survival and resistance to a stress test measured 40 d.a.h. For larvae weaned at 17 d.a.h., the best growth and survival were obtained with diets containing fish protein hydrolysates; for larvae weaned at 22 d.a.h., best results were obtained with squid meal and fish protein hydrolysate. Growth and survival were significantly lower when using beef blood meal in both weaning treatments. The best relative and total survival were for larvae weaned at 22 d.a.h. After the resistance test, 100% survival occurred in larvae fed on any microparticulate diet and either weaning treatment. No significant differences in arachidonic acid, eicosapentaenoic acid, or docosahexaenoic acid concentrations in fish fed on any diet occurred. Results suggest that weaning at 22 d.a.h. with diets containing fish protein hydrolysate or squid meal is preferred by this species.

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INVITED REVIEW

A REVIEW OF THE FUNCTIONALITY OF PROBIOTICS IN THE LARVICULTURE FOOD CHAIN

Nguyen Thi Ngoc Tinh, Kristof Dierckens, Patrick Sorgeloos, Peter Bossier-2008

Marine Biotechnology 10(1)

Abstract: During the past two decades, the use of probiotics as an alternative to the use of antibiotics has shown to be promising in aquaculture, particularly in fish and shellfish larviculture. This article reviews the studies on probiotics in larviculture, focusing on the current knowledge of their in vivo mechanisms of action. The article highlights that the in vivo mechanisms of action largely remain to be unravelled. Several methodologies are suggested for further in vivo research, including studies on gut microbiota composition, the use of gnotobiotic animals as test models, and the application of molecular techniques to study host-microbe and microbe-microbe interactions.

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MOLECULAR DIET ANALYSIS OF PHYLLOSOMA LARVAE OF THE JAPANESE SPINY LOBSTER *PANULIRUS JAPONICUS* (DECAPODA: CRUSTACEA)

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Abstract:

To clarify the natural diet of phyllosoma larvae of the Japanese spiny lobster *Panulirus japonicus*, the sources of 18S rDNA clones obtained from the hepatopancreas were investigated. Of a total of 1537 clones examined, 160 had different restriction profiles from the host larvae, in which 21 restriction types were observed. Nucleotide sequences of 16 of 21 restriction types were successfully determined and their assignments were investigated by homology search and phylogenetic analysis. From seven late-stage larvae collected in spring to early summer, eukaryote DNA molecules of Teleostei, Oomycetes, Mycetozoa, and Fungi were identified. Exogenous DNA from four younger phyllosoma larvae collected in late autumn could not be recovered. A previous study identified DNAs of cnidarians and urochordates in late-stage phyllosoma larvae of a closely related species collected in winter. This indicates that the phyllosoma larvae are opportunistic carnivores, whose diets correlate with the relative abundance of prey organisms in the ambient water.

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VALUABLE DISCOVERIES IN THE CULTIVATION OF FINFISH LARVAE

By Jane Jordan, Editor, TheFishSite.

The development of novel marine finfish production requires reliable and cost effective supplies of juvenile fish. The OPEL project - 'The optimisation of environmental conditions for cultivating marine finfish larvae' - was set up to evaluate production methods and establish the economic value of improving the quality of juveniles produced by hatcheries.

The investigations, at the Martin Ryan Institute, Carna, Ireland and Fosen Aquasenter, Norway, aimed to evaluate and refine protocols for cold water larval culture - the premise was to provide a network of information on marine finfish hatchery techniques.

Cod: Stability essential

The worldwide production of cod juveniles is regarded as a rather erratic process. Some of the major problems are attributed to fluctuations in water quality, relating to temperature, salinity, total gas pressure, microbiological parameters and the feeding regimes used. The high incidence of malformed juveniles seen in the early days of production are thought to be a result of these issues, and so there is scope to improve production techniques.

Traditionally, most marine finfish larval culture processes employ single-use flow-through seawater systems. However, this method is only really effective when sea water conditions are stable, production is seasonal, pumping costs are low and temperature control is both efficient and economic.

There can be financial and operating incentives with re-use water systems, in particular for locations where quality parameters are variable. However, current knowledge on this technology in aquaculture is only suitable for rearing adult fish, youngstock of warm water species and/or for freshwater organisms. But by using a water re-use/ recirculation system, the water used can be treated and isolated from exterior influences, thus allowing the establishment of optimal larviculture conditions. A re-use systems can also reduce the volume of effluent/waste water produced which is also a key environmental consideration.

Re-use rewards

King (2003) reported a survival rate over the first 100 days post-hatch of 30 per cent in a commercial cod hatchery that used a water reuse system. And, in a subsequent year, this research reported larval survival rate of 55 percent, which is probably the highest recorded survival rate achieved by an intensive cod hatchery to date.

The development of water re-use systems is important to northern aquaculture industries - a more sustainable and cost effective cod industry would be economically advantageous. It's particularly significant in Western Ireland and Sweden, which have huge interests in the cod business.

In addition to water quality issues, another of OPEL's objectives was to develop an efficient and reliable live feed feeding system. Rearing youngstock with live food is a very labour-intensive process and incurs considerable costs. It is also a potentially unstable component of larval culture.

The research compared the hatchery process at the MRI finfish unit in West Ireland with the practices used at the Fosen Aquasenter, Norway. It details hatchery layout and describes in detail, water treatment and reuse systems, the husbandry protocols associated with live food production and larviculture management. It also assesses results of water chemistry in the larval unit and biometric data on cod juveniles reared at MRI in 2005. The water treatment and re-use systems used at Fosen Aquasenter is also evaluated, along with the results obtained

from water quality monitoring and overall juvenile production performance at this hatchery during 2005.

The results indicate that during the winter period, intensive water quality treatment can vastly improve the survival of fish compared to batches grown without water treatment. Unfortunately, during the summer months survival rates were not as good, indicating that there is still a need to address water quality issues.

Conclusions

As a result of comparative water sampling between the two project partners, the Fosen centre changed its water system from the reuse process to a vigorously treated flow through supply that offered better production results. Fosen have since compared this treated flow through system with an untreated seawater supply and have found that the untreated supply yielded production batches of only 1,000 to 35,000 cod per six litres of eggs, while the treated flow through system produced 150,000 fish for the same volume of eggs in the first two batches.

Fosen has also established a live algal production unit to augment its cod larval culture protocols. Work at MRI has shown that microalgae present in the larval tanks can enhance the survival and proliferation of Artemia, a vital fish food.

The collaboration and information exchange between the project partners, encouraged MRI Carna to introduce a number of improvements to its live feeding system and general husbandry techniques. The hatchery invested in automatic feeders, which provide a more reliable and consistent supply of rotifers and have significantly reduced labour requirements. During the project standing stocks of rotifers ranging from 4-6 billion were maintained throughout the larval culture period and 600-1000 million rotifers were harvested each day. Hygiene protocols were also upgraded which addressed bacterial contamination issues. Using microalgae has benefits here too. The major benefit at MRI Carna was seen from the automatic live feed developed during this project. It significantly improved the feeding of microalgae, rotifers and Artemia to the larval tanks - and so overall productivity.

OPEL was a collaborative venture between a commercial operation and research organisations Martin Ryan Institute, Carna, Ireland and Fosen AS, Norway under the Aquareg programme.

Aquareg was a regional framework initiative, funded by the EU, that linked marine industries operating in three peripheral regions of Europe: the Western Coast of Ireland, Galicia in Spain and Trondelag in Norway.

The programme comprised 12 research and development projects aimed at improving the commercial viability of marine businesses in these regions. It linked science and commercial interests through knowledge transfer, collaborative and applied research and co-operative projects involved with education, resource management and environmental development.

Information about Aquareg, its partners and the projects can be found at: www.aquareg.com
