
INFORMATION OF INTEREST

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International Symposium on Aquaculture, Biology and Management of Commercially Important Crabs, Shanghai-China, November 8-11, 2009: [1st announcement](#)

FAO Programme of work in Fisheries and Aquaculture. [Document](#) (COFI/2009/9) discussed at the 28th Session of the FAO Committee on Fisheries (Rome, Italy – March 2-6, 2009)

Webcast [presentation](#) of the State of the World Fisheries and Aquaculture 2008 at the 28th Session of the FAO Committee on Fisheries (Rome, Italy, March 2, 2009)

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COMPARATIVE GROWTH OF PACIFIC OYSTER (CRASSOSTREA GIGAS) POSTLARVAE WITH MICROFEED AND MICROALGAL DIETS

Circe E. Badillo-Salas, Enrique Valenzuela-Espinoza, Marco A. González-Gómez, Griselda Pares-Sierra, Francisco Ley-Lou, Zaul Garcia-Esquivel-2009

Aquaculture International 17(2): 173-186

Abstract:

Two trials were carried out in the laboratory in order to assess the effect of microparticulated feed (F) and live (*Thalassiosira pseudonana*, M) diets on the growth of recently set ($396 \pm 13 \mu\text{m}$ shell height) and 2 mm *Crassostrea gigas* postlarvae. Different proportions of M and F (100:0, 75:25, 50:50; 25:75, 0:100) were delivered in a single dose of 3 h d⁻¹ in trial 1. Dietary M:F proportions of 100:0, 50:50, and 0:100 were delivered as a single pulse of 8 h d⁻¹ (P1) or two pulses of 4 h⁻¹ (P2) in trial 2. Maximal daily M ration was 296 cells μl^{-1} d⁻¹ (trial 1), 150 M cells μl^{-1} d⁻¹ (trial 2), or their equivalent F dry weight. Shell height (SH), dry (DW), and organic weight (AFDW) were evaluated weekly. Oysters from trial 1 significantly increased their size after 28 days, and exhibited no significant dietary differences in terms of DW (1.21 ± 0.15 to 2.01 ± 0.28 mg) or AFDW (0.091 ± 0.022 to 0.166 ± 0.029 mg). Newly set postlarvae (trial 2) also exhibited significant growth after 25 days. No dietary differences were observed in trial 2, yet P2 oysters attained significantly higher shell heights (825–912 μm) than P1 oysters (730–766 μm) after 25 d. Pulse effects were marginally not significant in terms of AFDW and growth rate. Together, these findings showed that balanced microfeeds have a practical potential for the culture of early *C. gigas* postlarvae, when they are delivered in pulse-feeding schemes.

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MONTHLY ASSESSMENTS OF PROTEINS, FATTY ACIDS AND AMINO ACIDS IN ARTEMIA FRANCISCANA CULTIVATED IN 'LAS SALINAS DE HIDALGO', STATE OF SAN LUIS POTOSÍ, MEXICO

T. Castro, H. Sandoval, A. Castro, J. Castro, G. Castro, R. De Lara, L.H. Hernandez-2009

Aquaculture Nutrition 15(2): 123 – 128

Abstract:

This study presents the biochemical contents of *Artemia* biomass produced in a pond in 'Las Salinas de Hidalgo', State of San Luis Potosí, Mexico. The culture was realized over a period of 1 year in an 80 × 50 × 0.65 m (200 m³) pond. The feed consisted of a mixture of four micro algae. Samples of 1 kg of *Artemia* biomass (wet basis) were taken monthly and total protein, total lipid, amino acids and

fatty acids were assessed. The contents of total protein and lipids showed a similar tendency from July to December (maintained values of about 300 mg g⁻¹ for protein and 90 mg g⁻¹ for lipids). With the exception of methionine and arginine, other seven indispensable amino acids were detected in the monthly samples, having similar values during the period from July to December. The most common fatty acids determined were the C16, C18, C18:1 and C18:3n6. Both, C20:4n6 and C20:5n3, were observed occasionally, but in high quantities. The use of the four micro algae as food for the *Artemia* cultured extensively, improved the biochemical composition and allows using this crustacean as feed for several species of aquatic organisms used for ornamental or human consumption.

(Laboratorio de Alimento Vivo, Departamento El Hombre y su Ambiente, Universidad Autónoma Metropolitana-Xochimilco. Calzada del Hueso1100, Col. Villa Quietud, Mexico D.F., México, C.P. 04960; email of Luis Héctor Hernández: luish3@yahoo.com)

COMPARISON OF ROTIFER BRACHIONUS PLICATILIS AS A CHOICE OF LIVE FEED WITH DRY FEED IN REARING COREGONUS LAVARETUS FRY

H. Mahmoudzadeh, M.R. Ahmadi, M. Shamsaei-2009

Aquaculture Nutrition 15(2): 129 – 134

Abstract:

This experiment, designed for the first time in the Middle East region to sustain *Coregonus lavaretus* production, examined the efficacy of a live organism (*Brachionus plicatilis*), an artificial diet (48% crude protein) and a mixed feed for the first 3 month of rearing fry. Nine rearing cages were floated on the surface of a natural pond supplied with hyporheic-zone river water, each containing 150 numbers of white fish fry, where they were treated with each of the three diets in triplicates. The fry were fed eight times daily starting at the onset of exogenous feeding. Results showed that fry utilized live organisms more efficiently than the artificial and mixed diets. Rotifer-fed group consistently showed higher growth rate during the entire experiment. Length increment (29.6 mm), weight gain (572.3 mg) after 12 weeks of feeding were higher ($P < 0.05$) in this group. Also, their mean weekly specific growth rate (4.97% day⁻¹) was the highest and feed conversion rate (2.97) was the lowest among all treatments. Survival rates of the fry declined from 75% to 61.4%, from 74.3 to 45.8% and from 72.7 to 54.5% for live feed, mixed diet and artificial diet, respectively.

(Department of Health, and Aquatic Diseases, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran; email of Mohammad Reza Ahmadi: mahmadi@ut.ac.ir)

ENZYME AND ACID TREATMENT OF FISH MEAL FOR INCORPORATION INTO FORMULATED MICROBOUND DIETS FOR BARRAMUNDI (*LATES CALCARIFER*) LARVAE

L. Nankervis, P.C. Southgate-2009

Aquaculture Nutrition 15(2):135 – 143

Abstract:

This study reports on two experiments in which the use of enzyme- and acid-treated fish meal were evaluated for incorporation into formulated microbound diets for barramundi (*Lates calcarifer*) larvae. In the first experiment, partially hydrolysed fish meal was used to determine whether partial hydrolysis increased the dietary value of fish meal used in microbound diets fed to *L. calcarifer* larvae. Total length and dry weight at the end of the experiment were both higher for larvae fed diets containing untreated fish meal than those fed diets containing any level of hydrolysate. Larval survival ranged from 15.8% to 47.2% but there were no significant differences between treatments (Fig. 3; $P > 0.05$). Carcass pepsin levels of larvae fed diets containing untreated fish meal were significantly higher than pepsin levels of larvae fed all other diets ($P < 0.05$). The second experiment determined the effects of incorporating graded levels of denatured fish meal (DF) into microbound diets for *L. calcarifer* larvae. Acid treatment increased the digestibility of fish meal approximately twofold when compared with intact fish meal. Larvae fed diets containing 45% DF had significantly higher total length and dry weight at the end of the growth trial than those fed a diet containing only intact fish meal. Larval survival ranged from 30.2% to 58.2%, with no significant differences between treatments. Whole homogenate pepsin levels were significantly affected by the level of dietary DF

inclusion with larvae fed diets containing a greater proportion of intact fish meal containing higher pepsin levels. There was a significant correlation between dietary DF inclusion level and decreasing pepsin level ($r_2 = 0.569$, $P < 0.01$); however, larval pepsin level did not correlate to either dry weight or total length (Pearson correlation, $P > 0.05$). The results of this study are a valuable contribution to our understanding of factors influencing the utilization of ingredients in microbound diets developed for marine fish larvae and will facilitate development of more effective formulated foods for them. (Hatchery Feeds Research Group, School of Marine and Tropical Biology James Cook University, Townsville, Queensland, Australia; email of Leo Nankervis: Leo.Nankervis@Skretting.com)

AN EVALUATION OF POTENTIAL DIETS FOR THE CULTURE OF POSTPUERULI SPINY LOBSTERS PANULIRUS ARGUS (PALINURIDAE)

S.L. Cox, M. Davis-2009

Aquaculture Nutrition 15(2): 152 – 159

Abstract:

Provision of a suitable feed is paramount for the ongoing success of spiny lobster culture. This study compared and evaluated the performance of seven diets for first instar juvenile spiny lobster *Panulirus argus* [5–6 mm carapace length (CL)] based on growth rates, survival, and feed conversion ratio. Results demonstrated that a seafood-based juvenile formulation produced the fastest growth rate (3.49% weight gain day⁻¹ and 0.90% CL increase day⁻¹ over a 28-day period). These growth rates were also reflected by a low feed conversion rate (3.04) for this formulated feed. Similar results were also obtained for juveniles fed a frozen seafood diet, however, frozen brine shrimp, *Artemia salina* (both enriched and un-enriched), frozen enriched mysis shrimp, a dry pellet, and a meal-based juvenile formulation did not produce consistent growth rates. Survival rates ranged between 38% and 85% and demonstrate that juvenile lobsters have better likelihoods of survival in captive culture environments compared to the wild. Although further nutritional refinement is recommended, the results from this research have significant implication for the possible expansion of juvenile spiny lobster growout to a larger scale.

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EVALUATION OF INDIGENOUS MARINE PERIPHYTIC AMPHORA, NAVICULA AND CYMBELLA GROWN ON SUBSTRATE AS FEED SUPPLEMENT IN PENAEUS MONODON POSTLARVAL HATCHERY SYSTEM

H. Khatoon, S. Banerjee, F.. Yusoff, M. Shariff-2009

Aquaculture Nutrition 15(2): 186 – 193

Abstract:

Three isolated marine diatoms (*Amphora*, *Navicula* and *Cymbella*) grown on substrate were evaluated as feed supplement for *Penaeus monodon* postlarvae (PL) in hatchery system for a period of 19 days without changing water. Specific growth rate (day⁻¹) (0.27 ± 0.0) and survival (%) (56.3 ± 1.8) of PLs were significantly higher ($P < 0.05$) in treatment tanks when compared with the control (0.20 ± 0.0 ; 36.0 ± 1.5 , respectively). Shrimp PLs reared in substrate-based tanks had significantly higher ($P < 0.05$) levels of protein, lipid (521.0 ± 7.0 ; 304.0 ± 2 g kg⁻¹ dry weight, respectively), ecosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) (189.0 ± 2.0 ; 176.0 ± 2 g kg⁻¹ of total fatty acid, respectively) than the control (435.0 ± 22.0 ; 258.0 ± 22 g kg⁻¹ dry weight; 172.0 ± 5.0 ; 152 ± 2 g kg⁻¹ total fatty acid, respectively). The periphytic diatoms contained protein and lipid (430–490; 230–260 g kg⁻¹ dry weight, respectively), EPA (30–150 g kg⁻¹ of total fatty acids), DHA (20–30 g kg⁻¹ of total fatty acids) and nine essential amino acids. The results showed that isolated marine periphytic diatoms grown on substrate could be used as feed supplement in enhancing the growth and survival of *P. monodon* postlarvae.

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NUTRIENT VALUES OF DIETARY ASCORBIC ACID (L-ASCORBYL-2-POLYPHOSPHATE) ON GROWTH, SURVIVAL AND STRESS TOLERANCE OF LARVAL SHRIMP, *LITOPENAEUS VANNAMEI*

J. Niu, L.-X. Tian, Y.-J. Liu, K.S. Mai, H.-J. Yang, C.-X. Ye, W. Gao-2009

Aquaculture Nutrition 15(2): 194 – 201

Abstract:

l-ascorbyl-2-polyphosphate (ApP) was used as a vitamin C source to investigate the ascorbic acid (AsA) requirements on growth performance and stress resistance of the larval white shrimp, *Litopenaeus vannamei*. Five isoenergetic and isonitrogenous fish meal-fish protein hydrolysate-based diets with five levels of ApP, AsA equivalent to 91.8, 188, 271, 360 and 436 mg kg⁻¹ diet were fed to triplicate groups of *L. vannamei* (mean initial wet weight 1 mg) for 32 days. The diet with AsA 91.8 mg kg⁻¹ showed high cumulative mortality after 10 days of feeding. After the 32-day trial, the shrimp that fed the diet had significantly lower survival and weight gain (WG, %) than those that fed 188, 271, 360 and 436 mg AsA kg⁻¹ diets. Specific growth rate (SGR, % day⁻¹) and final body wet weight (FBW, mg) showed the same pattern as WG (%). There were no significant differences in growth performance (FBW, WG and SGR) among the groups that fed 188, 271, 360 and 436 mg kg⁻¹ of AsA at the termination of feeding trial. Broken-line regression analysis on WG indicated that 191 mg AsA kg⁻¹ in the diet was the optimum for larval *L. vannamei*. On the contrary, dietary level of more than 360 mg AsA kg⁻¹ was needed to ensure high resistance to stressful conditions such as low dissolved oxygen stressors.

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EFFECTS OF PROTEIN HYDROLYSATE IN WEANING DIETS FOR ATLANTIC COD (*GADUS MORHUA* L.) AND ATLANTIC HALIBUT (*HIPPOGLOSSUS HIPPOGLOSSUS* L.)

A. Kvale, T. Harboe, A. Mangor-Jensen, K. Hamre-2009

Aquaculture Nutrition 15(2): 218 – 227

Abstract:

The study aims to test whether predigested dietary protein enhances the utilization of formulated diets at weaning, and also whether it stimulates intestinal maturation. In this study, Atlantic cod [*Gadus morhua* L.; 41 days posthatch (dph)] and Atlantic halibut [*Hippoglossus hippoglossus* L.; 63 days postfirst feeding (dpff)] were weaned onto diets with graded levels of protein hydrolysate. By increasing the inclusion of dietary protein as hydrolysate from 0 to 400 g kg⁻¹, cod increased the rate of survival from 7 ± 1% to 18 ± 2% (82 dph; regression, $P = 4 \cdot 10^{-7}$). In halibut, the survival rate decreased from 57 ± 9% to 22 ± 7% as the inclusion of protein in the form of hydrolysate increased from 0 to 450 g kg⁻¹ (119 dpff; regression, $P = 8 \cdot 10^{-5}$). Growth was not affected in any of the species. Results in specific activities of the intestinal enzymes leucine aminopeptidase (LAP) and alkaline phosphatase (AP) supported the results in survival in halibut and partly also in cod, by showing increased activities in groups with increased survival (anova, $P < 0.05$). The lower optimal level of hydrolysed protein in halibut than in cod is suggested mainly because of a slower feeding practice in halibut, which allows more extensive nutrient leaching before ingestion.

(National Institute of Nutrition and Seafood Research (NIFES), Nordnes, Bergen, Norway; email of Audil Kvåle: audbruf1@online.no)

INFLUENCE OF WATER TEMPERATURE ON SPAWNING INDUCTION AND LARVAL DEVELOPMENT OF THE SEA SQUIRT *HALOCYNTHIA RITTERI* (OKA, 1906)

Kyoung Ho Kang, Zhi Feng Zhang, Zhen Min Bao, Bin Zhou, Chan Bae Han-2009

Aquaculture Research 40(5): 513 – 518

Abstract:

In order to establish a large-scale hatchery technique for the sea squirt *Halocynthia ritteri*, the influences of water temperature on spawning induction, larval development and survival of *H. ritteri* were studied under laboratory conditions. The larvae of *H. ritteri* exhibited high sensitivity to changes in temperature. As temperature increased from 10 to 21 °C, the duration of larval stage was inversely

related to temperature and the time to reach attached larvae stage decreased from 42.0 to 59.4 h. The biological minimum temperature for the early development of *H. ritteri* was estimated to be 0.22 °C. In relation to temperature, quadratic equations showed significant fits to the data of spawning rate, fecundity, fertilization, larval survival and attachment. Optimal temperatures for spawning rate, fecundity, fertilization rate, larval survival rate and attachment rate were estimated to be 14.9, 14.7, 13.2, 14.1 and 14.7 °C respectively. It is concluded that the range of 13–15 °C is optimal for spawning and larval rearing of sea squirts.

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IDENTIFICATION AND PARTIAL CHARACTERIZATION OF SELECTED PROTEOLYTIC ENZYMES IN THE DIGESTIVE SYSTEM OF GIANT FRESHWATER PRAWN *MACROBRACHIUM ROSENBERGII* (DE MAN) POSTLARVAE

Mohamed Ayaz Hasan Chisty, Roshada Hashim, Alexander Shu -Chien Chong-2009

Aquaculture Research 40(5): 519 – 525

Abstract:

Biochemical assays and substrate SDS-PAGE were conducted to partially characterize and identify various types of proteases present in the digestive tract of PL15 giant freshwater prawn (*Macrobrachium rosenbergii*). Casein hydrolytic assay of the enzyme extracts showed major proteolytic activities at pH 3.0, 6.0 and 9.0, while assay of preincubated enzyme extracts with phenylmethylsulphonyl fluoride (PMSF), a serine protease inhibitor produced a 33.17% reduction in alkaline protease activity. When specific inhibitors tosyl-lysine chloromethyl ketone and tosyl-phenylalanine chloromethyl ketone were used, they resulted in a reduction in activity of proteases in the enzyme extracts by 82.41% and 55.03%, respectively, confirming the presence of trypsin and chymotrypsin, while ethylenediamine tetraacetic acid produced protease activity reduction in 33.92% showing the presence of metalloproteases in the digestive tract of the prawn. Further characterization of the alkaline proteases using SDS-PAGE technique, after incubating the extract in the presence or absence of specific inhibitors, produced six bands corresponding to molecular masses of between 13.48 and 136.1 kDa; two trypsin bands of 13.48 and 36.4 kDa, three chymotrypsin bands in the range of 23.0–73.4 kDa and one for metalloprotease of 136.1 kDa, all of which were identified from a zymogram. This study suggests that protein digestion in *M. rosenbergii* is initiated by an acid protease followed by a combination of action of alkaline proteases: trypsin, chymotrypsin and metalloproteases.

(Laboratory of Aquafeed and Feeding Management, Aquaculture Research Group, School of Biological Sciences, Universiti Sains Malaysia, 11800 Penang, Malaysia; email of R. Hashim: roshadahashim@gmail.com)

PROXIMATE BIOCHEMICAL VARIATIONS IN EGGS OF THE PRAWN *MACROBRACHIUM AMERICANUM* (BATE, 1869) DURING ITS EMBRYONIC DEVELOPMENT

Marcelo García-Guerrero-2009

Aquaculture Research 40(5): 575 – 581

Abstract:

Eggs of seven females were sampled to analyse the lipid, protein and carbohydrate content during the embryonic development of the prawn *Macrobrachium americanum*. Sampling was performed from recently spawned eggs to hatching. A hundred of eggs were sampled every 48 h during the trial. Proteins, lipids and carbohydrates were quantified. Proteins were the most abundant component, followed by lipids and carbohydrates as only minor constituents. Lipid decreased significantly from 42% to 23% of the total composition, while proteins increased from 55% to 76% and carbohydrates varied inconsistently. The change in total energy per egg through time during the embryonic development is represented by the equation $y = -0.0133x + 0.334$; $r^2 = 0.94$ (y represents the energy content and x represents days). The main energy provider was lipids whose energy consumption is described by the equation $y = -0.0158x + 0.203$; $r^2 = 0.96$.

(CIIDIR-IPN Unidad Oaxaca, Calle Hornos No.1003, C.P. 71230, Oaxaca, Mexico; E-mail: mgarciagu@ipn.mx)

SELECTION OF PROBIOTIC BACTERIA FOR USE IN SHRIMP LARVICULTURE

Jiin-Ju Guo, Kuan-Fu Liu, Shin-Hong Cheng, Chin-I Chang, Jiunn-Jyi Lay, Yueh-O Hsu, Jan-Yen Yang, Tzyy-Ing Chen-2009

Aquaculture Research Volume 40 Issue 5, Pages 609 – 618

Abstract:

Three candidate probiotics, *Bacillus foraminis*, *Bacillus cereus* biovar *toyoi* and *Bacillus fusiformis*, were isolated from hydrogen-producing fermented solution and identified using 16S rRNA sequence analysis. *Bacillus foraminis* and *B. cereus* biovar *toyoi* exhibited strong antagonism against *Streptococcus iniae* and *Photobacterium damsela* subsp. *piscicida* in in vitro co-culture for competitive exclusion assay and then were conducted in the larviculture system of *Penaeus monodon* reared from zoea 1 to postlarva 1. The daily addition of *B. cereus* biovar *toyoi* resulted in significantly deleterious effects on survival ($P < 0.01$) whereas the daily addition of *B. fusiformis* showed highest survival rate ($88.7 \pm 0.7\%$) but no statistically significant difference from control ($73.3 \pm 12.1\%$). *Bacillus fusiformis* was continuously applied in the larviculture system of *Litopenaeus vannamei*. Administration of *B. fusiformis* significantly increased survival ($P < 0.01$) in both treatments added daily ($87.9 \pm 1.7\%$) and every other day ($54.7 \pm 1.2\%$), respectively, at a concentration of 10^5 CFU mL⁻¹ over control ($41.2 \pm 1.3\%$).

(Tungkang Biotechnology Research Center, Fisheries Research Institute, Council of Agriculture, Pingtung 928, Taiwan; email of J-J Guo: jjguo@mail.tfrin.gov.tw)

REAL-TIME PCR DETECTION AND QUANTIFICATION OF FISH PROBIOTIC PHAEOBACTER STRAIN 27-4 AND FISH PATHOGENIC VIBRIO IN MICROALGAE, ROTIFER, ARTEMIA AND FIRST FEEDING TURBOT (*PSETTA MAXIMA*) LARVAE

M.J. Prol, J.B. Bruhn, J. Pintado, L. Gram-2009

Journal of Applied Microbiology 106(4): 1292 – 1303

Abstract:

Aims: To develop a SYBR Green quantitative real-time PCR protocol enabling detection and quantification of a fish probiotic and two turbot pathogenic *Vibrio* spp. in microcosms.

Methods and Results: *Phaeobacter* 27-4, *Vibrio anguillarum* 90-11-287 and *Vibrio splendidus* DMC-1 were quantified as pure and mixed cultures and in presence of microalgae (*Isochrysis galbana*), rotifers (*Brachionus plicatilis*), *Artemia* nauplii or turbot (*Psetta maxima*) larvae by real-time PCR based on primers directed at genetic loci coding for antagonistic and virulence-related functions respectively. The optimized protocol was used to study bioencapsulation and maintenance of the probiont and pathogens in rotifers and for the detection and quantification of *Phaeobacter* and *V. anguillarum* in turbot larvae fed rotifers loaded with the different bacteria in a challenge trial.

Conclusions: Our real-time PCR protocol is reproducible and specific. The method requires separate standard curve for each host organism and can be used to detect and quantify probiotic *Phaeobacter* and pathogenic *Vibrio* bioencapsulated in rotifers and in turbot larvae.

Significance and Impact of the Study: Our method allows monitoring and quantification of a turbot larvae probiotic bacteria and turbot pathogenic vibrios in in vivo trials and will be useful tools for detecting the bacteria in industrial rearing units.

(Instituto de Investigaci3n Marianas (CSIC), Eduardo Cabello, Vigo, Spain; email of Lone Gram: gram@aqua.dtu.dk)

VIRULENCE OF LUMINESCENT AND NON-LUMINESCENT ISOGENIC VIBRIOS TOWARDS GNOTOBIOTIC ARTEMIA FRANCISCANA LARVAE AND SPECIFIC PATHOGEN-FREE LITOPENAEUS VANNAMEI SHRIMP

L.H. Phuoc, T. Defoirdt, P. Sorgeloos, P. Bossier-2009

Journal of Applied Microbiology 106(4): 1388 – 1396

Abstract:

Aims: This study was conducted to test the virulence of luminescent (L) and non-luminescent (NL) isogenic strains of *Vibrio campbellii* LMG21363, *Vibrio harveyi* BB120 (wild type) and quorum-sensing mutant strains derived from the wild type such as *Vibrio harveyi* BB152, BB170, MM30 and BB886.

Methods and Results: The NL strains could be obtained by culturing rifampicin-resistant luminescent strains in the dark under static condition. The virulence of the L and NL strains was tested in gnotobiotic *Artemia franciscana* larvae challenged with 104 CFU ml⁻¹ of bacteria. All luminescent isogenic tested strains showed higher virulence compared to the NL strains. The virulence of L and NL *V. campbellii* and *V. harveyi* BB120 was also tested in specific pathogen-free juvenile shrimp upon intramuscular injection with 106 CFU of bacteria. In contrast with *Artemia*, there was no significant difference in mortality between the groups challenged with L and NL strains ($P > 0.05$). The non-luminescent strains were not able to revert back to the luminescent state and quorum sensing did not influence this phenotypic shift.

Conclusions: Luminescent *Vibrio* strains can switch to a non-luminescent state by culturing them in static conditions. The NL strains become less virulent as verified in *Artemia*.

Significance and Impact of the Study: The luminescent state of *Vibrio* cells in a culture needs to be verified in order to assure maintenance of virulence.

(Faculty of Bioscience Engineering, Laboratory of Aquaculture and *Artemia* Reference Center, Ghent University, Gent, Belgium; email of Peter Bossier: peter.bossier@ugent.be)

TRANSGENERATIONAL MARKING OF MARINE FISH LARVAE: STABLE-ISOTOPE RETENTION, PHYSIOLOGICAL EFFECTS AND HEALTH ISSUES

D. H. Williamson, G. P. Jones, S. R. Thorrold, A. J. Frisch-2009

Journal of Fish Biology 74(4): 891 – 905

Abstract:

This study examined the toxicological and physiological responses of a commercially important coral-reef grouper, *Plectropomus leopardus* (Serranidae), to injection of enriched stable-isotope barium chloride (BaCl₂) solution. Thirty adult *P. leopardus* were subject to one of two ¹³⁸BaCl₂ injection treatment groups (corresponding to dosage rates of 2 and 4 mg ¹³⁸Ba kg⁻¹ body mass), and a control group in which fish were injected with 0.9% sodium chloride (NaCl) solution. Fish from each group were sampled at post-injection intervals of 48 h and 1, 3, 5 and 8 weeks, at which time blood and tissue samples were removed from each fish. Residual concentrations of Ba and ¹³⁸Ba:¹³⁷Ba ratios were measured in muscle, gonad, liver and bone tissues of each experimental fish. Elevated Ba concentrations were detected in all treatment fish tissue samples within 48 h post injection. Residual Ba concentrations decreased throughout the remainder of the 8 week experimental period in all tissues except bone. The BaCl₂ injection had no significant effects on measured whole blood variables or on the plasma concentrations of steroid hormones. Enriched Ba stable isotopes can therefore be used at low dosages to mark larvae of commercially important marine fishes, without adverse effects on the health of the fishes or on humans who may consume them.

(ARC Centre of Excellence for Coral Reef Studies, and School of Marine and Tropical Biology, James Cook University, Townsville, QLD 4811, Australia ; email of David Williamson: david.williamson@jcu.edu.au)

A COMPARISON OF GUT EVACUATION MODELS FOR LARVAL MACKEREL (SCOMBER SCOMBRUS) USING SERIAL PHOTOGRAPHY

R. Dunbrack, L. A. Giguère, J.-F. St-Pierre-2009

Journal of Fish Biology 74(4): 906 – 920

Abstract:

A novel technique is described, using serial photography of the gut contents of transparent living larval fishes, to generate individual gut evacuation time series. This technique was applied to Atlantic mackerel *Scomber scombrus* larvae to compare three widely used models of gut evacuation: linear, exponential and square-root. Regression r^2 for the exponential model exceeded those for the linear and square root models in 20 of 21 time series, strongly supporting the exponential model. At the initial gut fullness for each time series, total gut evacuation rates calculated with the exponential model averaged 2.2 and 1.3 times greater than those calculated with the linear and square-root models, respectively, and would produce correspondingly higher estimates of feeding rates for field-collected larvae with similar levels of gut fullness. The results highlight the importance of choosing the appropriate evacuation model in feeding studies, particularly those intended to examine short-term changes in larval fish feeding rates, a contributing factor to the highly variable yearly recruitment of many marine fish species.

(Biology Department, Memorial University, St John's, NL, A1B 3X9 Canada; email of R. Dunbrack: dunbrack@mun.ca)

EFFECTIVENESS OF PADDY FIELDS AS AN INITIAL GROWTH ENVIRONMENT FOR LARVAL AND JUVENILE NIGOROBUNA CARASSIUS AURATUS GRANDOCULIS

Shigefumi Kanao, Taisuke Ohtsuka, Masayoshi Maehata, Noriyasu Suzuki, Hirochi Sawada-2009

Nippon Suisan Gakkaishi 75 (2): 191-197 (2009)

Abstract:

Carassius auratus grandoculis larvae and juveniles were released in paddy fields near Lake Biwa. Later, they were periodically collected and subject to growth analysis of total length (TL) and body weight (BW). As a result, daily growth rates in both TL and BW reared in paddy fields were high in comparison to those of fish reared in fishery ponds and raised naturally in reed zones of Lake Biwa. The survival rate of *C. a. grandoculis* in paddy fields increased with lower population density. Meanwhile, daily growth increments shifted from an increase to a decrease at 11-24 days of age in TL, and at 15-44 days of age in BW. Therefore, paddy fields are considered to be highly effective as an initial growth (until about 40 days of age) environment for *C. a. grandoculis*.

(Taga Town Museum, Inukami, Shiga 522-0314, Japan)

SURVIVAL, GROWTH, DENSITY AND STANDING STOCK OF UNDERYEARLING WHITE-SPOTTED CHARR SALVELINUS LEUCOMAENIS FROM EYED EGGS STOCKED IN A JAPANESE MOUNTAIN STREAM

Tomoyuki Nakamura, Takahide Doi-2009

Nippon Suisan Gakkaishi 75 (2): 198-203 (2009)

Abstract:

We stocked eyed eggs of the white-spotted charr *Salvelinus leucomaenis* in fish-uninhabited reaches of the Kirizushisawa Stream of Kinu River, Tone River System, central Japan in January 2005 and 2006 using the Vibert box technique and surveyed the incubation rate, survival rate, growth, density and standing stock of the underyearling charr from the eyed eggs between August and November. In each year, the incubation rates were 93.2 and 99.0% and survival rates from eyed egg to November were 5.6 and 3.6%. The average standard length and body weight were 57.4 mm, 3.8 g and 60.3 mm, 3.8 g, and density and standing stock per 1 m² water surface were 0.67 fish, 2.6 g and 0.48 fish, 1.8 g in November for each year, respectively. The number of eggs/fish decreased exponentially from January to November in both years.

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