
EFFECT OF N-3 AND N-6 FATTY ACIDS IN BROODSTOCK DIET ON REPRODUCTION AND FATTY ACID COMPOSITION OF BROODSTOCK AND EGGS IN THE JAPANESE EEL *ANGUILLA JAPONICA*

H. Furuita, K. Horib, Suzuki, T. Sugita, T. Yamamoto-2007

Aquaculture 267(1-4): 55-61

Abstract:

This study investigated the effect of n-3 to n-6 fatty acid ratios in broodstock diets on reproduction and fatty acid composition of broodstock and eggs of the Japanese eel. Broodstock were fed with a commercial diet supplemented with various lipids for 3 months before induction of maturation. The supplemental lipids were prepared by a combination of corn oil and pollack oil (corn oil alone (CO); corn oil:pollack oil = 1:1 (MX); pollack oil alone (PO)). Weight gain of broodstock during the feeding trial was slightly lower in fish fed PO compared to the other two groups, but the differences were not significant. Buoyant egg rate and fertilization rate in the CO group were higher than the other two groups. However, the lowest hatching rate was found in the CO group. Fatty acid composition of diets affected the composition of broodstock and egg fatty acids, in particular arachidonic acid (AA) and eicosapentaenoic acid (EPA) levels. Elevated levels of the corn oil supplementation significantly increased AA level and decreased EPA level in polar lipids. In contrast to AA and EPA, there was no notable effect of dietary lipids on docosahexaenoic acid (DHA) level. The present study suggests that both n-3 and n-6 fatty acids are necessary for reproduction as well as growth of eel broodstock, and a higher ratio of n-6 to n-3 fatty acids negatively affected embryogenesis.

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TRACERS IN FISH LARVAE NUTRITION: A REVIEW OF METHODS AND APPLICATIONS
Luís E.C. Conceição, Sofia Morais, Ivar Rønnestad-2007

Aquaculture 267(1-4): 62-75

Abstract:

Knowledge on fish larval nutritional requirements is limited and mostly qualitative rather than quantitative information is available. The assessment of these nutritional requirements has been held up due to the small size of the animals, the fact that most species do not grow well on inert microdiets, and difficulties to determine feed intake and digestibility of diets. To overcome such difficulties, tracers have been intensively used in recent years, following intermittent use since the 60's. However, tracer studies have also known limitations and interpretation of results should be done with care. This paper reviews tracer methodologies used in nutritional studies for fish larvae, including their advantages and limitations, and illustrates with examples of such studies dealing with feed intake, digestion, absorption and utilization of nutrients. A range of tracer methodologies to perform larval nutrition studies is currently available. These may be instrumental to improve the understanding of nutritional physiology of marine fish larvae and their nutritional requirements. Tube feeding of a radiolabeled nutrient (normally ¹⁴C-labeled), followed by quantification of the tracer that is present in faeces, retained in tissues and catabolised, after some hours, has been used to assess the digestion/absorption capacity for different amino acids (AA), fatty acids (FA) and lipid classes, as well as their relative utilization for energy production. A method combining the use of live food in which proteins are labeled with a stable isotope and a spectroscopic/spectrometric technique that allows determination of the isotopic enrichment in individual AAs, can be used to estimate ideal dietary indispensable AA (IAA) profiles. Feed intake can be estimated using either microdiets or live food labeled with radio or stable isotopes, in order to study factors impinging on feed intake regulation, and to improve knowledge on the effect of feed intake in nutritional requirements and digestive physiology. However, results obtained using tracer studies do not necessarily represent the digestive and metabolic performance of an undisturbed larvae feeding ad libitum in a culture system or in the open ocean. Still, when these methods are used in standardized conditions, they can serve as

tools to assess and compare performance between treatments and to study ontogenetic changes. It is nonetheless advisable that long term effects be assessed in subsequent validation growth trial-type experiments. Furthermore, tracer studies can be very useful to screen effects and reduce the number of treatments to be tested in growth-trial experiments.

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MODELLING RETINOID CONTENT IN LIVE PREY: A TOOL FOR EVALUATING THE NUTRITIONAL REQUIREMENTS AND DEVELOPMENT STUDIES IN FISH LARVAE

Gemma Giménez, Yannis Kotzamanis, Francisco Hontoria, Alicia Estévez, Enric Gisbert-2007
Aquaculture 267 (1-4): 76-82

Abstract:

This study was conducted to evaluate the accumulation of different levels of total vitamin A in live prey (*Brachionus plicatilis* and *Artemia nauplii*) enriched with a commercial emulsion (0.15 and 0.6 g l⁻¹ for rotifers and *Artemia nauplii*, respectively), which contained increasing levels of all-trans retinyl acetate. Emulsions used for rotifer enrichment contained 124, 138, 151, 165, 178, 192, 226, 259 and 327 µg total vitamin A l⁻¹, whereas those used for *Artemia nauplii* contained 494, 548, 602, 629, 710, 764, 899, 1034 and 1334 µg total vitamin A l⁻¹. Total vitamin A incorporation in rotifers was constant until a threshold comprised between 226 and 327 µg total vitamin A l⁻¹, above which the incorporation of total vitamin A from the emulsion was maximum (806 ng total vitamin A mg DW⁻¹ in rotifers enriched with 327 µg total vitamin A l⁻¹). In *Artemia nauplii*, total vitamin A increased from 4.0 ng mg DW⁻¹ up to 52 ng mg DW⁻¹ in nauplii enriched with an emulsion containing 1334 µg total vitamin A l⁻¹. Retinoid levels in live prey increased as the content of all-trans retinyl acetate augmented in the emulsion, although they did not accumulate in a dose-dependent manner because retinoid incorporation in live prey was found to be not proportional to the content in the emulsion. Rotifers exhibited a higher retinoid incorporation pattern than *Artemia nauplii*, which seemed to be related to species-specific differences between both live prey. Both live prey were able to absorb and metabolize the vitamin A compounds administered through the emulsion, according to the results regarding retinol and retinoic acid content although the levels were higher in the rotifers than in the nauplii. The differential pattern of total vitamin A accumulation between rotifers and *Artemia nauplii* should be considered when designing nutritional studies dealing with this vitamin and first feeding marine larvae reared on live prey due to the difficulty in maintaining constant levels of total vitamin A especially during the transition feeding phase from rotifers to *Artemia nauplii*.

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PACIFIC BLUEFIN TUNA, *THUNNUS ORIENTALIS*, LARVAE UTILIZE ENERGY AND NUTRIENTS OF MICROBIAL LOOP

Yoshizumi Nakagawa, Mitsuru Eguchi, Shigeru Miyashita-2007

Aquaculture 267(1-4): 83-93

Abstract:

Prey-predator interactions among planktonic organisms in larval tanks of bluefin tuna and red sea bream were investigated quantitatively, and carbon flow models were constructed from the results of feeding experiments. Two different carbon pathways were uncovered in the rearing water of both fish species. One was from autotrophic nano-plankton (ANP) to rotifers to fish larvae (artificial food chain) and the other was from bacteria to heterotrophic nano-plankton (HNP) to heterotrophic microplankton (HMP) (a microbial loop). Surprisingly, bluefin tuna selectively consumed HMP, especially dinoflagellates, throughout the experiment. In the bluefin tuna tank, the microbial loop was linked to the artificial food chain. On the other hand, red sea bream larvae did not consume HMP and the pathway in the red sea bream tank was more straightforward than in the bluefin tuna tank. Energy and nutrients transferred to red sea bream larvae via the artificial food chain only, except for 3 days after hatching. Biomass of micro-protzoa were high (3.2–158.4 ng C ml⁻¹) in the bluefin tuna tank with

higher water temperature (26.0–27.6 °C) and low (3.0–4.9 ng C ml⁻¹) in the red sea bream tank with lower temperature (19.8–20.1 °C). The study suggests that difference in water temperature is a significant factor for the microbial loop in rearing tanks of fish larvae. This is the first report suggesting that a microbial loop, established naturally, contributes energy and nutrient gain to bluefin tuna larvae reared in an artificially controlled environment.

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CHANGES IN THE GASTROINTESTINAL PH FROM LARVAE TO ADULT IN SENEGAL SOLE (SOLEA SENEGALENSIS)

M. Yúfera, M.J. Darías-2007

Aquaculture 267(1-4): 94-99

Abstract:

This study examines the changes of pH in the lumen of the digestive tract during the transition from larvae to juveniles and in adults of the invertebrate-feeder marine flatfish *Solea senegalensis*. Digestive pH was determined in the different segments of the gut with a pH microelectrode (tip diameter 600 µm). The smaller larvae in which the measurement was possible ranged between 20 and 40 mg wet weight. This size roughly coincides with the apparition of the first gastric glands. The juveniles and adults of this species have a small stomach, long intestine and lack a pyloric caeca. The gastric pH declined slightly with an increase in weight and never decreased below 6.0 irrespective of the age. In older fish the gastrointestinal pH was significantly lower than in younger ones. The values in the anterior part of the intestine were close to those measured in the stomach, but an increase in pH was observed progressing through the medium and posterior intestine. Acid digestion and proteolysis in the stomach seems to be residual in the Senegal sole. The digestion occurs primarily in its long intestine in a slightly alkaline environment.

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TOTAL AROMATIC AMINO ACID REQUIREMENT OF INDIAN MAJOR CARP LABEO ROHITA (HAMILTON) FRY

Mukhtar A. Khan, S.F. Abidi-2007

Aquaculture 267(1-4): 111-118

Abstract:

An 8-week growth trial was conducted to quantify the total aromatic amino acid (phenylalanine + tyrosine) requirement of Indian major carp *Labeo rohita* fry (3.5 ± 0.2 cm; 0.18 ± 0.04 g) by feeding isonitrogenous (40% crude protein) and isocaloric (17.90 kJ g⁻¹ gross energy) amino acid test diets containing casein, gelatin and l-crystalline amino acids with graded levels of phenylalanine (0.40, 0.65, 0.9, 1.15, 1.4 and 1.65% dry diet, with 1% tyrosine fixed in each diet) to apparent satiation in triplicate groups, twice a day at 07.00 and 17.30 h. Specific growth rate (SGR) 2.53%, feed conversion ratio (FCR) 1.41, protein efficiency ratio (PER) 1.77 and body protein deposition (BPD) 33.69 were significantly (P < 0.05) higher in fish fed the diet containing 1.15% phenylalanine. Second-degree polynomial regression analysis of SGR, FCR, PER and BPD data indicated the dietary phenylalanine requirement at 1.21, 1.22, 1.22 and 1.16% of the dry diet, corresponding to 3.02, 3.05, 3.05 and 2.90% of the dietary protein, respectively. On the basis of the quadratic regression analysis of SGR, FCR, PER and BPD data, it is recommended that the inclusion of total aromatic amino acid (phenylalanine + tyrosine) in the range of 2.16% (1.16% phenylalanine + 1.0% tyrosine) of the dry diet, corresponding to 5.40% (2.9% phenylalanine + 2.5% tyrosine) of protein to 2.22% (1.22% phenylalanine + 1.0% tyrosine) of the dry diet, corresponding to 5.55% (3.05% phenylalanine + 2.5% tyrosine) of the dietary protein is essential in developing total aromatic amino acid balanced diets for intensive culture of fry *L. rohita*.

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IS IT POSSIBLE TO INFLUENCE EUROPEAN SEA BASS (*DICENTRARCHUS LABRAX*) JUVENILE METABOLISM BY A NUTRITIONAL CONDITIONING DURING LARVAL STAGE?

M. Vagner, J.L. Zambonino Infante, J.H. Robin, J. Person-Le Ruyet-2007

Aquaculture 267(1-4): 165-174

Abstract:

The purpose of this study was to check if it is possible to influence sea bass juvenile metabolism by a conditioning of larvae from day 6 post hatching to day 45 to a low or a high HUFA compound diet (LH, 0.8% EPA + DHA and HH, 2.2% EPA + DHA) when reared at 16 or 22 °C. Following a 3-month intermediate period (at 19 °C using a commercial diet), the adaptability of the 4 initial larval groups to a HUFA experimental deprived diet (0.5% EPA + DHA) were tested at 19 °C in a 60 day-experiment (d-151–211). The four experimental duplicated conditions were ex-LH16 and ex-HH16 for the 2 groups previously reared at 16 °C (initial weight, 7.3 ± 0.5 g) and ex-LH22 and ex-HH22 for the 2 groups previously reared at 22 °C (initial weight, 11.1 ± 0.5 g). Survival was maximal and there was a 1.6–2 fold increase in mass during the experiment. Growth was similar in the 4 experimental groups: NS difference in growth curve slopes ($P = 0.7$). At the end of the experiment (d-211), whole body fat levels were in the same range in all groups (13–15% WW). The fatty acid (FA) composition in polar lipids (PL) and total lipids (TL) were significantly affected by initial weight related to larvae conditioning, which can be mainly attributed to a dilution effect (impact of initial FA content on final FA content versus relative mass increase during the course of the experiment). Conversely to this trend, DHA content in PL was higher in the ex-LH groups than in the ex-HH groups whatever thermal conditioning of larvae was. This indicated that ex-LH groups had a better capacity to adapt to a deficient HUFA diet than ex-HH fish. The relative expression of the delta-6 desaturase ($\Delta 6D$) was significantly higher in ex-LH than in ex-HH groups ($P < 0.001$) between d-151 and d-181, which suggested that $\Delta 6D$ transcription in ex-LH groups was positively modulated by the HUFA-deprived diet. This stimulation of the first step of the desaturation/elongation pathway could allow synthesizing FA needed to compensate low dietary HUFA supply. This study shows for the first time that it seems possible to influence juvenile fish metabolism by a nutritional conditioning during the larval stage.

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YELLOW HEAD-LIKE VIRUSES AFFECTING THE PENAEID AQUACULTURE INDUSTRY: A REVIEW

James Munro, Leigh Owens-2007

Aquaculture Research 38(9): 893-908

Abstract:

This review focuses on relevant scientific information regarding the current knowledge of the yellow head complex viruses, yellow head virus and gill-associated virus. The yellow head complex viruses have been problematic within the aquaculture industry for over 10 years and still retain their research topicality. Presently, there are numerous research papers from different journals covering the identification, disease expression and spread, pathogenesis, detection, morphology, genomic sequence and protein profiles of the yellow head complex viruses. Indeed, there has been no extensive review to compare these studies, and as a corollary, to assess flaws in contemporary research and knowledge. Additionally, the yellow head complex viruses rank within the top four prawn viruses with respect to disease impact and economic loss. This review collectively reports on all the findings and current methods of research and aims to identify weak areas of research where conclusions have been unjustifiably drawn and furthermore to elucidate areas that have a gap of knowledge.

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A COMPARISON OF HUMAN CHORIONIC GONADOTROPIN AND LUTEINIZING HORMONE RELEASING HORMONE ANALOGUE FOR OVULATION INDUCTION IN BLACK SEA BASS *CENTROPRISTIS STRIATA* (LINNAEUS, 1758)

Michael R. Denson, Wallace E. Jenkins, David L. Berlinsky, Theodore I. J. Smith-2007

Aquaculture Research 38 (9): 918–925

Abstract:

Mature black sea bass, *Centropristis striata* L. (200–800 g), were captured in coastal South Carolina during the spawning season and administered hormones for ovulation induction and strip spawning. During both study years, control groups of females were incorporated into the study design and administered sham injections containing physiological saline solution. In 2004, females received a single intramuscular injection of human chorionic gonadotropin (hCG) (330 IU kg⁻¹) (n=8) or two injections of hCG at 24-h intervals (n=8). In 2005, females received a single injection of hCG (n=10) or an analogue of luteinizing hormone releasing hormone (LHRHa) (n=10). In 2004, all fish administered a single dose of hCG ovulated at least once. Six fish ovulated on two consecutive days and one fish ovulated on 3 days consecutively. In contrast, six of eight fish receiving two doses of hCG ovulated once, five ovulated on 2 days successively and three fish ovulated 3 days in succession. Of the fish that spawned, no differences were found in any reproductive parameters. In 2005, all fish administered hCG or LHRHa ovulated at least once. Three fish administered hCG ovulated twice, four fish ovulated on three consecutive days and one fish 4 days successively. All fish administered LHRHa spawned at least twice, six fish ovulated thrice and three fish ovulated 4 days, successively. A significant difference in fertility was found between hCG (75.6±11.4%) and LHRHa (55.6±27.4%). The results of this study indicate that both hCG and LHRHa are effective for ovulation induction in prespawning black sea bass.

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BIODIVERSITY AND THE FUNCTIONING OF HYPERSALINE LAKE ECOSYSTEMS FROM CRIMEA PENINSULA (BLACK SEA)

Golubkov, Sergey; Kemp, Richard; Golubkov, Mikhail; Balushkina, Evgenia; Litvinchuk, Larisa; Gubelit, Yulia-2007

Fundamental and Applied Limnology/Archiv für Hydrobiologie 169(1): 79-87(9)

Abstract:

Environmental variables, biodiversity-productivity relationships and energy pathways were investigated in six shallow lakes of the Crimea with salinity ranging from 24 to 429 g/l. The research included estimations of primary production and total phosphorus concentrations, evaluation of species composition and abundance of planktonic and benthic organisms. There were considerable inter- and intra-annual fluctuations in the abiotic characteristics of the lakes. All lakes had a very high concentration of total phosphorus in the water (up to 5.6 gP/m³) due to a great influence of the watershed on the lakes. A high level of primary production (up to 14.9 gC m⁻²d⁻¹) was found in most of the lakes. The lowest primary production was in the most saline lake with a dense population of the filtrator, *Artemia* sp. There were weak negative relationships between the species richness of phytoplankton and the salinity, but species richness of zooplankton and zoobenthos was strongly negatively related to salt concentration. Positive relationships were found between the total number of planktonic and benthic species and primary production of plankton. Grazing benthic energy pathways were dominant at salinities between 25 and 62.5 g/l. Greater levels of salinity led to the gradual reduction of benthic and to an increase of planktonic energy pathways. There were strong positive relationships between species richness and the primary production of phytoplankton. Three different mechanisms are discussed that provide an explanation for this result. They are energy allocation for osmoregulation at high salinities, complementarity in resource utilization of phytoplankton species and trophic-cascade interactions in ecosystems.

ANALYSIS OF BACTERIAL COMMUNITIES IN NANNOCHLOROPSIS SP. CULTURES USED FOR LARVAL FISH PRODUCTION

Gentoku Nakase, Mitsuru Eguchi-2007

Fisheries Science 73 (3): 543–549

Abstract:

Phytoplankton used in fish hatcheries is mass-cultured in the open air and usually contains large numbers of bacteria. In commercial fish production, the phytoplankton cultures are usually added into the larval rearing tanks; however, the numbers and types of bacteria introduced into the rearing tanks simultaneously are unknown. In this study, the bacterial community structures in *Nannochloropsis* sp. cultures were analyzed by using fluorescence in situ hybridization (FISH). A direct viable count (DVC)-FISH analysis was also performed as DVC is useful for the detection of actively growing cells. Total numbers of bacteria in *Nannochloropsis* sp. cultures ranged from 7.72×10^5 – 2.39×10^6 cells/mL. High proportions of the total bacteria (31.6–53.6%) in the *Nannochloropsis* sp. cultures showed growth potential. DVC-FISH analysis revealed that α -proteobacteria and the Cytophaga–Flavobacterium cluster were abundant in the bacterial community of actively growing cells. Thus, the high growth potentials of the distinct bacterial communities in *Nannochloropsis* sp. culture must influence the bacterial communities in larval rearing tanks.

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ASSESSMENT OF MARINE THRAUSTOCHYTRID SCHIZOCHYTRIUM LIMACINUM OUC88 FOR MARICULTURE BY ENRICHED FEEDS

Xiaojin Song, Xuecheng Zhang, Nan Guo, Luying Zhu, Chenghong Kuang-2007

Fisheries Science 73 (3):565–573

Abstract:

In the present study, *Schizochytrium limacinum* OUC88, a thraustochytrid with high content of docosahexaenoic acid (DHA, 22:6 n–3), was used as feed for rotifer *Brachionus plicatilis* and *Artemia franciscana*. The rotifer and *Artemia* were harvested at 3, 6, 9, 12, 18, and 24-h intervals, analyzed for fatty acid composition, and compared with the control which fed on yeast only. The highest DHA content resulted from an enrichment period of 12 h for both fed organisms, reached 13.4 and 10.9% of the total fatty acids (TFAs) in rotifers and *Artemia* nauplii, respectively, and the DHA level reduced sharply if enrichment time was longer than 12 h. The pseudoalbinism rate of turbot *Scophthalmus maximus* juveniles fed enriched rotifers and *Artemia* nauplii reduced greatly (40% lower than in control group). Thus, enrichment of rotifers and *Artemia* nauplii by DHA-rich *Schizochytrium limacinum* OUC88 may provide a practical strategy for feeding fish juveniles in aquaculture.

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IMMUNOHISTOCHEMICAL CHANGES IN PRODUCTION OF PITUITARY HORMONES DURING ARTIFICIAL MATURATION OF FEMALE JAPANESE EEL *ANGUILLA JAPONICA*

Yuichi Ozaki, Koichi Ishida, Koji Saito, Kazuhiro Ura, Shinji Adachi, Kohei Yamauchi-2007

Fisheries Science 73 (3): 574–584

Abstract:

Specific antibodies against follicle-stimulating hormone β subunit (FSH β), prolactin (PRL), and somatolactin (SL) of the Japanese eel *Anguilla japonica* were produced. These antibodies, as well as antibodies against luteinizing hormone β subunit (LH β) and growth hormone (GH) produced previously, were used to examine changes in the production of pituitary hormones in female eels during maturation induced by salmon pituitary homogenate (SPH) injection. Immunohistochemical observations showed a decrease in FSH production after SPH injection, suggesting that SPH inhibits FSH production. In contrast, LH production increased markedly with maturation. The number of GH producing cells decreased gradually during maturation, possibly because of inhibition by exogenous GH present in the SPH and/or endogenous insulin-like growth factor-I produced by the stimulation of

salmon GH. Although changes in the number of PRL producing cells with maturation were not evident, the number of SL producing cells showed a peak at the late vitellogenic stages, and thereafter decreased to the migratory nucleus stage. These results suggest that GH and SL are involved in sexual maturation in SPH injected eels, as in other fishes.

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OBSERVATIONS ON FEED SIZE AND CAPTURE SUCCESS IN THE LARVAL BUTTERFLY SPLITFIN (*AMECA SPLENDENS* MILLER & FITZSIMONS, 1971, PISCES: GOODEIDAE) REARED ON ZOOPLANKTON

F. Peña-Aguado, S. Nandini, S. S. S. Sarma-2007

Journal of Applied Ichthyology 23 (3): 264–269

Abstract:

In this study, we quantified the feeding behaviour (encounter, attack, capture and ingestion) of larval *A. splendens* on micro-crustacean prey [cladocerans: *Alona rectangula*, *Simocephalus vetulus* (separately neonates and adults), *Ceriodaphnia dubia*, *Daphnia pulex* (juveniles), *Moina macrocopa* and ostracods: *Heterocypris incongruens*]. Although we initially (first 4 weeks) offered rotifers (*Brachionus calyciflorus* and *B. patulus*), they were not consumed by the larvae and hence observations with these prey were discontinued. Feeding behaviour was observed during the first 10 weeks. Fifteen observations were made with each prey species (seven diets × four replicates). Experiments were conducted in 50 ml transparent containers with 20 ml fish-conditioned water into which one fry was introduced. Before introducing the fish, 20 individuals of a given cladoceran prey species or 50 individuals of a rotifer prey species were introduced. Until the fourth week, we used 20 ml of medium and thereafter 30 ml, but the prey density used remained constant (1 ind. ml⁻¹). Observations (10 min per fry per cladoceran replicate) were taken under a stereomicroscope (20×) for the first 2 weeks and later with a lamp and a magnifying lens. The number of encounters (E), attacks (A), captures (C) and ingestions (I) were recorded. During the study period, there was a 60% increase in gape size but only a 30% increase in body length. The number of encounters of larval *A. splendens* was highest (192) on *M. macrocopa* and lowest (29) on ostracods and adult *S. vetulus* (59). The inverse relationship between capture success and prey size was more pronounced during the latter half of the study period. Compared with all the other prey types offered, *A. splendens* fed maximally on *M. macrocopa*, which therefore could be a suitable diet for the larval rearing of this fish species.

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TRYPSIN AND CHYMOTRYPSIN AS INDICATORS OF NUTRITIONAL STATUS OF POST-WEANED SEA BASS LARVAE

B. Cara, F. J. Moyano, J. L. Zambonino, C. Fauvel-2007

Journal of Fish Biology 70 (6): 1798–1808

Abstract:

The aim of the present work was to evaluate to what extent variation in the activity of either trypsin or chymotrypsin could be a sensitive and reliable indicator of nutritional deficiencies during post-weaning stages in a marine fish. Sea bass *Dicentrarchus labrax* larvae obtained from two different spawns classified as high quality (HQ) or low quality (LQ) on the basis of their hatching variables, were used to evaluate if enzyme production could be conditioned by factors other than those related to the feeding regime. In addition, larvae in each group were either fed normally or received a ration reduced by 60%. Trypsin and chymotrypsin activities were separately measured in larvae at days 3 and 15 after weaning. Changes in mass and final survival were also recorded. Food limitation resulted in a lower final mass only in the HQ larvae. Survival was significantly higher in HQ larvae, but also in larvae suffering food restriction, irrespective of the quality of the spawn. In both groups of larvae, lower food availability was correlated to increased values of trypsin, and particularly, of

chymotrypsin. Variations were high enough to support the usefulness of such enzymes as indicators of a modified nutritional status. It is suggested that the noticeable increase in the activity of both enzymes observed in the restrictedly fed larvae could compensate initial deficiencies and explain the good results in growth and survival obtained in LQ larvae.

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STUDIES ON THE TRANSMISSION OF WSSV (WHITE SPOT SYNDROME VIRUS) IN JUVENILE MARSUPENAEUS JAPONICUS VIA MARINE MICROALGAE

Bo Liu, Zhiming Yu, Xiuxian Song, Yueqiang Guan-2007

Journal of Invertebrate Pathology 95(2): 87-92

Abstract:

We studied the possible role that marine microalgae may play during the outbreaks of WSS (white spot syndrome). In order to elucidate the possibility of marine microalgae carrying WSSV (white spot syndrome virus), six marine microalgae (*Isochrysis galbana*, *Skeletonema costatum*, *Chlorella* sp., *Heterosigma akashiwo*, *Scrippsiella trochoidea*, *Dunaliella salina*) were co-cultured with adult *Marsupenaeus japonicus* infected with WSSV and were assayed daily by nested-PCR to study whether they could carry WSSV. Further experiments were conducted to investigate whether the virus carried by microalgae could re-infect juvenile *M. japonicus*. Results showed that all of the experimental microalgae, except *H. akashiwo* could carry WSSV, and among them, *Chlorella* sp. and *S. trochoidea* had the strongest WSSV-carrying ability. Unlike other invertebrate carriers of WSSV, the WSSV detections in microalgae, which were positive after 1 and 3 days, were negative after 10 days of incubation. WSSV detection results in juvenile *M. japonicus* showed that the juvenile shrimp were re-infected by co-cultured *Chlorella* sp., although the juvenile *M. japonicus* carried so small an amount of WSSV that it could only be detected by nested-PCR. The results of this experiment suggest that microalgae might be one possible horizontal transmission pathway for WSSV. Further research, however, is required to better understand the factors behind the different carrying abilities and virus-carrying mechanisms of different microalgae.

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