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> Dennis McIntosh
> WAS Web Editor

AASA and our mailing list

> I have for many years maintained a mailing list to disseminate opportunities and new information pertaining to fisheries and aquaculture in Africa. As the sector becomes better organized and more professional, a number of similar lists have evolved. To try and work together as much as possible to create critical mass and a common perspective, the Aquaculture Association of Southern Africa, a non-profit organization that seeks to share information and represent the continent's fish faming community and I have agreed that my periodic news items will be in future shared through their monthly newsletter. This increases the size of our network and the possibilities for productive collaboration. You should have

received a copy of the latest AASA newsletter this week. If not, please contact me and I will rectify.

In addition, new networking efforts are underway to establish the Aquaculture Network for Africa (ANAf) which seeks to create synergies among Africa's widely dispersed aquaculture research community. An early project that is collaborating and hoping to reinforce ANAf is SARNISSA, a 3-year project being run by the University of Stirling, WorldFish and CIRAD. You will be hearing more about these two initiatives anon. It would be excellent if you can avail yourselves of these networks to identify regional projects to reinforce the knowledge base and expertise upon which African aquaculture can grow.

Randall E Brummett, PhD
Senior Scientist -WorldFish
Humid Forest Center
BP 2008 (Messa)
Yaounde, Cameroun
Tel: (237) 22 23 74 34

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EFFECTS OF FOOD NITROGEN CONTENT AND CONCENTRATION ON THE FORMS OF NITROGEN EXCRETED BY THE CALANOID COPEPOD, ACARTIA TONSA
Carolyn A. Miller, Michael R. Roman-2008
Journal of Experimental Marine Biology and Ecology 359(1): 11-17
Abstract:
Nitrogen excreted as ammonium, urea, and dissolved primary amines (DPA), and nitrogen ingested by the planktonic calanoid copepod, Acartia tonsa, were measured while fed 4 foods with different N/C ratios in high (500 μg C l− 1) and low (50 μg C l− 1) concentrations. Adult copepods were fed the ciliate, Uronema marinum (N/C = 0.26), the diatom, Thalassiosira weissflogii, in log-phase growth (N/C = 0.20), and in senescent-phase growth (N/C = 0.12), and detritus derived from the saltmarsh grass, Spartina alterniflora, (N/C = 0.04). Total nitrogen excreted ranged from 0.06 to 0.18 μg N copepod− 1 d− 1 whereas nitrogen ingested exhibited considerably more variation (0.01 to 0.39 μg N copepod − 1d − 1). Ammonium was the dominant form of nitrogen excreted and was influenced by both food concentration and N/C ratio. Copepods fed foods with N/C ratios resembling their own body composition (log-phase diatoms and ciliates) excreted more ammonium when fed higher concentrations of food. In contrast, copepods fed foods with lower N/C ratios than their own body composition excreted more ammonium when fed lower concentrations of food, suggesting that they were catabolizing body protein for survival. Excretion of urea varied with food N/C ratio, with more

urea excreted when the copepods were fed higher N/C foods. The excretion of DPA did not vary with either food concentration or food N/C ratio. Homeostasis serves to conserve the N/C ratio of copepods. Thus nitrogen excretion by healthy copepods should be expected to increase with ingestion only when copepods have high quantities of nitrogen-rich foods relative to the body composition of the copepods.

(Horn Point Laboratory, University of Maryland Center for Environmental Science, P.O. Box 775, Cambridge, MD 21613, USA; email of M. Roman: roman@hpl.umces.edu)

EFFECT OF ROTIFER ENRICHMENT ON SUNSHINE BASS MORONE CHRYSOPS × M. SAXATILIS LARVAE GROWTH AND SURVIVAL AND FATTY ACID COMPOSITION

Gerald M. Ludwig, Steven D. Rawles, Steve E. Lochmann-2008

Journal of the World Aquaculture Society 39(2):158-173

Abstract:

The effect of enriching rotifer prey with highly unsaturated fatty acids on sunshine bass Morone chrysops × M. saxatilis larval survival and growth from ages 4 to 12 d posthatch was determined. Comparisons were made among larvae fed (1) rotifers cultured with Nannochloropsis paste versus rotifers cultured with Nannochloropsis paste and enriched with Culture Selco 3000; (2) no rotifers versus rotifers cultured with Nannochloropsis paste and enriched with Culture Selco 3000; and (3) rotifers cultured with Nannochloropsis paste and enriched with Culture Selco 3000, rotifers cultured with Nannochloropsis and Pavlova pastes and enriched with Culture Selco 3000, and rotifers cultured with Nannochloropsis paste and enriched with Culture Selco 3000 and Super Selco. The only differences in survival were unfed larvae with practically no survival compared to 55.4% survival for larvae fed rotifers cultured with paste plus Culture Selco 3000. Larvae fed rotifers cultured with paste plus Culture Selco 3000 were longer and had greater condition than those fed rotifers cultured with paste. Additional enrichment with Pavlova sp. or Super Selco had no affect. A canonical analysis of fatty acid contents of diets, rotifers, and fry supported evidence from harvest results. Distances between centroids indicated distinct differences among diets, less distinction among the rotifers, and little difference among fry. Enrichment enhanced growth, but additional enrichment beyond that done during rotifer culture did not increase survival, growth, or condition.

(Stuttgart National Aquaculture Research Center, PO Box 1050, Stuttgart, Arkansas 72160 USA)

GROWTH, MATURATION, INDUCED SPAWNING, AND PRODUCTION OF THE FIRST GENERATION OF SOUTH AMERICAN CATFISH, PSEUDOPLATYSTOMA SP., IN NORTH AMERICA

Konrad Dabrowski, Murat Arslan, Jacques Rinchard, Maria Esther Palacios-2008

Journal of the World Aquaculture Society 39 (2): 174–183

Abstract:

Growth, plasma steroids, and the appearance of gonads (histology and gonadosomatic index) were followed in South American catfish (surubim, Pseudoplatystoma sp.) raised in captivity in the aquaculture facility at The Ohio State University, Columbus, Ohio, USA, from 2003 until 2006. Broodstock growth showed a great individual variation and it did not seem sex dependent. The levels of 11-ketotestosterone were high in males during the reproductive season. Three out of six females spawned after receiving two doses of carp pituitary extract (0.5 and 5 mg/kg) at 11-h intervals. Fertilization was performed in only one female in February 2006. Egg size was 0.73 ± 0.06 mm in diameter at stripping. Two males released sperm, and it was used for fertilization. Sperm concentrations were 24 × 109 and 15.5 × 109 spermatozoa/mL in Male 1 and Male 2, respectively, and viability was confirmed after activation in 0.3% NaCl. Embryo survival at 9 h after fertilization was 44 and 23% for Male 1 and Male 2, respectively. Embryos hatched 15 h after fertilization. Larvae were 3.53 ± 0.09 mm in length at hatching and were successfully raised (72% survival after 2 wks) using live brine shrimp nauplii.

(School of Environment and Natural Resources, The Ohio State University, Columbus, Ohio 43210 USA)

DEVELOPMENT OF A SQUID-HYDROLYSATE-BASED LARVAL DIET AND ITS FEEDING PERFORMANCE ON SUMMER FLOUNDER, PARALICHTHYS DENTATUS, LARVAE

Peizhi Lian, Chong M. Lee, David A. Bengtson-2008

Journal of the World Aquaculture Society 39(2): 196–204

Abstract:

Locally generated squid-processing byproduct was processed into concentrated hydrolysate (22% solids, 17.3% protein, and 3.0% lipid, primarily phospholipids—11.6% eicosapentaenoic acid/24.5% docosahexaenoic acid on a lipid weight basis). Two microparticulate diets (65% protein, 19% lipid, 7.5% carbohydrate, and 19.12 MJ/kg energy, on a dry weight basis) were prepared using squid hydrolysate (SH) and squid-herring hydrolysate as sole protein sources (73.3 and 78.65% of the whole diet, respectively). A 22-d feeding trial with summer flounder, Paralichthys dentatus, larvae of 17 d after hatch showed that the survival rate (92%) of larvae fed SH was significantly ($P < 0.05$) higher than those of larvae fed live Artemia nauplii (81%) and a commercial diet, Proton (65%), while specific growth rates (SGR) were comparable (2.23% /d for SH and 2.86% /d for Artemia) with the lowest for Proton (1.39% /d). After switching from commercial and Artemia diets to a SH diet for 17 d following the 22-d feeding, significant improvements were seen in survival rates of postweaning larvae fed previously commercial (65.28–76.57%) and Artemia diets (81.25–89.07%).

(Department of Nutrition and Food Sciences, University of Rhode Island, 530 Liberty Lane, West Kingston, RI 02892, USA)

COMPARISON OF GROWTH AND FATTY ACIDS COMPOSITION OF FRESHWATER ROTIFER, BRACHIONUS CALYCIFLORUS PALLAS, FED WITH TWO TYPES OF MICROALGAE AT DIFFERENT CONCENTRATIONS

Abdolmohammad Abedian Kennari, Nasrollah Ahmadifard, Jafar Seyfabadi, Maryam Fallahi Kapourchali-2008

Journal of the World Aquaculture Society 39(2): 235–242

Abstract:

As algae and their concentrations are important factors for mass culture of rotifer, two experiments were conducted to find the effects of two types of algae, Chlorella sp. and Scenedesmus obliquus, and three concentration of chosen algae (0.1 × 106, 1 × 106, and 10 × 106 cells/mL) on growth and fatty acid composition of freshwater rotifer, Brachionus calyciflorus. The result of the first experiment showed that the maximum density of rotifer was significantly higher when fed with Chlorella sp. (478 individuals/mL) than fed with S. obliquus (328 individuals/mL). Mean population growth rate (r) was 0.61 and 0.44 for rotifer fed with Chlorella sp. and S. obliquus, respectively. The amount of highly unsaturated fatty acid (HUFA) in rotifer fed with Chlorella sp. (3.32%) was relatively more than those fed with S. obliquus (2.65%). Then, Chlorella sp. was selected based on better performance. In the second experiment, the maximum rotifer density of 108 ± 8, 489 ± 47, and 493 ± 51 individuals/mL was reached after 5 d for the respective Chlorella sp. concentrations; at concentration of 10 × 106 cells/mL, the maximum density of 1820 ± 47 individuals/mL was obtained. Mean growth rate at mentioned concentrations was 0.18, 0.42, and 0.51/d, respectively. Increase in algal concentration was associated with a relative increase in HUFA and decrease in monounsaturated fatty acid.

(Department of Fisheries, Faculty of Natural Resources & Marine Sciences, Tarbiat Modares University, Noor, Mazandaran, Iran 46414-3561)

EVALUATION OF GAMBUSIA, GAMBUSIA AFFINIS, FISH MEAL IN PRACTICAL DIETS FOR FRY NILE TILAPIA, OREOCHROMIS NILOTICUS

Mohammad H. Ahmad-2008

Journal of the World Aquaculture Society 39(2): 243–250

Abstract:

This study was conducted to evaluate the use of gambusia, Gambusia affinis, fish meal (GFM) in practical diets for fry Nile tilapia, Oreochromis niloticus (2.11 ± 0.11 g). Six isonitrogenous diets (35%) were formulated in which GFM replaced 0.0, 10, 25, 50, 75, or 100% of the protein supplied

by herring fish meal (HFM). Fish were fed one of the test diets at a feeding rate of 4% of the fish body weight 6 d a week, 2 times a day for 13 wk. Results demonstrated that fish growth increased with increasing GFM up to 75%, which produced the highest growth of the treatments. The lowest fish growth was obtained at 100% GFM. Feed intake (FI), protein efficiency ratio (PER), and apparent protein utilization (APU) increased significantly, while feed conversion ratio (FCR) decreased significantly with increasing GFM up to 75%. FI, PER, and APU decreased significantly, while FCR increased significantly for diets containing 100% GFM. There were no significant differences in moisture, protein, lipid, or ash contents in final fish body following inclusion of GFM in fish diet. There was no significant difference in the digestibility coefficient of dry matter. The digestibility coefficients of protein and gross energy for diets containing 100% GFM replacement were the lowest as compared with other GFM levels. The present study recommended that GFM is a suitable protein source in practical diets for fry Nile tilapia and could replace HFM up to 75%.
(Department of Fish Nutrition, Central Laboratory for Aquaculture Research, Abbassa, Abo-Hammad, Sharkia 44662, Egypt)

EFFECTS OF AN EXTENDED HATCHERY PHASE AND VACCINATION AGAINST ENTERIC SEPTICEMIA OF CATFISH ON THE PRODUCTION OF CHANNEL CATFISH, ICTALURUS PUNCTATUS, FINGERLINGS

Abel A. Carrias, Jeffery S. Terhune, Christopher A. Sayles, Jesse A. Chappell-2008
Journal of the World Aquaculture Society 39(2): 259–266
Abstract.:
The present study was conducted to evaluate production management methods to improve overall survival of channel catfish, Ictalurus punctatus, fry to the fingerling stage by incorporating the use of a live, attenuated vaccine against Edwardsiella ictaluri and employing an extended hatchery phase. In this experiment, four treatments were used. In Treatment 1, 10-d posthatch (PH) fry were vaccinated and then directly stocked into earthen ponds. In Treatments 2 and 3, 10-d PH fry were sham-vaccinated (control) and vaccinated, respectively, kept in nursery tanks for 22 d, and then stocked into earthen ponds. Fry in Treatment 4 were sham-vaccinated at 10 d PH, kept in nursery tanks for 22 d, and then vaccinated prior to stocking into earthen ponds. Mean fingerling yield at harvest ranged from 4716 kg/ha in Treatment 1 to 8112 kg/ha in Treatment 4. Mean individual fish weight ranged from 38.8 g in Treatment 1 to 40.9 g in Treatment 4, and feed conversion ratios (FCR) ranged from 1.15 in Treatment 4 to 1.51 in Treatment 1. Mean survival ranged from 47.5% in Treatment 1 to 73.4% in Treatment 4. In specific comparisons to evaluate the nursery effect (Treatments 1 and 3), yield and overall survival were significantly different ($P < 0.05$) between these two treatments. In specific comparisons to evaluate the effect of the use of the vaccine (Treatments 2, 3, and 4), overall survival was significantly different ($P < 0.05$) between Treatment 2 (sham-vaccinated control with nursery phase) and Treatment 4 (vaccinated at 32 d PH with nursery phase). No significant differences ($P > 0.05$) in yield, average weight, and FCR were observed between treatments. Results indicate that implementing an extended hatchery phase and vaccination strategy with older fry can improve overall survival of fingerling fish.
(Department of Fisheries and Allied Aquacultures, Auburn University, Auburn, Alabama 36849 USA)

EFFECTS OF VARYING CONCENTRATIONS OF L-CARNITINE-INCORPORATED DIETS ON GROWTH AND BODY COMPOSITION OF FRY OF CIRRHINUS MRIGALA (HAMILTON, 1822)

Ravendra Kumar Singh, Ajay S. Desai, Sugandha L. Chavan, Punam A. Khandagale-2008
Journal of the World Aquaculture Society 39(2): 275–280
Abstract:
Experiment was conducted to ascertain the effect of l-carnitine on growth and body composition of Cirrhinus mrigala fry (0.342 ± 0.03 g) using five different concentrations (0.25, 0.50, 0.75, 1, and 0%) of l-carnitine-incorporated diets for 120 d. At the end of trial, weight gain, feed conversion efficiency, and protein efficiency of fishes fed with 0.25% l-carnitine diet were observed to be significantly

higher. Poor growth was recorded in the fry fed diet with no carnitine, while intermediate growth was observed when fed with 0.50, 0.75, and 1% l-carnitine-incorporated diets. The analysis of body composition of C. mrigala fry indicated that there is no significant difference ($P > 0.05$) in moisture, protein, and ash contents, but significant difference ($P < 0.05$) was found in body lipid content of fry, fed with different concentrations of l-carnitine. Decrease in viscerosomatic and hepatosomatic indices were observed in fishes fed with l-carnitine-incorporated diets. Results of this study indicated that diet containing 0.25% l-carnitine can promote higher growth in C. mrigala fry.
(Taraporevala Marine Biological Research Station, New Administrative Building, 3rd Floor, Govt. Colony, Bandra (East), Mumbai 400 051, India)

THE BASICS OF BIO-FLOCS TECHNOLOGY: THE ADDED VALUE FOR AQUACULTURE P. De Schryver, , R. Crab, , T. Defoirdt, , N. Boon, W. Verstraete-2008
Aquaculture 277(3-4): 125-137
Abstract:
The expansion of the aquaculture production is restricted due to the pressure it causes on the environment by the discharge of waste products in the water bodies and by its dependence on fish oil and fishmeal. Aquaculture using bio-flocs technology (BFT) offers a solution to both problems. It combines the removal of nutrients from the water with the production of microbial biomass, which can in situ be used by the culture species as additional food source. Understanding the basics of bio-flocculation is essential for optimal practice. Cells in the flocs can profit from advective flow and as a result, exhibit faster substrate uptake than the planktonic cells. The latter mechanisms appear to be valid for low to moderate mixing intensities as those occurring in most aquaculture systems (0.1–10 W m− 3). Yet, other factors such as dissolved oxygen concentration, choice of organic carbon source and organic loading rate also influence the floc growth. These are all strongly interrelated. It is generally assumed that both ionic binding in accordance with the DLVO theory and Velcro-like molecular binding by means of cellular produced extracellular extensions are playing a role in the aggregation process. Other aggregation factors, such as changing the cell surface charge by extracellular polymers or quorum sensing are also at hand. Physicochemical measurements such as the level of protein, poly-β-hydroxybutyrate and fatty acids can be used to characterize microbial flocs. Molecular methods such as FISH, (real-time) PCR and DGGE allow detecting specific species, evaluating the maturity and stability of the cooperative microbial community and quantifying specific functional genes. Finally, from the practical point of view for aquaculture, it is of interest to have microbial bio-flocs that have a high added value and thus are rich in nutrients. In this respect, the strategy to have a predominance of bacteria which can easily be digested by the aquaculture animals or which contain energy rich storage products such as the poly-β-hydroxybutyrate, appears to be of particular interest.
(Laboratory Microbial Ecology and Technology (LabMET), Ghent University, Coupure Links 653, B-9000 Ghent, Belgium; email of Peter Deschryver: Peter.Deschryver@ugent.be)

DOES DIFFERENT TANK BOTTOM COLOUR AFFECT THE GROWTH, SURVIVAL AND FORAGING BEHAVIOUR OF ATLANTIC COD (GADUS MORHUA) LARVAE?
Jennifer Monk, Velmurugu Puvanendran, Joseph A. Brown-2008
Aquaculture 277(3-4): 197-202
Abstract:
We examined the foraging behaviour, growth and survival of Atlantic cod (Gadus morhua) larvae in two different colours of tank bottom; either beige (light hereafter) or black (dark hereafter) bottomed tanks with black walls. Results showed no significant differences in the growth, foraging behaviour, or survival of Atlantic cod larvae in response to tank bottom colour indicating that larvae could be reared in lighter bottom tanks without any detrimental effect to the larvae. Using a light bottom tank is also of greater benefit to the culturist as they provide better contrast to monitor the behavioural and morphological development of the larvae.
(Ocean Sciences Centre, Memorial University of Newfoundland, St John's, Newfoundland, Canada A1C5S7; email of J. Monk: jmonk@mun.ca)

INHIBITION OF EMBRYO DEVELOPMENT OF THE MYTILUS GALLOPROVINCIALIS MARINE MUSSEL BY ORGANIC POLLUTANTS; ASSESSMENT OF RISK FOR ITS EXTENSIVE CULTURE IN THE GALICIAN RIAS

R. Beiras, J. Bellas-2008

Aquaculture 277(3-4): 208-212

Abstract:
This study evaluates the risk posed by selected organic pollutants on the culture of the marine mussel in the Galician coast (NW Iberian Peninsula), which depends on collection of natural seed in densely populated coastal areas. With this aim toxicity tests were carried out with embryos of the Mytilus galloprovincialis mussel, and the toxicity of the surfactant sodium dodecyl sulphate (SDS) and the biocides TBT, chlorpyrifos and lindane was quantified in terms of median effective concentration (EC50) and toxicity threshold (EC10 and LOEC), using embryogenesis success as end point. The EC10 and EC50 values were 161 and 377 ng/L for TBT, 79 and 154 µg/L for chlorpyrifos, 495 and 2353 µg/L for SDS, 1.41 and 1.99 mg/L for lindane. Toxicity thresholds for mussel embryos from this study and crustacean larvae from the literature were compared to environmental concentrations in coastal waters, either directly measured or estimated from mussel bioaccumulation data, in an attempt to evaluate the risk posed by those pollutants to these commercial species. It was concluded that SDS and, especially, chlorpyrifos and lindane, do not pose a threat to these commercial resources. In contrast, TBT risk quotients derived either from actual seawater measurements or mussel bioaccumulation data were both unacceptably high. TBT pollution represents thus a potential threat to natural availability of spat, the basis of extensive mussel culture. At the light of the data presented, current TBT seawater quality criterion seems underprotective and it should be revised.

(Laboratorio de Ecoloxía Mariña, Área de Ecoloxía, Universidade de Vigo, Campus Lagoas-Marcosende, E-36200, Vigo, Galicia, Spain; email of R. Beiras: rbeiras@uvigo.es)

ARTEMIA ENRICHED WITH HIGH N-3 HUFA MAY GIVE A LARGE IMPROVEMENT IN PERFORMANCE OF ATLANTIC HALIBUT (HIPPOGLOSSUS HIPPOGLOSSUS L.) LARVAE

Kristin Hamre, Torstein Harboe-2008

Aquaculture 277(3-4): 239-243

Abstract:
Atlantic halibut larvae were fed Artemia enriched with two different oil emulsions (cod liver oil and 2050TG) from first feeding to 70 days after first-feeding (dpff). Larvae fed 2050TG enriched Artemia had better growth, survival and eye migration than larvae fed the cod liver oil enriched Artemia, while pigmentation rate was similar in the two groups. In addition to the difference in fatty acids, the two emulsions differed in lipid class composition, since 2050TG is a synthetic oil and a mixture of mono-, di- and tri-acylglycerol, while cod liver oil is a tri-acylglycerol. Total lipid level, estimated as fatty acid methyl esters (FAME) was similar in the two Artemia types, but sum of n-6 and n-3 fatty acids, arachidonic acid (20:4n-6, ARA), docosahexaenoic acid (22:6n-3, DHA) and eicosapentaenoic acid (20:5n-3, EPA) were higher in Artemia enriched with 2050TG than in the cod liver oil enriched Artemia. However, the main difference in fatty acid composition in the larvae, was a higher DHA (% of total fatty acids) in 2050TG larvae than in cod liver oil larvae. The lipid level measured as FAME was up to four times higher in the 2050TG larvae than in the cod liver oil larvae, and the reason for this may have been a better bioavailability of the partly digested lipid in the 2050TG emulsion. The correlation between a high level of lipid in the larval tissues (e.g. high energy status) and improved eye migration in larvae fed the 2050TG enriched Artemia supports the hypothesis that energy limitation on the larval stage may be a cause of the impaired eye migration commonly observed in farmed Atlantic halibut juveniles.

(National Institute of Nutrition and Seafood Research (NIFES), PO Box 2029, 5817 Bergen, Norway; email of Kristin Hamre: kristin.hamre@nifes.no)

INFLUENCE OF DIETARY HUFA LEVELS ON REPRODUCTIVE PERFORMANCE, TISSUE FATTY ACID PROFILE AND DESATURASE AND ELONGASE MRNAS EXPRESSION IN FEMALE ZEBRAFISH DANIO RERIO

Annette Jaya-Ram, Meng-Kiat Kuah, Phaik-Siew Lim, Sagiv Kolkovski, Alexander Chong Shu-Chien-2008

Aquaculture 277(3-4): 275-281

Abstract:
We conducted a study to investigate the effect of different levels of dietary highly unsaturated fatty acids (HUFAs) on tissue fatty acid profiles and reproductive performance in female zebrafish. In addition, the mRNA expression of desaturase and elongase genes in liver, muscle and ovarian tissues were also analysed. Three iso-nitrogenous experimental diets utilizing different ratios of squid oil and linseed oil which were SO (100% squid oil), SLO (1:1 squid oil:linseed oil) and LO (100% linseed oil) as lipid sources were formulated and fed to female zebrafish for 12 weeks. Spawning was carried out twice weekly during the experimental feeding period. Results showed that fatty acid profiles of liver, muscle, ovary and egg reflected profiles of the corresponding dietary treatment. In general, increasing levels of dietary linseed oil lowered deposition of docosahexaenoic acid (DHA, 22:6n-3), eicosapentaenoic acid (EPA, 20:5n-3) and arachidonic acid (ARA, 20:4n-6) in all tissues. Liver fatty acid profile implied increasing biosynthesis activities during feeding of low dietary HUFA diets, which was supported by increased expression of hepatic desaturase and elongase mRNAs. However, the increased HUFA biosynthesis activities were unable to compensate for the inferior hepatic ARA, EPA and DHA levels of fish fed diet LO. In muscle and ovary tissues, relatively lower concentrations of ARA and EPA were also obtained with diet LO. There was no significant difference in EPA and ARA levels in eggs, which imply accumulation of EPA and ARA in eggs. We also showed an increasing trend of ovarian desaturase and elongase gene expression during low dietary HUFA levels. Highest egg production and hatching rate was obtained with diet SLO, which strongly suggests the need for both inclusion and balanced ratio of dietary n-3 and n-6 unsaturated fatty acids by spawning females. Collectively, this study shows that female zebrafish reproduction benefits from the supply of dietary HUFA during reproductive stages, despite possessing ability to increase transcription of desaturase and elongase in various tissues during low dietary HUFA intake.

School of Biological Sciences, Universiti Sains Malaysia, 11800, Minden, Penang, Malaysia; email of Alexander Chong Shu-Chien: alex@usm.my)

GAMETOGENETIC CYCLE AND REPRODUCTIVE EFFORT ASSESSED BY TWO METHODS IN 3 AGE CLASSES OF PACIFIC OYSTERS, CRASSOSTREA GIGAS, REARED IN NORMANDY

Juliette Royer, Catherine Seguineau, Kyung-Il Park, Stéphane Pouvreau, Kwang-Sik Choi, Katherine Costil-2008

Aquaculture 277(3-4) : 313-320

Abstract:
Two methods were used to estimate the reproductive output of female Pacific oysters reared in Normandy: histology with image analysis and ELISA (Enzyme-Linked ImmunoSorbent Assay) which allowed the quantification of egg protein. Condition indices, gonad area and gametogenetic stages of the oysters were determined in the entire population (males and females) between May and October 2005. All investigations were performed in 3 age classes: oysters in their first, second or third years (corresponding to spat, half-grown and market-sized oysters, respectively). Both quantitative histology and ELISA provided similar results in terms of reproductive effort (illustrated by the gonado-somatic index, GSI) except during the GSI drop, corresponding to spawning, which was less marked with the ELISA method. Growth depended on oyster age, the sex ratio was well balanced and the reproductive cycle was synchronized in all age classes. In the 3 age classes, most of the oysters were ripe and ready to spawn on August 8, and ten days after the post-spawning stage was observed in 40% of spat oysters and 70% of half-grown and market-sized bivalves. The major difference between age classes was observed in the reproductive investment, with spat having a lower reproductive output. For example, in males and females, the gonad area reached 78–79% in the median animal section at full maturity (August 8) in half-grown and marketable oysters while it attained only 59% in

spat. At the same time, GSI in females was, respectively in spat and the 2 oldest age classes, 33% (quantitative histology)–36% (ELISA) and 55% (quantitative histology)–60% (ELISA). The mean assessed gonad weight and fecundities increased with the age of the oysters: 1.3 g and 12 million eggs, 7.8 g and 135 million eggs, and 11.5 g and 146 million eggs in spat, half-grown and market-sized oysters, respectively. Marked differences thus appear between 2 and 3-year-old oysters and spat. As early as their first reproductive cycle, the young oysters not only showed the reproductive features of the species in Normandy, but also a pronounced lower reproductive effort. This lower energy demand could explain their higher survival rate.
(Laboratoire de Biologie et Biotechnologies Marines (UMR IFREMER 100; IFR ICORE), Université de Caen Basse-Normandie, Esplanade de la Paix, 14032 Caen, France ; email of Katherine Costil : katherine.costil@unicaen.fr)

EFFECT OF SOYBEAN PHOSPHOLIPID SUPPLEMENTATION IN FORMULATED MICRODIETS AND LIVE FOOD ON FOREGUT AND LIVER HISTOLOGICAL CHANGES OF PELTEOBAGRUS FULVIDRACO LARVAE
Sufang Lu, Na Zhao, Ayong Zhao, Ruiguo He-2008
Aquaculture 278(1-4): 119-127
Abstract:
The effect of supplementation of soybean phospholipid (PL) to Pelteobagrus fulvidraco larvae diets on growth and histological changes in intestine and liver were investigated. P. fulvidraco larvae were fed from day 6 to 21 posthatch with four diets containing the same basal diet, coated with different lipid fractions (6% diet). The lipid fractions consisted of increasing levels of soybean PL (0, 2, 4 or 6% of diet) and decreasing levels of mixed oil (fish oil:soybean oil, 2:1). A group of larvae was fed rotifers as a control. The body weight and total length of larvae increased as a result of PL supplementation. Larvae fed diet supplemented with 6% PL exhibited the best growth performance and similar to those fed rotifers. Larvae fed 6% PL and larvae fed rotifers had normal appearance of enterocytes and liver. The addition of PL to the diet caused a reduction in the degree of lipid accumulation and an increased number of goblet cells in the enterocytes of the anterior intestine. The degree of lipid accumulation in the anterior intestine and in the liver on day 21 was lower than that on day 14, which indicated that the ability of PL synthesis was enhanced as the fish aged. These results confirm that PL has a growth-promoting effect and indicate that soybean PL is suitable as a lipid and PL source in microdiets for P. fulvidraco larvae feed.
(College of Animal Science and Technology, Huazhong Agricultural University, Wuhan 430070, PR China; email of Ruiguo He: hruiguo@yahoo.com.cn)

STUDY ON EARLY-STAGE DEVELOPMENT OF CONCHOSPORE IN PORPHYRA YEZOENSIS UEDA
Fan Xiaolei, Wang Guangce, Li Demao, Xu Pu, Shen Songdong-2008
Aquaculture 278(1-4) : 143-149
Abstract:
Porphyra yezoensis Ueda (Rhodophyta) is a seaweed of economic importance with a typical dimorphic life cycle consisting of a leafy gametophyte and a filamentous sporophyte. Recently, it has been recognized as a model system for fundamental and applied studies in marine biological sciences. Conchospore, a major spore linking the two distinct multicellular phases in the life cycle, is most widely used in the breeding of P. yezoensis. In this paper, the early-stage development of conchospore, including the attachment and the cell wall formation, was studied with fluorescent reagents staining and Scanning Electron Microscopy detection. Results displayed: (1) the cell wall began to be generated after culturing for 4 h in the attached conchospores; (2) the initially released conchospores were plastids with some filmy, amorphous substance on the surface, and they attached to the fibers firmly via the actively secreted mucilaginous substances after their touch to the fibers; (3) cellulase and pectolase prohibited the attachment of conchospores in the different ways; and (4) only attached conchospores generated cell walls and developed normally, while the suspending ones could not. It indicated that the cellulose played crucial roles in the permanent attachment as the pectin did in

the initial attachment. The conchospore attachment seemed to trigger the cell wall formation and the further development. Affects of light on the development of conchospores were also discussed. The results showed that high intensity (200 μmol•m− 2•s− 1) and long-wave (≥ 580 nm) light facilitated the division rate of conchospores.
(Graduate School, Chinese Academy of Sciences, Beijing 100039, China; email of Wang Guangce: gcwang@ms.qdio.ac.cn)

SHORT COMMUNICATION
LARVAL REARING OF BARRAMUNDI (LATES CALCARIFER) IN SALINE GROUNDWATER
G.J. Partridge,A.J. Lymbery, D.K. Bourke-2008
Aquaculture 278(1-4): 171-174
Abstract:
Barramundi (Lates calcarifer) larvae were reared from 2 to 25 days post hatch in 14‰ saline groundwater with either no potassium supplementation (38% K-equivalence) or full potassium supplementation (100% K-equivalence). Growth, survival and swimbladder inflation of these larvae were compared against those grown in control treatments of seawater (32‰) and seawater diluted to 14‰. Those reared in saline groundwater with 38% K-equivalence exhibited complete mortality within 2 days, while those held in groundwater with full supplementation survived at a rate equal to both control treatments (pooled average 51.1 ± 0.5%). At 25 days post hatch, there was no significant difference in larval length or dry weight between those grown in the 14‰ control treatment and those in the saline groundwater with full potassium supplementation. There were no significant differences in swim bladder inflation between any of the surviving treatments (average 93.3 ± 2.5%). This is the first description of rearing barramundi larvae both in low salinity seawater and in saline groundwater and demonstrates that the requirement for potassium by larval barramundi is higher than for juveniles of the same species.
(Aquaculture Development Unit, Challenger TAFE, Fremantle, Australia; email of Gavin Partridge: gavin.partridge@challengertafe.wa.edu.au)

SHORT COMMUNICATION
INFLUENCE OF THE TIME TO EGG STRIPPING ON EYEING AND HATCHING RATES IN RAINBOW TROUT ONCORHYNCHUS MYKISS UNDER COLD TEMPERATURES
Azin Mohagheghi Samarin, Mohammad Reza Ahmadi, Teruo Azuma, Gholam Reza Rafiee, Bagher Mojazi Amiri, Mohammad Reza Naghavi-2008
Aquaculture 278(1-4) : 195-198
Abstract:
The effects of egg retention time in the abdominal cavity after ovulation on eyeing and hatching rates were studied in rainbow trout, Oncorhynchus mykiss, at cold temperatures of 2 and 8 °C. Two types of experiments were performed: 1) eggs with different retention times were grouped by 3-day intervals until 30 days post-ovulation (DPO) and fertilized with mixed milt from the same sources, and 2) partial volumes of eggs were obtained from individually identified females and stripped and fertilized with mixed milt at 7-day intervals for 35 days. The first experiment showed that the eyeing and hatching rates remained greater than 70 and 60%, respectively, throughout the 30-day experimental period except in the shortest DPO group which exhibited rates of 37.6% and 31.5%. The second experiment clarified that deterioration in egg quality did not occur before 30 DPO at 2 °C and 14 DPO at 8 °C. The eyeing rate also did not show any marked reduction during the experimental period (83%) at 2 °C during the period 28–35 DPO in marked contrast with the sharp drop to 3.6% at 8 °C during the same period. The present study demonstrated that the best stripping time was estimated in the range from 30 to 40 degree-days, and over-ripening of the eggs occurred from 224 degree-days after ovulation at least under cold temperature than in studies reported so far.
(Department of Fisheries and Environmental Science, Faculty of Natural Resources, University of Tehran, 31585-4314, Karaj, Iran; email of Mohammad Reza Ahmadi: mahmadi@ut.ac.ir)

ADVANCES IN HATCHERY AND GROW-OUT TECHNOLOGY OF COBIA RACHYCENTRON CANADUM (LINNAEUS)

Daniel D Benetti, Mehmet R Orhun, Bruno Sardenberg, Brian O'Hanlon, Aaron Welch, Ronald Hoenig, Ian Zink, José A Rivera, Bristol Denlinger, Donald Bacoat, Kevin Palmer, Fernando Cavalin-2008

Aquaculture Research 39(7): 701-711

Abstract:

This paper describes advances in hatchery and grow-out technology of cobia (Rachycentron canadum, Linnaeus). In 2007, methods for capture, transport, acclimation, sampling, conditioned spawning, larval rearing, fingerling production, nursery, shipping and grow-out have been perfected. Survival rates ranging from 17.5% to 35% were achieved from egg to shipping size fingerlings (1.0 g) in 2007 at the University of Miami Experimental Fish Hatchery, with production of approximately 20 000 fingerlings per 12 000 L tank. Wild and F1 broodstock cobia have been conditioned to spawn through temperature manipulation producing viable eggs for experimental and production level larval rearing trials in several hatcheries. Brood fish have also been induced to spawn using hormones. Cobia appear to be susceptible to infestations by parasitic protozoa such as Amyloodinium ocellatum and to infections caused by deleterious bacteria such as Photobacterium spp. and Vibrio spp. Prophylactic methods used to prevent and control epizootic diseases at the hatchery are summarized. Improved techniques for cage management were implemented, and both novel designs of submerged cages deployed in exposed areas and traditional gravity cages in protected areas have been used for commercial ongrowing of cobia in the Americas and the Caribbean region.

(Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, FL, USA; email of. D. D. Benetti: dbenetti@rsmas.miami.edu)

HORMONE-INDUCED OVULATION, NATURAL SPAWNING AND LARVICULTURE OF BRAZILIAN FLOUNDER PARALICHTHYS ORBIGNYANUS (VALENCIENNES, 1839)

Luís A Sampaio, Ricardo B Robaldo, Adalto Bianchini -2008

Aquaculture Research 39 (7) : 712–717

Abstract:

Mature Brazilian flounders Paralichthys orbignyanus were captured in coastal southern Brazil and their reproduction in captivity was studied. Brazilian flounder will spawn naturally in captivity when the water temperature is around 23 °C and 14 h of light is provided daily. Females were induced for ovulation and hand stripping using human chorionic gonadotropin, luteinizing hormone-releasing hormone analogue or carp pituitary extract. There was no need to inject males, as running milt was observed during the spawning season. Fertilization and hatching rates were above 80% independent of the hormone used. Notochord length at hatching was 2.18±0.07 mm for larvae hatching from naturally spawned eggs. Larvae were reared in salt water (30–35 g L−1) at 24 °C and under continuous illumination. Larviculture was with green water (Tetraselmis tetrathele 50 × 104 cells mL−1). Rotifers (10–20 ind mL−1) were offered as first food 3 days after hatching and gradually replaced by Artemia nauplii (0.5–10 ind mL−1). Larvae settled to the bottom 20 days after hatching and completed metamorphosis within a week after that. The total length for newly metamorphosed juveniles was 12.9±2.2 mm and the mean survival was 44.8%. The results demonstrate the feasibility of producing Brazilian flounder fingerlings for stock enhancement or grow-out purposes.

(Departamento de Oceanografia, Laboratório de Maricultura, Fundação Universidade Federal do Rio Grande – FURG, Rio Grande–RS, Brazil, 96201-900; email of L A Sampaio: sampaio@mikrus.com.br)

INDUCED BREEDING AND LARVAL REARING OF SURUBÍ, PSEUDOPLATYSTOMA FASCIATUM (LINNAEUS, 1766), FROM THE BOLIVIAN AMAZON

Jésus Nuñez, Rémi Dugué, Navil Corcuy Arana, Fabrice Duponchelle, Jean François Renno, Thomas Raynaud, Nicolas Hubert, Marc Legendre-2008

Aquaculture Research 39 (7): 764–776

Abstract:

Brooders of Surubí (Pseudoplatystoma fasciatum) were caught in the Ichillo River (Bolivian Amazon) and adapted to captivity conditions for 1 year in the facilities of the experimental aquaculture station of 'El Prado' (Santa Cruz de la Sierra) under natural temperature and photoperiod conditions. Induced reproduction was obtained by means of Ovaprim® (Syndel, Canada) injections and artificial fertilization. Sperm and ova were obtained by gentle stripping of male and female brooders. Fertilized eggs were incubated in 60 L Zug jars. A mean hatching rate of 73.7±19.0% was obtained after 24 h at 26.5 °C. For larval rearing, several protocols were tested with different settings of photoperiod, light intensity, food type and period of distribution, and stocking density. The best survival rates were obtained with Artemia nauplii feeding in total darkness. A high level of aggressiveness between larvae and precocious appearance of jumpers was observed, but these can be controlled with appropriate rearing conditions.
(IRD UR 175, GAMET, BP 5095, 34196 Montpellier, cedex 5, France; email of J Nuñez: Jesus.Nunez@ird.fr, nunez@ird.fr

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COMPARISON OF BEHAVIOURAL DEVELOPMENT BETWEEN JAPANESE FLOUNDER (PARALICHTHYS OLIVACEUS) AND SPOTTED HALIBUT (VERASPER VARIEGATUS) DURING EARLY LIFE STAGES

F. de la S. Sabate, Y. Sakakura, A. Hagiwara-2008

Journal of Applied Ichthyology 24(3): 248–255

Summary:
Behavioural development was compared between two flatfish species (Japanese flounder and spotted halibut) from hatching to settlement (juvenile stage) in order to speculate on the ecology of their early life stages and to provide fundamental knowledge for improving seedling production techniques for stock enhancement. Fish were cultured under identical rearing conditions (500-L tank maintained at 17.8 ± 0.4°C, 34 ppt, 10L : 14D light regime and an initial stocking density of 20 larvae L−1). Behavioural observations were conducted at about 4-day intervals from hatching to the juvenile stage. Fish were sampled randomly from the rearing tank, and one fish was transferred into a 250-ml observation container. Behaviour was video-recorded for 5 min without food and for an additional 5 min with live feed (rotifer or Artemia). All behavioural data were sorted according to eight developmental stages and compared among developmental stages and between species. The average standard length of the spotted halibut was significantly greater than that of the Japanese flounder in all developmental stages, while the development of Japanese flounder was faster than that of the spotted halibut. For Japanese flounder, feeding, swimming and Ohm-posture (typical shivering behaviour observed during early life stages in flatfishes) frequency were highest before metamorphosis (mean ± SD; 1.0 ± 2.0 attacks min−1, 24.0 ± 9.6 actions min−1, 1.1 ± 1.1 counts min−1, respectively). Spotted halibut expressed feeding behaviour frequently from the beginning of metamorphosis (3.6 ± 5.2 attacks min−1), had relatively low swimming activity during all developmental stages, and showed a peak of Ohm-posture frequency during the flexion stage (2.6 ± 1.0 counts min−1).
(Graduate School of Science and Technology, Nagasaki University, Bunkyo 1-14, Nagasaki 852-8521, Japan; email of Francisco de la Serna Sabate: d706076h@cc.nagasaki-u.ac.jp)

CHANGES IN FATTY ACIDS AND STEROLS DURING BATCH GROWTH OF PAVLOVA VIRIDIS IN PHOTOBIOREACTOR

Zhibiao Xu, Xiaojun Yan , Luqing Pei, Qijun Luo, Jilin Xu-2008

Journal of Applied Phycology 20(3): 237-243

Abstract :
Changes in the composition of fatty acids and sterols of Pavlova viridis cultured in an air-lift photobioreactor were studied using gas chromatography-mass spectrometry (GC-MS). The results show that radical changes in fatty acid and sterol contents and compositions occurred during growth phase transitions: the total lipid increased along with the culture age, from 166.4 mg g−1 (late exponential phase) to 232.7 mg g−1 (linear phase), and increased further to be 235.1 mg g−1 in the stationary phase. Polyunsaturated fatty acids (PUFAs), especially eicosapentaenoic acid (EPA), decreased along with the culture time, PUFAs, and EPA contents maximized in the late exponential

phase to become 46.2 mg g−1 and 22.1 mg g−1 respectively; there was no significant change in docosahexaenoic acid (DHA) content during the whole growth phase, although it reached the peak in the linear phase with 3.5 mg g−1. As for the sterols, two unique sterols with two hydroxyl groups, termed pavlovols, were observed. 4α,24-Dimethylcholestan-3β,4β-diol, one of the pavlovols, increased almost 2-fold from the late exponential phase (2.5 mg g−1) to the stationary phase (4.3 mg g−1). On the contrary, the contents of stigmasterol and sitosterol decreased with culture age, with the maximum content of 2.4 mg g−1 and 3.1 mg g−1, both obtained in the late exponential phase, respectively. The results indicate that growth phase control could be used as a methodology to optimize the total lipid, EPA, PUFA, and sterol contents with the potential for both aquaculture feeds and nutraceutical applications, especially for further research into unique pavlovols.
(Marine Biotechnology Laboratory, Ningbo University, Ningbo, 315211, China; email of Xiaojun Yan: xiaojunyan@hotmail.com)