INFORMATION OF INTEREST

- More on fish meal / fish oil use in aquaculture diets: two articles in SeaFoodSource.com
- Global Aquaculture Advocate, the monthly magazine of the Global Aquaculture Alliance is now also available free in electronic form. Click to receive notices of new issues, as well as subscribe to the GAA Update e-newsletter.
- FAO yearbook, Fisheries and Aquaculture Statistics 2007 (FAO, 2009): overview of major trends and issues
- SARNISSA Project Newsletter February 2010: link to download
- Success stories in Asian Aquaculture: a 2009 NACA publication
- 2009 Manual for the Commercial Pond Production of the African Catfish in Uganda – site for download
- Epidemiology of different agents causing disease in aquatic animals: scientific review and database development: scientific & technical report submitted to EFSA
- Guide to the co-construction of sustainable development indicators in aquaculture: Cirad, Ifremer, INRA, IRD, UM1, 2008
- Environmental impact assessment and monitoring in aquaculture - requirements, practices, effectiveness and improvements.FAO 2009 Fisheries and Aquaculture Technical Paper 527
- Integrated Mariculture – a global review.FAO 2009 Fisheries and Aquaculture Technical Paper 529
- Climate change implications for fisheries and aquaculture - overview of current scientific knowledge.FAO 2009 Fisheries and Aquaculture Technical Paper 530
- Planning and Management for Sustainable Coastal Aquaculture Development. IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP). FAO 2001 GESAMP Reports and Studies No 68.

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- 461 February 12, 2010
- 462 February 19, 2010
- 463 February 26, 2010
- 464 March 5, 2010

ONTOGENY OF LYMPHOID ORGANS IN THE ASIAN SEA BASS (LATES CALCARIFER, BLOCH)

I.S. Azad, A.R. Thirunavukkarasu, M. Kailasam, R. Subburaj, J.J.S. Rajan-2010

Asian Fisheries Science 22(3): 901-913

Abstract:

Ontogeny of the lymphoid organs of hatchery-reared larvae/juveniles Lates calcarifer (Bloch) was studied from zero day post hatch (dph) to 60 dph. Histological sections of the samples, collected at daily intervals from zero dph till 25 dph, and at weekly intervals till 60 dph were examined. The thymus was first noticed, at 2 dph, as a bi-lobed organ, situated dorso-posteriorly in the oro-pharyngeal cavity, in the angle between the opercular bone and the head bone. The lymphoid kidney (pronephros) was seen with undifferentiated stem cells at 2 dph, though the excretory kidney tubules were noticed at zero dph. The developed kidney runs ventral to the vertebral column all along the length of the peritoneal cavity,

distinctly bi-lobed at its proximal end forming the head-kidney and fused in the mid and tail kidney portions. The spleen, seen mostly as an erythropoietic organ, is capsulated and appeared, at 2 dph, attached to the mesogastrium. The sequence of development of these lymphoid organs was: the thymus (2 dph), the kidney (excretory kidney-0 dph and lymphoid kidney -2dph), the spleen (2 dph) and the gut associated lymphoid tissue (GALT, 5 dph). Various cellular components of these lymphoid organs and their probable role in immune response of the fish have been discussed.

ORIENTATION AFFECTS THE SENSITIVITY OF ACARTIA TONSA TO FLUID MECHANICAL SIGNALS

David M. Fields-2010

Marine Biology 157(3): 505-514

Abstract:

Nearly all organisms show directional bias in sensitivity to environmental signals. In this study, the behavioral sensitivity of a common estuarine copepod, Acartia tonsa, varies significantly with respect to their orientation to a well-characterized fluid mechanical signal. Maximum sensitivity occurs at an angle of 25°–30° and lowest sensitivity occurs at angles of 60°–90° relative to the source. These results support the hypothesis that copepods are not uniformly sensitive to fluid signals and show directional bias in mechanosensitivity. The data also show that large copepods initiate their escape reaction further from the source than small copepods. There is, however, an uncharacteristically large increase in sensitivity at the transition between the nauplii and C1 stage despite being similar in size. This suggests that the mechanosensory system of the naupliar stages is less sensitive to fluid signals and helps to explain the higher predation rates experienced by nauplii.

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VARIABILITY OF ARTEMIA SALINA CYSTS FROM SABKHET EL ADHIBET (SOUTHEAST TUNISIA) WITH SPECIAL REGARD TO THEIR USE IN AQUACULTURE

H. Ben Naceur, A. Ben Rejeb Jenhani, M. S. Romdhane-2010

Inland Water Biology 3(1): 70-78

Abstract :

Brine shrimp Artemia (Crustacea, Anostraca) diverge in biometry and nutritional quality. These differences in Artemia characteristics are significant not only from strain to strain but also from one harvest to another within same strain. The main objective of this study was to compare Artemia salina cysts harvested from Sabkhet El Adhibet (southeast Tunisia) on different dates between 2002 and 2007 with special regard to their use in aquaculture, using cysts and naupliar biometrics, protein, carbohydrate, and lipid content. Fatty acid profiles as well as hatching characterisation were also evaluated. Hydrated cysts measures ranged between 258.1 and 263.7 μm, while the freshly hatched nauplii of Artemia measures ranged between 458.1 and 476.1 μm. Lipid contents of the samples ranged from 16.2 to 18.3% of the dry weight. Fatty acid profiles showed that cysts from Sabkhet El Adhibet contain a high quantity of eicosapentaenoic acid (20: 5n-3) with a percentage ranging between 7.8 and 14.3% of the dry weight. The highest hatching efficiency was obtained for decapsulated cysts collected in 2007 (139500 nauplii g−1 of cysts). Cysts treated with hydrogen peroxide had a hatching percentage of 14.49 to 42.99%. The hatching synchronization time for untreated cysts varied between 23.5 to 27.4h.

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SHARP PHYLOGEOGRAPHIC BREAKS AND PATTERNS OF GENEALOGICAL CONCORDANCE IN THE BRINE SHRIMP ARTEMIA FRANCISCANA

Stefania Maniatsi, Ilias Kappas, Athanasios D. Baxevanis, Theodora Farmaki, Theodore J. Abatzopoulos-2009

Int. J. Mol. Sci. 10(12): 5455-5470

Abstract:
Genealogical concordance is a critical overlay of all phylogenetic analyses, irrespective of taxonomic level. To assess such patterns of congruence we have compiled and derived sequence data for two mitochondrial (16S rRNA, COI) and two nuclear (ITS1, p26) markers in 14 American populations of the hypersaline branchiopod Artemia franciscana. Cladistic analysis revealed three reciprocally monophyletic mitochondrial clades. For nuclear DNA, incomplete lineage sorting was evident presumably as a result of slower coalescence or male-mediated dispersal. Our findings capture the genealogical interval between gene splitting and population divergence. In this sense, strong indications are provided in favour of a superspecies status and ongoing speciation in A. franciscana.
(Department of Genetics, Development & Molecular Biology, School of Biology, Aristotle University of Thessaloniki, 541 24, Greece; email of S. Maniatsi: smaniats@bio.auth.gr)

THE PARASITISM OF FLAMINGOLEPIS LIGULOIDES (GERVAIS, 1847) (CESTODA, HYMENOLEPIDIDAE) IN ARTEMIA SALINA (CRUSTACEA, BRANCHIOPODA) IN TWO SALINE LAKES IN ALGERIA

M. Amarouayache, F. Derbal, M. Hichem Kara-2009

Acta Parasitologica 54(4): 330-334

Abstract:
Studies reveald the role of Artemia salina as intermediate host in the life-cycle of a cestode species parasitizing flamingos, i.e. Flamingolepis liguloides. Cysticercoids of this parasite were found for the first time in the Algerian populations of Artemia salina in winter of 2000 and 2001 in Chott Marouane and spring of 2003 in Sebkha Ez-Zemoul. The prevalence ranged between 10 and 33% for the two examined populations. The intensity of infection was 1-3 cysticercoids per individual. The abdomen was the most targeted site of infection (95 % of the population of Sebkha Ez-Zemoul) followed by the thorax and the ovisac. Infected females were less fertile than uninfected ones (28.43 vs 43.7 cysts/brood) in Sebkha Ez-Zemoul or castrated in Chott Marouane.
(Laboratoire Bioressources Marines, Université d'Annaba, BP 230 Oued Kouba, Annaba 23003, Algeria)

CARACTERISTIQUES ECOLOGIQUES ET BIOLOGIQUES D'ARTEMIA SALINA (CRUSTACE, ANOSTRACE) DE LA SEBKHA EZ-ZEMOUL, ALGERIE NORD-EST
(ECOLOGICAL AND BIOLOGICAL CHARACTERISTICS OF ARTEMIA SALINA (CRUSTACEA, ANOSTRACA) OF THE SEBKHA EZ-ZEMOUL, NORTHEASTERN ALGERIA; in French with English Abstract)

M. Amarouayache, F. Derbal, M.H. Kara-2010

Rev. Ecol (Terre Vie) 65: 13-22

Abstract:
This study concerned some biological and ecological aspects of Artemia salina (Branchiopoda, Anostraca) from the sebkha Ez-Zemoul, situate in North-Eastern Algeria (35 53' N – 06° 30' E). The survey of the demographic structure and density of Artemia population between January 2003 and February 25 shows that this brine shrimp appeared in November after the first hatching, reached a maximum density in March (56 ind. L-1 in 2003 and 38 ind. L-1 in 2004) and disappeared completely in July. The sex ratio was always in favour of males. Its values were very high (1.77-31.80). Males were smaller than females. Their respective lengths varied, according to the sampling period, between 7.10 mm and 8.80 mm and between 8.70 mm and 10.40 mm. The length of females at first sexual maturity varied between 7 mm (November) and 9 mm (April). Oviparity was the main mode of reproduction (90-100%). Females were relatively fertile with an average brood size comprised between 19.50 (May 2003) and 104.7 (March 2003) offsprings/female.
(Laboratoire Bioressources Marines, Université d'Annaba – Badji-Mokhtar, B.P. 230 Oued Kouba, 23003 Annaba, Algeria ; email of F. Derbal : m.derbal@yahoo.fr)

DIFFERENT COLONIZATION AND RESIDENCE TIME OF LISTONELLA ANGUILLARUM AND VIBRIO SPLENDIDUS IN THE ROTIFER BRACHIONUS PLICATILIS DETERMINED BY REAL-TIME PCR AND DGGE

María J. Prol-García, Miquel Planas, José Pintado-2010

Aquaculture 302(1-2): 26-35

Abstract:
Listonella anguillarum 90-11-287 and Vibrio splendidus DMC-1 were incorporated in the rotifer Brachionus plicatilis, which was subsequently maintained under larval rearing conditions to determine the residence time of both pathogens in rotifers.

Real-time PCR was applied to specifically detect and quantify both pathogens. L. anguillarum colonized rotifers more efficiently than V. splendidus and both pathogenic strains were released from rotifers to seawater, after infected rotifers were transferred to rearing tanks. V. splendidus grew and became predominant in the seawater of tanks. Both pathogens remained in rotifer or seawater enough time to infect fish larvae, but their different behaviour could determine different infection patterns, preferentially by ingestion of prey or by active intake or contact with surrounding seawater.

The effect of L. anguillarum and V. splendidus on the bacterial community associated with rotifers and seawater of rearing tanks was analysed by DGGE of PCR-amplified 16S rDNA fragments. The bacterial community of rotifers did not present a marked species dominance. The incorporation of L. anguillarum or V. splendidus did not reduce bacterial diversity and shifts could be explained by bacterial exchange between rotifers and seawater. Main bacterial groups were identified by sequencing the DNA extracted from Marine Agar (MA) bacterial isolates and DGGE excised bands. Only 2 DGGE bands corresponded to bacteria isolated from MA plates, suggesting that bacterial groups present in rotifers may not be easily cultivable. The bacterial community of rotifers was composed by Gram negative bacteria belonging to α-Proteobacteria (Ruegeria spp), γ-Proteobacteria (Alteromonas alvinellae, Marinobacter sp, an Oceanospirillaceae bacterium and Pseudoalteromonas sp), Cytophaga–Flexibacter–Bacteroides.

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EFFECTS OF SALINITY ON EMBRYOS AND LARVAE OF TAWNY PUFFER TAKIFUGU FLAVIDUS

Genyu Zhang, Yonghai Shi, Yazhu Zhu, Jianzhong Liu, Weiling Zang-2010

Aquaculture 302(1-2): 71-75

Abstract:
Tawny puffer Takifugu flavidus is a fish species that has aquaculture potential in China because of its high market value. To determine the optimal condition of salinity for embryo development and larval culture of the species, the effects of salinity (0‰, 5‰, 10‰, 15‰, 20‰, 25‰, 30‰, 35‰, 40‰, and 45‰) on egg hatching and the survival and growth of larvae at 3–23 days post-hatch (dph) were assessed. Embryonic hatching rates were above 70% at salinities of 5‰ to 45‰, and all embryos at 0‰ died 4 days after fertilization. Survival rates (> 75%) of larvae at 24 h post-hatch at salinities of 10‰ to 40‰ were significantly higher than that at salinities of 5‰ and 45‰. The highest hatching rates and lowest percentage of mortalities occurred at salinities of 10‰ to 20‰. Results suggest that the embryos can tolerate a wide range of salinity (10–40‰), and optimal range of salinity for embryo development is between 10‰ and 20‰. The time of egg hatching was not influenced by salinity. Larvae of tawny puffer continued to survive until Day 23 of post-hatch at salinities of 5‰ to 35‰, but all larvae died within 20 dph at 45‰. The highest survival rate occurred at salinities of 15‰ to 35‰, and the highest growth rate was found at salinities of 15‰ to 25‰. The results suggest that the optimal salinity for larval survival and growth is between 15‰ and 25‰.

(Shanghai Fisheries Research Institute, Shanghai, 200433, China; email of Genyu Zhang: zhanggenyu1963@163.com)

THE EFFECT OF POLY B-HYDROXYBUTYRATE ON LARVICULTURE OF THE GIANT FRESHWATER PRAWN MACROBRACHIUM ROSENBERGII

Dinh The Nhan, Mathieu Wille, Peter De Schryver, Tom Defoirdt, Peter Bossier, Patrick Sorgeloos-2010

Aquaculture 302(1-2): 76-81

Abstract:

In this study, we investigated the effect of poly β-hydroxybutyrate (PHB) on the culture performance of larvae of the giant freshwater prawn Macrobrachium rosenbergii and on the bacterial levels inside the larval gut. Instar II Artemia nauplii were cultured with or without PHB (5 g−1l) and/or a lipid emulsion rich in highly unsaturated fatty acids (HUFA) for 24 h. The effect of feeding PHB and/or HUFA-enriched Artemia nauplii on the performance of Macrobrachium larvae was investigated. Feeding larvae of the giant freshwater prawn with PHB-containing Artemia nauplii significantly increased survival and development of the larvae. Moreover, total bacterial counts and Vibrio spp. counts were found to be significantly lower in PHB-fed larvae when compared to control larvae, indicating that the PHB addition had a growth-inhibitory effect towards these potentially pathogenic microorganisms. Finally, a combination of PHB addition and lipid enrichment resulted in the best overall culture performance since it significantly improved larval survival as well as larval development. The optimal PHB concentration and formulation for bio-encapsulation into Artemia should be investigated further to increase the economical efficiency of Macrobrachium larval production.

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EFFECT OF LARVAL DENSITY AND FEEDING SEQUENCE ON MEAGRE (ARGYROSOMUS REGIUS; ASSO, 1801) LARVAL REARING

J. Roo, C.M. Hernández-Cruz, C. Borrero, D. Schuchardt, H. Fernández-Palacios-2010

Aquaculture 302(1-2): 82-88

Abstract:

This paper summarizes results from two comparative studies of the effect of initial larval density and feeding sequence on meagre (Argyrosomus regius) rearing trials. To determine the density effect, two initial larval densities of 50 larvae L−1 and 100 larvae L−1 were established. For each larval density, three feeding sequences were tested, applying different combinations of rotifers (Brachionus sp.) and Artemia sp. at different larval ages. Every 4 days, standard length (SL) and body height (BH) of 25 larvae per treatment were measured. After 30 days after hatching (dah), dry weight (DW) and final survival were determined. Biochemical analysis was performed to determine, ash, protein, lipid content and fatty acid composition from preys, microdiets and larvae at 30 dah from different treatments. The lower larval density, promoted better growth in terms of standard length, body height and dry weight. Early Artemia introduction improved also larval growth. A positive interaction was found between rearing density and feeding sequence. Final survival was also affected by initial larval density and feeding sequence. The best final survival (53.4 ± 12.03%) was obtained in high larval density treatment, while early Artemia introduction reduced final survival (36.75 ± 3.62%). Regarding larval biochemical composition, no significant differences were found in ash, lipid and moisture content among treatments, while significantly higher protein content was measured in larvae reared under low density conditions. Furthermore, no significant interaction was found among density and feeding sequences on biochemical composition, and no significant differences were detected on total fatty acid composition.

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CHARACTERIZATION OF LARVAL MOULTING CYCLES IN MAJA BRACHYDACTYLA (BRACHYURA, MAJIDAE) REARED IN THE LABORATORY

Guillermo Guerao, Guiomar Rotllant, Klaus Anger-2010

Abstract:

The moulting cycles of all larval instars (zoea I, zoea II, and megalopa) of the spider crab Maja brachydactyla Balss 1922 were studied in laboratory rearing experiments. Morphological changes in the epidermis and cuticle were photographically documented in daily intervals and assigned to successive stages of the moulting cycle (based on Drach's classification system). Our moult-stage characterizations are based on microscopical examination of integumental modifications mainly in the telson, using epidermal condensation, the degree of epidermal retraction (apolysis), and morphogenesis (mainly setagenesis) as criteria. In the zoea II and megalopa, the formation of new setae was also observed in larval appendages including the antenna, maxillule, maxilla, second maxilliped, pleopods, and uropods. As principal stages within the zoea I moulting cycle, we describe postmoult (Drach's stages A–B combined), intermoult (C), and premoult (D), the latter with three substages (D0, D1, and D2). In the zoea II and megalopa, D0 and D1 had to be combined, because morphogenesis (the main characteristic of D1) was unclear in the telson and did not occur synchronically in different appendices. The knowledge of the course and time scale of successive moult-cycle events can be used as a tool for the evaluation of the developmental state within individual larval instars, providing a morphological reference system for physiological and biochemical studies related to crab aquaculture.
(IRTA, Unitat de Cultius Experimentals. Ctra. Poble Nou, Km 5.5, 43540 Sant Carles de la Ràpita, Tarragona, Spain ; email of Guillermo Guerao : guillermo.guerao@irta.cat)

ONTOGENY OF THE DIGESTIVE TRACT IN YELLOW CATFISH PELTEOBAGRUS FULVIDRACO LARVAE

Ruibin Yang, Congxin Xie, Qixue Fan, Chao Gao, Libao Fang-2010

Aquaculture 302(1-2): 112-123

Abstract:
The study on histological and ultrastructural characteristics of the digestive tract of yellow catfish (Pelteobagrus fulvidraco) was carried out from hatching (0 day after hatching, DAH) until 35 DAH. Larvae for this study were maintained in the laboratory conditions (water temperature ranged from 23 °C to 25 °C). They were fed with zooplankton from 3 DAH to 17 DAH, with zoobenthos added from 10 DAH, and only zoobenthos from 18 DAH to 35 DAH. Development of the digestive tract in P. fulvidraco followed the general pattern described for other fish species with some peculiar findings. At hatching, it consisted of an undifferentiated straight tube laying over the yolk sac. The digestive tract was differentiated into buccopharynx, esophagus, primary stomach and intestine by 2 DAH. The liver and pancreas also appeared at this time. The intestine became differentiated into anterior and posterior regions separated by the intestine bend at 3 DAH. Gastric gland appeared in cardiac stomach at 3 DAH, the earliest appearance time among fishes studied to date. Oxynticopeptic cell contained pepsinogenic granules and abundant tubulovesicular systems at 3 DAH. As larvae grew, more pepsinogenic granules but less tubulovesicular systems were found in oxynticopeptic cell. The abundant visible tubulovesicular systems suggested that oxynticopeptic cell was still in rest phase with little hydrogen chloride (HCl) secreted at the first appearance time. The ultrastructure of oxynticopeptic cell indicated the asynchronous development of acid-secreting and pepsinogen-secreting function. The epithelial absorptive cell of the anterior and posterior intestinal segments showed electron-opaque lipid droplets and heavy pinocytosis, respectively at 3 DAH. Heavy pinocytosis could be observed in the posterior intestine until 25 DAH. Lipid vacuole accumulation appeared in liver at 13 DAH, the same time as the storage of abundant glycogen. These results suggested that the development of the digestive tract of P. fulvidraco larvae was functional rapidly, however it was still incomplete at 3 DAH. The functions of digestive tract and accessory glands were developed gradually until 25 DAH.
(Fisheries College, Huazhong Agricultural University, Wuhan 430070, China; email of Congxin Xie: xiecongxin@mail.hzau.edu.cn)

LABORATORY INVESTIGATION OF DAILY FOOD INTAKE AND GUT EVACUATION IN LARVAE OF AFRICAN CATFISH CLARIAS GARIEPINUS UNDER DIFFERENT FEEDING CONDITIONS

Armando García-Ortega, Johan Verreth, Karen Vermis, Hans J. Nelis, Patrick Sorgeloos, Martin Verstegen-2010

Aquaculture International 18(2): 119-134
Abstract:
Temporary accumulation of ascorbic acid 2-sulfate (AAS) was measured to estimate food intake and gut evacuation in larvae of African catfish. Fish larvae were fed decapsulated cysts of Artemia containing AAS. In a first experiment it was found that no biosynthesis of AAS occurs in the larvae of this species. In a second experiment, the gut contents of the fish larvae fed were calculated as they changed during development. In a third experiment, the gut evacuation rate of fish larvae was determined during continuous and discontinuous feeding regimes in the first five days after the start of exogenous feeding. Food consumption by catfish larvae increased from 46.5% of their body dry weight (BDW) on day 1 after the start of exogenous feeding to 53.8% BDW on day 3. Thereafter, food consumption decreased to 27.8% BDW on day 5. A similar pattern was observed for gut evacuation, which increased during the first days of exogenous feeding and decreased as fish growth continued. The rate of gut evacuation in a continuous feeding regime was significantly higher ($P < 0.05$) than that under discontinuous feeding. On day 1 post-hatch and 7 h after first food ingestion the fish larvae evacuated 87% of the food in continuous feeding compared with 43% under discontinuous feeding. It was found that gut emptying differs during larval development. Under continuous feeding, on days 1 and 3 post-hatch and 11 h after the first meal 90% of the food was evacuated compared with 71% evacuated on day 5. The advantages and limitations of the AAS method for estimation of food consumption by fish larvae are discussed.
(Laboratory of Nutrition and Larviculture, CIAD Mazatlan Unit in Aquaculture and Environmental Management, P.O. Box 711, 82010 Mazatlan, Sinaloa, Mexico; email of Armando García-Ortega: agarcia@ciad.mx)

EFFECTS OF THE TIMING OF INITIAL FEEDING ON GROWTH AND SURVIVAL OF LOACH (MISGURNUS ANGUILLICAUDATUS) LARVAE

Youji Wang, Menghong Hu, Weimin Wang, S. G. Cheung, P. K. S. Shin, Ling Cao-2010
Aquaculture International 18(2): 135-148
Abstract:
The effects of delayed first feeding on growth and survival and starvation on the point-of-no-return of loach Misgurnus anguillicaudatus larvae were studied by evaluating morphometric characteristics under controlled conditions. Larvae began to feed exogenously at 3 days after hatching (DAH) and the PNR occurred between 9 and 10 DAH at 23 ± 1.0°C. The experimental design included a conventional feeding regime with initial feeding from 3 DAH as a control, delayed first feeding for 4, 5 and 6 DAH. Morphometric characteristics (head depth, body depth, eye diameter, mouth diameter, musculature height, total length and yolk sac volume) were evaluated under different initial feeding time (3, 4, 5 and 6 days after hatching). Loach larvae initiated first feeding at 4, 5 and 6 days after hatching achieved comparatively lesser growth performance in all morphometric characteristics than that of 3 days at the end of the experiment. By day 6, significant differences were observed between 3 and 6 days initial feeding larvae for all morphometric characteristics except eye diameter and mouth diameter. Similarly, significant differences were noticed between 3 and 5 days initial feeding. However, there were no significant differences in head depth, body depth, eye diameter, mouth diameter, and total length between 3 and 4 days initial feeding until 12 DAH. After 15 days rearing, significant differences in all morphometric characteristics appeared between 3 and 4 days initial feeding and followed to the end of the experiment. It was also observed that the yolk absorption in loach larvae was completed by 6 days irrespective of the differences in the initial feeding. The yolk volume of 4 and 5 DAH larvae initiated first feeding at 3 days (0.0125 ± 0.0015; 0.0077 ± 0.0009 mm3) had significant differences compared with yolk volume of larvae initiated first feeding at 4 days (0.0081 ± 0.0011; 0.0039 ± 0.0004 mm3), 5 days (0.0079 ± 0.0010; 0.0017 ± 0.0002 mm3) and 6 days (0.0082 ± 0.0011; 0.0016 ± 0.0001 mm3). Survival rates of four treatments were estimated daily for 30 days and significant differences were observed between the treatments at the end of the experiment. The final survival rate was higher when the loach larvae initiated feeding at 3 days (75.9%) when compared with 4 days (31.8%), 5 days (14.5%) and 6 days (6.4%). The present study suggests that the first feeding of loach larvae should be initiated at 3 DAH for achieving better growth and survival or else bad growth performance will

engender if the first feeding is delayed.
(College of Fishery & Key Laboratory of Agricultural Animal Genetics, Breeding and Reproduction of Ministry of Education, Huazhong Agricultural University, Wuhan, 430070, Hubei, China; email of Weimin Wang: wangwm@mail.hzau.edu.cn)

ESTIMATE BY MEANS OF FLOW CYTOMETRY OF VARIATION IN COMPOSITION OF FATTY ACIDS FROM TETRASELMIS SUECICA IN RESPONSE TO CULTURE CONDITIONS
Héctor Mendoza Guzmán, Adelina de la Jara Valido, Laura Carmona Duarte, Karen Freijanes Presmanes-2010
Aquaculture International 18(2): 189-199
Abstract:
The present work shows the possibility of determining variations in the lipid composition in Tetraselmis suecica under different conditions of culture by means of flow cytometry in cells marked with Nile Red (NR). A significant correlation was observed between the cellular contents in polar and neutral lipids and the cytometric signal of the marked cells. Likewise, there was a significant correlation between the ratio of polar and neutral lipids, estimated by cytometry, and the relative composition of polyunsaturated fatty acids (PUFAs) in Tetraselmis, which corresponded to the greater content of PUFAs detected in the polar lipid fraction of this microalgae. This relationship between the polar/neutral ratio and the relative contents of PUFAs, together with the flow cytometry and the marking by means of NR, would make it possible to have an effective indicator of the abundance of PUFAs in Tetraselmis, as well as the development of techniques of massive screening of strains which are hyperproductive of PUFAs and of rapid checking of the variations in lipid composition in response to cultivation conditions, which are much simpler and more rapid than traditional techniques.
(Department of Biotechnology, Instituto Tecnológico de Canarias, Pozo Izquierdo s/n, Santa Lucía de Tirajana, 35119 Las Palmas, Spain; email of Héctor Mendoza Guzmán: hmendoza@itccanarias.org)

SOCIAL ASPECTS OF THE SUSTAINABILITY OF INTEGRATED MULTI-TROPHIC AQUACULTURE
Kelly Barrington, Neil Ridler, Thierry Chopin, Shawn Robinson, Bryn Robinson-2010
Aquaculture International 18(2): 201-211
Abstract:
A pilot project in the Bay of Fundy, Canada, is growing kelps, mussels, and salmon in an integrated multi-trophic aquaculture (IMTA) system. Biological and economic results are positive, but social acceptability is also a critical component of aquaculture sustainability. Focus group sessions with several segments of the population (restaurateurs, residents of communities near aquaculture facilities, and the general population) were held and the participants' knowledge of, and opinions on, IMTA were recorded. Most participants felt that IMTA had the potential to reduce the environmental impacts of salmon farming, benefit community economies, and improve industry competitiveness and sustainability. All felt that seafood produced in IMTA systems would be safe to eat and 50% of the participants were willing to pay 10% more for these products if labelled as such. The participants felt that IMTA appears to be an improvement over current monoculture practices and would be cautiously welcomed in the marketplace. A promotional campaign educating the general public, food distributors, and other industry stakeholders about the positive benefits of IMTA would go a long way in gaining mainstream acceptance of this aquaculture practice.
(Centre for Coastal Studies and Aquaculture, University of New Brunswick, P.O. Box 5050, Saint John, NB, E2L 4L5, Canada; email of Thierry Chopin: tchopin@unbsj.ca)

COD LIVER OIL: FEED OIL INFLUENCES ON FATTY ACID COMPOSITION
Malcolm Jobling, Odd Leknes-2010
Aquaculture International 18(2): 223-230
Abstract:

The influence of feed oils on fatty acid compositions of cod liver oils was examined to investigate how fatty acid profiles are modified, and to provide estimates of feed oil compositions needed to give liver oils meeting production guidelines [3–11% 18:2n−6, 7–16% 20:5n−3 (EPA) and 6–18% 22:6n−3 (DHA)]. Attention was directed to examination of cod liver oil contents of n−6 and n−3 fatty acids, the essential fatty acids. Data, mostly taken from published work, were subjected to regression analysis to investigate the relationships between the percentages of fatty acids (18:2n−6, total n−6 fatty acids, 18:3n−3, 20:5n−3, 22:6n−3 and total n−3 fatty acids) in feed oils and their percentages in liver oils.
There were highly significant relationships between feed oil and liver oil percentages for all fatty acids examined:
Liver oil 18:2n−6 (%) = 0.787 Feed oil 18:2n−6 (%) + 1.329; (n = 21; R 2 = 0.957)
Liver oil total n−6 Fatty acids (%) = 0.831 Feed oil total n−6 Fatty acids (%) + 0.536; (n = 21; R 2 = 0.957)
Liver oil 18:3n−3 (%) = 0.814 Feed oil 18:3n−3 (%) + 0.022; (n = 21; R 2 = 0.985)
Liver oil 20:5n−3 (%) = 0.762 Feed oil 20:5n−3 (%) + 1.163; (n = 21; R 2 = 0.875)
Liver oil 22:6n−3 (%) = 0.785 Feed oil 22:6n−3 (%) + 1.393; (n = 21; R 2 = 0.831)
Liver oil total n−3 Fatty acids (%) = 0.770 Feed oil total n−3 Fatty acids (%) + 2.558; (n = 21; R 2 = 0.851)

Feed oil percentages of 18:2n−6, 20:5n−3 (EPA) and 22:6n−3 (DHA) required to produce liver oils that comply with guidelines were estimated to be 2.5–12.5% for 18:2n−6, 8–19.5% for 20:5n−3 and 6–21% for 22:6n−3. Given the fatty acid compositions of commercial feed oils it is unrealistic to expect that liver oils with highly unsaturated n−3 fatty acids percentages at the high end of the recommended range (15–18% for both 20:5n−3 and 22:6:n−6) can be produced from farmed cod, but it should be possible to obtain liver oils that fulfil fatty acid composition criteria without the need to manufacture feeds that have fatty acid compositions that deviate markedly from those in current use. As an alternative to using feeds with constant fatty acid compositions throughout production, finisher feeds could be used to manipulate fatty acid compositions of liver oils, but the economics of using this feeding strategy needs to be examined before commercial implementation can be recommended.
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THE IMPACTS OF AQUACULTURE DEVELOPMENT ON FOOD SECURITY: LESSONS FROM BANGLADESH

Khondker Murshed–e-Jahan, Mahfuzuddin Ahmed, Ben Belton-2010
Aquaculture Research 41(4): 481 - 495
Abstract:
Fish contribute a significant amount of animal protein to the diets of people in Bangladesh, about 63% of which comes from aquatic animals. In Bangladesh, fish is mainly derived from two sources: capture and culture. Aquaculture has shown tremendous growth in the last two decades, exhibiting by about 10% average annual growth in production. Capture fisheries, although still the major source of supply of fish, have become static or are in decline due to over-fishing and environmental degradation, and it is now believed that aquaculture has the greatest potential to meet the growing demand for fish from the increasing population. At present, aquaculture production accounts for about one-third of the total fish production in Bangladesh. This paper examines the impact of an aquaculture development project in Bangladesh on food security, with particular emphasis on the poor. The analysis shows a positive impact of aquaculture development on employment, income and consumption. A number of implications for policy in areas that might strengthen these outcomes are discussed and recommendations are presented.
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REPRODUCTION, GROWTH AND STRESS RESPONSE IN ADULT RED SEA BREAM, PAGRUS MAJOR (TEMMINCK & SCHLEGEL) EXPOSED TO DIFFERENT PHOTOPERIODS AT SPAWNING SEASON

Amal Biswas, Manabu Seoka, Hiroyuki Inagaki, Kenji Takii-2010

Aquaculture Research 41(4): 519 - 527

Abstract:

Adult red sea bream, Pagrus major (body weight, 1.0–2.0 kg) was exposed to three photoperiods [12 h light:12 h dark (12L:12D), 16 h light:8 h dark (16L:8D) and 24 h light:0 h dark (24L:0D)] from 2 months before spawning till the end of the spawning season to investigate growth, spawning and stress response. During the spawning season, tanks were checked every morning for spawned eggs. The growth performance in fish under 24L:0D was stimulated with significantly higher feed intake than those under other photoperiods ($P<0.05$). The number of eggs and gonadal histology confirmed that three and five females out of six in each of duplicate tanks of the 16L:8D treatment spawned. In contrast, only two out of six females in one tank of the 24L:0D treatment spawned, and no spawns were observed in the 12L:12D treatment. At the end of the spawning period, both 17β-estradiol and testosterone levels were significantly higher in fish exposed to 16L:8D followed by 12L:12D and 24L:0D photoperiods ($P<0.05$). Photoperiod manipulation did not cause significant stress response in fish ($P>0.05$). The results suggest that stimulating the growth performance of red sea bream at reproductive stage with a 24L:0D photoperiod is possible if the fish are subjected to this photoperiod long before the onset of the spawning season.

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THE EFFECT OF DIFFERENT CARBON SOURCES ON THE NUTRITIONAL VALUE OF BIOFLOCS, A FEED FOR MACROBRACHIUM ROSENBERGII POSTLARVAE

Roselien Crab, Bram Chielens, Mathieu Wille, Peter Bossier,Willy Verstraete-2010

Aquaculture Research 41(4): 559 - 567

Abstract:

A 15-day lab-scale experiment was performed to determine the possible use of bioflocs as a feed for Macrobrachium rosenbergii postlarvae. The bioflocs were grown on acetate, glycerol and glucose. A glycerol-fed reactor was initially inoculated with a Bacillus spores mixture. The highest protein content was obtained in the (glycerol+Bacillus) bioflocs, i.e. 58±9% dry weight (DW). The glycerol and acetate bioflocs showed a lower, but similar content (42–43% DW) and glucose bioflocs contained 28±3% DW. Higher total n-6 fatty acid contents were observed in the glycerol and (glycerol+Bacillus) bioflocs. The vitamin C content was variable, up to 54 μg ascorbic acid g^{-1} DW in the glycerol bioflocs. Bioflocs were fed to M. rosenbergii postlarvae as the sole feed. High survival levels were obtained in the (glycerol+Bacillus) and glucose groups, i.e. 75±7% and 70±0% respectively. This was significantly higher than the starvation control (0% survival after 15 days). This indicated that the prawns were able to feed on the bioflocs. These results are in accordance with the biofloc's nutritional parameters and suggest that the choice of the carbon source used for growing bioflocs is of prime importance.

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