

NUTRITIONAL TECHNOLOGIES IN ANIMAL FEED SCIENCE AND TECHNOLOGY:
PREFACE

A.F.B. van der Poel, M.W.A. Verstegen, P.H. Robinson-2007

Animal Feed Science and Technology 138(2): 89-91

Abstract:

This preface outlines some of the challenges facing animal nutritionists in the area of feed processing, why those challenges are important and why the articles in this issue help to provide information that might assist in meeting those challenges.

(Department of Animal Sciences, Wageningen University, Marijkeweg 40, 6709 PG Wageningen, The Netherlands; phrobinson@ucdavis.edu)

WHITE SPOT SYNDROME VIRUS IN CULTURED SHRIMP: A REVIEW

Jesús Genaro Sánchez-Martínez, Gabriel Aguirre-Guzmán, Humberto Mejía-Ruíz-2007

Aquaculture Research 38(13): 1339-1354

Abstract :

Shrimp is one of the main aquaculture species in the world. Different viruses affect them, which causes serious mortality to economically important species, such as *Penaeus monodon*, *Litopenaeus vannamei* and *L. stylirostris*, among others. White spot syndrome virus or WSSV is a highly lethal, stress-dependent virus, which belongs to the family Nimaviridae, genus Whispovirus. Three WSSV virus isolates were first detected in 1992 in Thailand, Taiwan and China. Later, a fourth isolate of the virus was detected in the Americas in 1999. This virus has a large circular double-stranded DNA genome with different sizes (292.9–307.2 kb), where the diverse isolates show differences in virulence. This virus infects a wide range of aquatic crustaceans by vertical and horizontal transmission, with different mortality results. The spread of infection between regions may be due to infected shrimp and carriers such as other crustaceans, seabirds, aquatic arthropods or other vectors. The aim of this work is to describe the current knowledge on the status, transmission, pathology, isolation, control and genomic characteristics of WSSV.

(Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma de Tamaulipas, Carretera Victoria-Mante Km. 5, Cd. Victoria, Tamaulipas, México; email of J G Sánchez-Martínez : jgsanchezmartinez@gmail.com)

OUT-OF-SEASON SPAWNING OF CULTURED PIKEPERCH [SANDER LUCIOPERCA
(L.)]

Zdzisław Zakeś-2007

Aquaculture Research 38(13): 1419-1427

Abstract:

The aim of this study was to determine the effectiveness of out-of-season spawning of cultivated pikeperch (fish that were reared from the larval stage in re-circulating systems and fed commercial feed exclusively) stimulated hormonally with human chorionic gonadotropin (hCG). The impact of fish age (2+ and 3+) and hormone dosage [200 or 400 IU hCG kg⁻¹ body weight (BW)] on spawning was analysed and expressed as the share of stripped females, commercial fecundity (% BW) and survival of embryos until the eyed-egg stage (EES index). The possibility of utilizing changes in female pikeperch body weight (CBW index) that are observed following hormone injections as an additional indicator for determining maturity was also investigated. The age and hormone dosage were not noted to have a significant impact on the number of stripped females ($\geq 80\%$ on all groups), the latency period (90–100 h), commercial fecundity (11.3–13.3% BW) or the values of the EES index (61–73%; $P > 0.05$). The mean value of EES from the 3+ age group females was higher than that in the

2+ females, and the interaction between the tested factors (fish age and hormone dosage) was statistically significant ($P < 0.05$). In the fish from the control group (injected with a 0.9% NaCl solution), no progress was noted in the maturation of oocytes and no eggs were obtained from any female. It was noted that these females lost BW over the course of the subsequent 24 h of the measurements ($P < 0.05$). In the groups of females that were stimulated hormonally, the opposite phenomenon was observed; in these groups, the CBW index increased significantly between 48 and 96 h following hormone injection. The value of the CBW index was not noted to have been statistically significantly determined by either hormone dose or fish age ($P > 0.05$). The regression equations that described the dependence between CBW and the oocyte maturity stage were highly significant statistically, and the determination coefficient R^2 assumed a value of 0.76. The most significant increase in BW was related to the oocytes achieving maturity stage III. The BW of pikeperch females with oocytes in this stage was 103% higher than the initial BW. This might be a valuable and useful tool for determining maturity in females of this fish species.

(Department of Aquaculture, The Stanisław Sakowicz Inland Fisheries Institute, 10-719 Olsztyn, Oczapowskiego 10, Poland; email of Z. Zakęś: zakes@infish.com.pl)

THE PROTECTIVE EFFECT AGAINST VIBRIO CAMPBELLII IN ARTEMIA NAUPLII BY PURE B-GLUCAN AND ISOGENIC YEAST CELLS DIFFERING IN B-GLUCAN AND CHITIN CONTENT OPERATED WITH A SOURCE-DEPENDENT TIME LAG

Siyavash Soltanian, Troung Quoc Thai, Jean Dhont, Patrick Sorgeloos, Peter Bossier-2007
Fish & Shellfish Immunology 23(5): 1003-1014

Abstract:

In invertebrates the defence system to fight infectious diseases depends mainly on a non-specific or innate immune response, contrary to the vertebrate immune system. The use of natural immunostimulants that enhance the defence mechanism or the immune response of target organisms may be an excellent preventive tool against pathogens. Several strains of baker's yeast *Saccharomyces cerevisiae* have been found to be good immune enhancers. Previously, it was shown that small quantities of the mnn9 yeast cells and/or glucan particles could protect *Artemia nauplii* against the pathogenic bacterium *Vibrio campbellii* in the gnotobiotic *Artemia* challenge test. Apparently, the higher amount and/or availability of β -glucans and/or chitin present in mnn9 yeast strain might play an essential role in such protection. The present study reveals that these compounds could only provide protection against the pathogen when they were supplied to *Artemia* well in advance of the challenge (8–48 h depending on the source). Also the putative immunostimulant did not have a curative action. Moreover, short-time exposure of *Artemia* to mnn9 strain (priming) did not provide protection against the pathogen longer than two days. Hence, it is hypothesized that the mere stimulation of known biochemical pathways, e.g. prophenoloxidase is not sufficient to explain the mechanisms involved in the observed immunostimulation obtained by β -glucans and/or mnn9 yeast in *Artemia nauplii*.

(Laboratory of Aquaculture and *Artemia* Reference Center, Faculty of Bioscience Engineering, Ghent University, Rozier 44, 9000 Gent, Belgium; email of Siyavash Soltanian: soltanian.siyavash@ugent.be)

OPTIMUM TEMPERATURE AND SALINITY CONDITIONS FOR GROWTH OF GREEN ALGAE CHLORELLA ELLIPSOIDEA AND NANNOCHLORIS OCULATA

Sung Hwoan Cho, Sung-Choon Ji, Sung Bum Hur, Jeanhee Bae, In-Seok Park, Young-Chae Song-2007

Fisheries Science 73(5):1050-1056

Abstract:

The effects of temperature and salinity on growth of green algae *Chlorella ellipsoidea* and *Nannochloris oculata* were determined to compare the optimum culture conditions. A four-

temperature (15, 20, 25, and 30°C) × three-salinity (10, 20, and 30) factorial design with triplicates was applied. Specific growth rate (SGR), maximum density, and duration to reach maximum density of *C. ellipsoidea* were significantly affected by both temperature and salinity. The highest SGR was observed in *C. ellipsoidea* at 25°C and salinity 10, but the maximum density was very low. The highest maximum density was achieved in *C. ellipsoidea* at 15°C and 10. The slope constant of the linear relationship between semilogarithmic growth of *C. ellipsoidea* and day of culture was highest at 15°C and 10. The SGR and duration to reach maximum density of *N. oculata* were significantly affected by both temperature and salinity. However, maximum density of *N. oculata* was significantly affected by temperature, but not salinity. The highest maximum density was achieved in *N. oculata* at 25°C and 30, but SGR was significantly lower than that of *N. oculata* at 25°C and 10. The slope constant of the linear relationship between semilogarithmic growth of *N. oculata* and day of culture was highest at 25°C and 30. Based on these results, the condition of 15°C and salinity 10 seemed to be optimal for maximum density of *C. ellipsoidea*, and the condition of 25°C and 10 and 30 for SGR and maximum density for *N. oculata*, respectively.

(Division of Marine Environment and Bioscience, College of Ocean Science and Technology, Korea Maritime University, Busan 606-791, South Korea; email of Sung Hwoan Cho: chosunh@hhu.ac.kr)

EFFECTS OF HEAVY METALS IN RIVER WATERS IN JAPAN ON IMMOBILITY AND MORTALITY OF DAPHNIA MAGNA AND ORYZIAS LATIPES LARVAE

Hirotsu Murano, Kanae Matsuzaki, Hiroaki Shiraishi, Meiko Wakabayashi-2007

Fisheries Science 73 (5), 1078–1086

Abstract:

Samples of river waters containing high concentrations of zinc and other heavy metals but low concentrations of other anthropogenic contaminants were collected to investigate the relationship between toxicity of heavy metals and naturally present organic matters or hardness, as well as the effects of heavy metals on aquatic organisms. Acute toxicity tests were conducted for the water samples using *Daphnia magna* and medaka *Oryzias latipes*. Almost all the *D. magna* died in river waters containing high concentrations of zinc, but *O. latipes* in the same waters were hardly affected. Since the test organisms were not only exposed to zinc but also other heavy metals in the river waters, we examined the toxicity using toxic units composed of zinc, copper, lead, and cadmium. The results of a bioassay with the river waters showed that the mortality of *D. magna* did not depend solely on the total number of toxic units of heavy metals. The organic matters and the hardness of the river waters could decrease the acute toxicity of zinc and other heavy metals to *D. magna*.

(Global Environmental Forum, Tsukuba, Ibaraki 305-8506, Japan; email of Meiko Wakabayashi: mwak@ccb.shukutoku.ac.jp)

PARENTAGE ASSIGNMENT IN HATCHERY POPULATION OF BROWN SOLE PLEURONECTES HERZENSTEINI BY MICROSATELLITE DNA MARKERS

Sang-Gyu Kim, Kagayaki Morishima, Nobukazu Satoh, Takashi Fujioka, Setsuo Saito, Katsutoshi Arai-2007

Fisheries Science 73 (5): 1087–1093.

Abstract:

Five loci (Phz2, Phz6, Phz7, Phz12, and Phz14) of microsatellite DNA markers developed in a previous study for parentage assignment in the hatchery population generated by mating among 61 broodstock fish (35 females and 26 males) in a spawning tank, were selected. After natural spawning in the same tank, larvae collected at three different times were categorized into early phase (EP), middle phase (MP), and late phase (LP) groups. In the parental broodstock, the mean number of alleles per locus was 21.8 and expected heterozygosity (HE) was 0.813. In the progeny, the mean number of alleles per locus decreased to 11.6 (EP), 14.4

(MP), and 6.4 (LP) and HE to 0.796 (EP), 0.833 (MP), and 0.681 (LP). Parental assignment determined eight dams and six sires as major parents for the EP group. In the MP group, 13 dams and ten sires genetically contributed to spawning, but only three dams and two sires were involved in LP group progeny. In the hatchery population produced from a limited number of parental fish such as the LP group, genetic variability was apparently decreased. (Graduate School of Fisheries Sciences, Hokkaido University, Hakodate, Hokkaido 041-8611, Japan; email of Katsutoshi Arai: araikt@fish.hokudai.ac.jp)

HYBRIDIZATION SUCCESS OF THREE COMMON EUROPEAN CYPRINID SPECIES, RUTILUS RUTILUS, BLICCA BJOERKNA AND ABRAMIS BRAMA AND LARVAL RESISTANCE TO STRESS TESTS

Billy Nzau Matondo, Michaël Ovidio, Pascal Poncin, Tampwo Alain Kakesa, Lunkayilakio Soleil Wamuini, Jean-Claude Philippart-2007
Fisheries Science 73 (5): 1137–1146

Abstract:

Hybridization success at early developmental stages and larval resistance to osmotic, thermal and fasting tests in roach *Rutilus rutilus*, silver bream *Blicca bjoerkna*, common bream *Abramis brama* and their F1 hybrids were investigated. Results revealed that hybrid survival rates were similar to parents. At the eyed embryo stage, however, a maternal effect was observed as a general trend during hatching and larval stages. After these stages, hybrids displayed a higher survival rate than their parents. Under stress tests, no survival was observed after 40 min for osmotic and thermal shocks and after 24 days for the prolonged fasting test in these species and their F1 hybrids. The median survivals of hybrids were intermediate between the two parents. For total mortality, hybrids were also affected by a maternal effect but to the advantage of the hybrids.

(Biology of Behavior Unit, Laboratory of Fish Demography and Hydroecology, University of Liège, 10 Chemin de la Justice, B-4500 Tihange, Belgium; email of Billy Nzau Matondo: bnzamat@yahoo.fr)

POST-RELEASE MOVEMENT AND DIEL ACTIVITY PATTERNS OF HATCHERY-REARED AND WILD BLACK-SPOT TUSKFISH *CHOERODON SCHOENLEINII* DETERMINED BY ULTRASONIC TELEMETRY

Yuuki Kawabata, Junichi Okuyama, Hiromichi Mitamura, Kimio Asami, Kenzo Yosedo, Nobuaki Arai-2007
Fisheries Science 73 (5): 1147–1154

Abstract: Post-release movement and diel activity patterns of hatchery-reared and wild black-spot tuskfish were examined using ultrasonic telemetry. Five hatchery-reared and four wild fish were released in the sandy bottom of Urasoko Bay, Ishigaki Island, Okinawa, Japan, and monitored using automated monitoring receivers from November 2005 to February 2006. Both hatchery-reared and wild fish tended to stay near the release site for over two weeks, before leaving the release site. Both hatchery-reared and wild tuskfish showed diurnal rhythm intermittently; signals were recorded more frequently in the daytime and less frequently in the nighttime, suggesting that the fish of both origins were active during the day and inactive during the night. These findings indicate that the one-year-old hatchery-reared tuskfish have some consistent behavioral characteristics with those of the wild.

(Graduate School of Informatics, Kyoto University, Sakyo, Kyoto, Kyoto 606-8501, Japan; email of Yuuki Kawabata: yuki-k@bre.soc.i.kyoto-u.ac.jp)

LARVAL REARING WITHOUT AERATION: A CASE STUDY OF THE SEVEN-BAND GROUPER *EPINEPHELUS SEPTEMFASCIATUS* USING A WAVE MAKER

Yoshitaka Sakakura, Shigeaki Shiotani, Masashi Shiozaki, Atsushi Hagiwara -2007

Fisheries Science 73 (5):1199–1201

(Faculty of Fisheries, Nagasaki University, Nagasaki 852-8521, Japan; email of Yoshitaka Sakakura: sakakura@nagasaki-u.ac.jp)

EXTENT OF CHUM SALMON EGG SOFTENING CAUSED BY SODIUM HYPOCHLORITE AS AN ANTIFUNGAL AGENT

Chutima Khomvilai, Masaaki Kashiwagi, Chanin Sangrungruang, Motoi Yoshioka -2007

Fisheries Science 73 (5): 1205–1207.

(Faculty of Bioresources, Mie University, Tsu, Mie 514-8507, Japan; email of Motoi Yoshioka: motoi@bio.mie-u.ac.jp)

AN INVESTIGATION OF THE SUBSTRATE PREFERENCE OF WHITE STURGEON (ACIPENSER TRANSMONTANUS) ELEUTHEROEMBRYOS

W. R. Bennett, G. Edmondson, K. Williamson, J. Gelley-2007

Journal of Applied Ichthyology 23 (5): 539–542

Summary: Fifty white sturgeon (*Acipenser transmontanus*) eleutheroembryos (average size 0.17 g) were placed onto each of four quadrants (0.45 m² quadrant¹; 200 fish tank¹) of different sized substrates in four circular tanks (approximately 562 L). Each of three quadrants had a different size substrate and the fourth quadrant was left bare. We used one replicate of smaller size substrates (0.5–11.9 mm) and one replicate of larger size substrates (21.7–88 mm). It was found that the white sturgeon eleutheroembryos preferred substrate with an average size (longest diameter) of 12 mm (11.9) in the smaller substrate range and 22 mm (21.7) in the larger substrate range. These data improve our knowledge of white sturgeon early life history, and if confirmed in the wild can be used to protect areas that are crucial for white sturgeon recruitment and survival.

(International Centre for Sturgeon Studies, Malaspina University College, Nanaimo, BC, Canada; email of W.R. Bennett: bennettw@pac.dfo-mpo.gc.ca)

ACUTE TOXICITY OF AMMONIA AND ITS EFFECTS ON THE HAEMOLYMPH OSMOLALITY, AMMONIA-N, PH AND IONIC COMPOSITION OF EARLY JUVENILE MUD CRABS, SCYLLA SERRATA (FORSKÅL)

Nicholas Romano, Chaoshu Zeng-2007

Comparative Biochemistry and Physiology - Part A: Molecular & Integrative Physiology 148(2): 278-285

Abstract:

The current study was conducted to determine the LC₅₀ value of ammonia-N as well as the effects of acute exposure to elevated ammonia on the haemolymph osmolality, ionic composition, ammonia-N and pH levels of early juvenile mud crabs, *Scylla serrata*. The results show that early *S. serrata* juveniles have a high 96-h LC₅₀ value of 95.35 mg/L ammonia-N (6.81 mg/L NH₃-N) or 6.80 mmol/L total ammonia-N (0.486 mmol/L NH₃-N). Following a 96-h exposure, the haemolymph osmolality and K⁺ levels of the surviving crabs remained unaltered ($p > 0.05$) at all ammonia-N concentrations, while the haemolymph Na⁺ and Ca²⁺ were significantly lower ($p < 0.05$) for the crabs exposed to 5.710 and 7.138 mmol/L ammonia-N. While the haemolymph ammonia-N levels of the crabs significantly increased ($p < 0.01$) with increasing external ammonia-N concentrations, the haemolymph ammonia-N of the crabs remained below the external ammonia-N concentrations. The haemolymph pH of the crabs significantly increased between 0.714 and 4.283 mmol/L total ammonia-N. However, at 5.710 mmol/L total ammonia-N the haemolymph pH dropped and was not significantly different ($p > 0.05$) from that of the control crabs which coincided with

significantly lower ($p < 0.05$) haemolymph Na^+ and Ca^{2+} levels. These physiological responses may explain the high ammonia tolerance of early *S. serrata* juveniles.
(School of Marine and Tropical Biology, James Cook University, Townsville, Qld 4811, Australia; email of Nicholas Romano: Nicholas.Romano@jcu.edu.au)

THE EFFECT OF TEMPERATURE STRESS ON DEVELOPMENT AND HEAT-SHOCK PROTEIN EXPRESSION IN LARVAL GREEN STURGEON (*ACIPENSER MIROSTRIS*)

Inge Werner, Javier Linares-Casenave, Joel P. Van Eenennaam, Serge I. Doroshov-2007

Journal Environmental Biology of Fishes 79(3-4): 191-200

Abstract:

Water temperature is an important environmental variable influencing the distribution and health of coldwater fishes such as the green sturgeon, *Acipenser medirostris*. In this study, we investigated if larval sturgeon were able to tolerate or recover from acute, non-lethal temperature stress that commonly causes deformed notochords, and sought to identify the role of heat-shock proteins (hsp) in stress tolerance. The hsp response is one of the most important cellular mechanisms to prevent the damaging effects of thermal cellular stress, and differences in the ability to over-express hsps during stressful conditions may be associated with an organism's vulnerability and the extent of thermal injury. In this study, newly hatched larvae were maintained at 17°C (control), or exposed to (a) 26°C for 3 d then maintained at 17°C until yolk-sac absorption or (b) 26°C until yolk-sac absorption. Individuals with deformed notochords were counted, and hsp60, 72, 78 and 89 were analyzed in both normal and deformed larvae by western blotting. Approximately 33% of fish developed curved notochords within the first 3 d of exposure to 26°C. After transfer to cool water 16.5% showed deformities at stage 45, suggesting a significant number of larvae had recovered. Hsp levels remained elevated for at least 9 days after termination of heat-exposure. Overall, percentage of deformed larvae, and hsp72/hsp78 levels were highest in fish continuously exposed to 26°C until yolk-sac absorption. Deformed individuals had significantly higher expression levels of hsp72 and hsp78, and lower hsp60 levels than normal larvae. We conclude that expression of hsp72 and hsp78 and potentially hsp60 are linked to phenotypic variation in the response and vulnerability of green sturgeon larvae to thermal stress.

(Department of Anatomy, Physiology and Cell Biology: School of Veterinary Medicine, University of California, One Shields Avenue, Davis, CA 95616, USA; email of Inge Werner: iwerner@ucdavis.edu)

THE EFFECTS OF SUBSTRATE COMPOSITION ON FORAGING BEHAVIOR AND GROWTH RATE OF LARVAL GREEN STURGEON, *ACIPENSER MEDIROSTRIS*

Rosalee M. Nguyen, Carlos E. Crocker-2007

Journal Environmental Biology of Fishes 79(3-4): 231-241

Abstract:

We investigated the effects of substrate composition on foraging behavior and growth rate of larval green sturgeon, *Acipenser medirostris*, in the laboratory at $20 \pm 1^\circ\text{C}$ over a period of 5 weeks. Larval groups ($n=100$) with mean wet weight (0.72 ± 0.01 g) at 50 days post-hatch were reared on slate-rocks, cobble, sand or glass. Typically, fish were negatively rheotactic and exhibited dispersed skimming behaviors on provided substrates during pre-feeding and feeding, respectively, but were all positively rheotactic during feeding. Fish reared on slate-rock substrates were negatively phototactic, remained benthic, and aggregated underneath the substrates. In all substrates except slate-rocks, fish displayed frequent episodes of burst and glide swimming activity, tank wall skimming and vertical swimming behaviors, however these behaviors ceased immediately during feeding and reappeared at the end of the feeding period. Substrate composition led to variable foraging effectiveness and likely contributed to significant differences in specific growth rates (2.28, 1.14, 1.77, and 2.27% body weight per day) and mortality (7%, 40%, 11%, 0%) among the treatment groups; slate-rocks, cobble,

sand, and glass, respectively. There were no significant differences in morphometrics, somatotopic indices, and whole-body lipid content among treatment groups at the end of the experiment. The present findings indicate that certain substrates in artificial/natural habitats may negatively affect larval growth and may lead to decreased recruitment of juvenile green sturgeon in the wild.

(Department of Biology, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA 94132, USA; email of Rosalee M. Nguyen: nrosalee@sfsu.edu)
