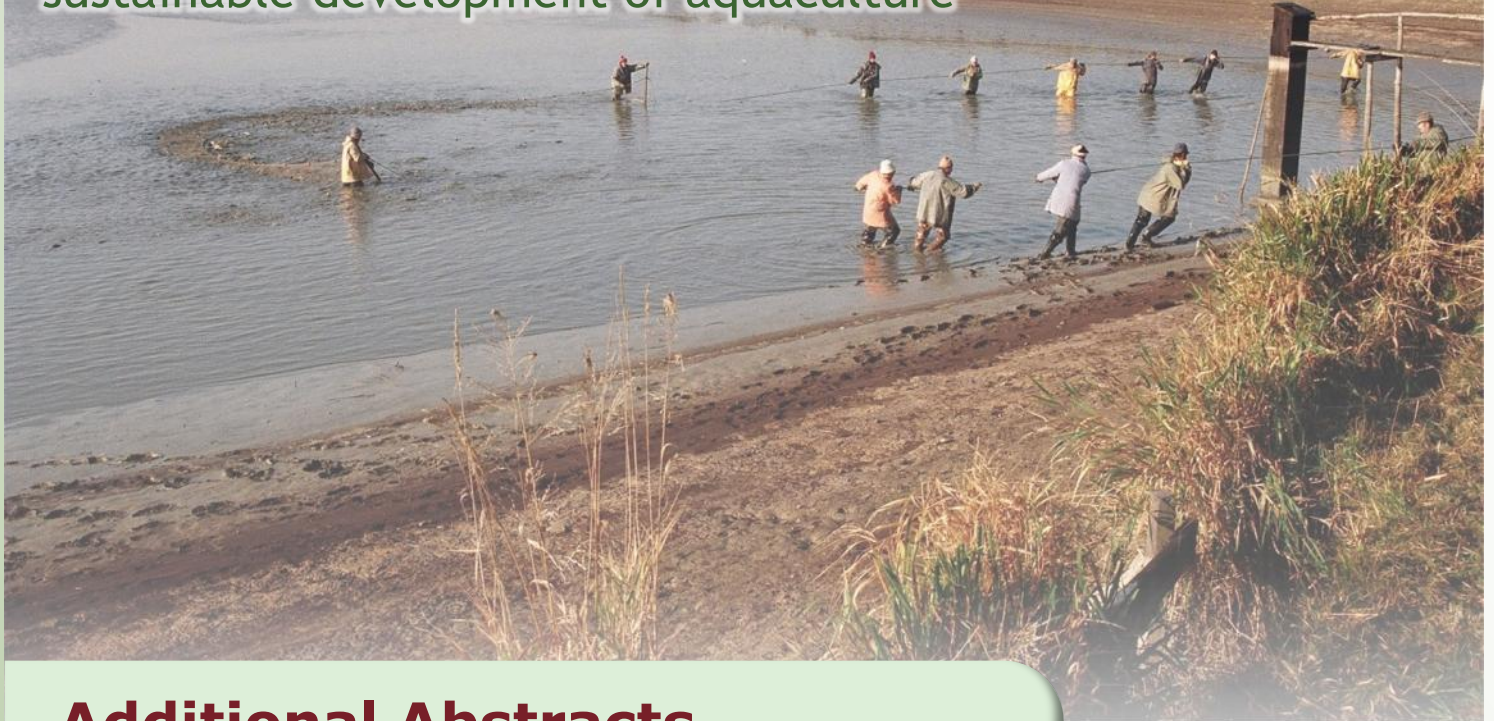


Resource Management

natural, human and material resources for the sustainable development of aquaculture



Additional Abstracts



A compilation of abstracts submitted after the deadline and hence not published in the printed publication of AE2008 Short Communications

TECHNOLOGY OF HIGH-QUALITY CARP GROWING

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Introduction

In Ukraine, as well as in other countries rearing market fish in ponds, demands carp weighing 0,8-1,0 kg. Market carps by the middle weigh 1 kg on comparison with 0,5 kg have more of edible parts – on 6,1%, dry matters – on 5%, fat – on 6%, calorie content – on 55,5 kkal/100 g, or on 66,8%, and prime price – below on 12,1%.

Advantages of large individuals of carp before small-sized fish is obvious. A question consists in that, what terms it is possible to rear two-year carp weighing 0,8-1,0 kg/ind.

We studied possibilities and terms at which market fish of high quality can be got in two-year age.

It was the purpose of researches to develop the scientifically based technologies of growing of carp planting stock and market fish at a two-year cycle with fish-productivity of ponds 1.4-1.5 t/ha and achievement of middle two-year fish weigh 0,8-1,0 kg.

Materials and methods

The generally accepted methods of researches in the fish-farming, hydrochemistry, hydrobiology, determinations of economic efficiency of market fish growing were used.

Results

In 2005-2007 researches in production terms upon the receipt of large carp hybrids fry at different density of larvae were conducted: in experimental pond №5 – a 23 thousand fish/ha and in the pond №6 – 150-200 thousand fish/ha.

Growing was carried out at the intensive feeding, since day's norm 25%, at the gradual decline to 10% from weight of fish in to the pond. Feeding carried out for one occasion, verification of feeds eating – in 4 hours. At the decline of oxygen concentration the quantity of feeds diminished, there were interruptions in feeding.

In the conditions of the water ecosystem present state of growing ponds in district «Konotop» (where experiment was carried out) were able for one year to rear carp hybrids fry by the middle weigh 80-100 g at growing ponds fish-productivity 1.43-1.60 t/ha and expense of feeds 2,72-2,80 units.

Growing of large fry (80-100 g/ind.) enables to eliminate the process of planting stock growing in the ponds of the second order and use them for other production purposes.

Comparative data on two-year carp hybrids growing show that yearlings weighing 73,8-95,2 g, used for a two-year cycle growing of fish, by the end of season arrive at 820-1050 g/ind. with fish-productivity 1040-1297 kg/ha and expense of feeds – 2,14-2,45 units. At the same time, yearlings by middle weigh 10,9-14,3 g to the autumn arrive at only 101,9-108,2 g and in order to get 0,8-1,0 kg/ind. market fish another vegetation period is needed.

The carp hybrids were growing with two-year old silver carp hybrids on density 223-297 fish./ha by middle weigh 236-373 g/ind. As a result of the joint carp hybrids and silver carps growing fish-productivity of growing ponds for 2006-2007 made 1364-1749 kg/ha, from them carp hybrids – 959-1297 kg/ha and expenditure of feeds of 2,1-2,9 units.

Conclusions

1. The carp hybrids yearlings growing at the density of larvae 22,9-23,0 thousand fish/ha at the observance of all technological requirements allows in the conditions of Ukraine Polissya to get growing ponds fish-productivity at the level of 1.43-1.60 t/ha, and achieve weigh 80-100 g/ind. on survival 63-87% from larvae.
2. For the carp hybrids receipt in two-year age by weigh 0,8-1,0 kg/ind. it is necessary stocking growing ponds by carp hybrids yearlings weighing 74-95 g/ind. by density 1728-1730 fish./ha jointly with the two-year silver carp hybrids from computation 226-288 fish./ha and mass 236-318 g/ind.
3. Receipt of the given results of the carp hybrids growing it is possible at adherence of technological receptions.
4. For providing of market by high-quality fish by weigh 0,8-1,0 kg/ind. it is necessary to develop new scientifically based technological norms in place of out-of-date.

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USE OF EXTRUDED RED LENTIL MEAL AS A PROTEIN SOURCE IN DIET FOR RAINBOW TROUT (*ONCORHYNCHUS MYKISS*)

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Abstract

Protein is the most important and expensive nutrient in aquaculture diets. Fish meal is still the major dietary protein source to meet the protein requirement of fish. An alternative protein sources have been investigated due to increasing of fish meal cost. The aim of this study was to determine the use of extruded red lentil meal as a protein source in diet for rainbow trout. A total of 276 rainbow trout were randomly allocated to three groups as one control and two treatment groups. Diets for control and treatment groups were formulated as isonitrogenous and isocaloric. Fish were fed the diet not including extruded red lentil meal in control group. Fish in treatment group 1 and 2 were fed the diets prepared by using extruded red lentil meal at the level of 10% and 15%, respectively. Fish were fed twice a day to apparent satiation for 84 days. The results showed no significant ($P>0.05$) differences in weight gain, feed conversion ratio, apparent nutrient digestibility, protein efficiency ratio, dorsal muscle composition and survival among groups. In conclusion, the extruded red lentil meal may be a protein source and can be used in diet for rainbow trout at the level of 15%.

Key words: apparent nutrient digestibility, diet, extruded red lentil meal, rainbow trout.

GROWTH AND FATTY ACIDS COMPOSITION OF FRESHWATER ROTIFER, *Brachionus calyciflorus* PALLAS, FED WITH TWO TYPES OF MICROALGAE

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Introduction

Rotifers of the genus *Brachionus* are widely used as live food in both marine and freshwater aquaculture (Sarma 1991). Because large-scale algae production is relatively cheap, both under field and laboratory conditions, various types of algae are routinely being produced for feeding planktonic rotifers (Lucia-Pavon et al. 2001). Among the biotic factors, phytoplankton concentration and diversity strongly affect rotifers abundance (Flores-Burgos et al. 2003) and nutritional quality (Sarma 1991). The aim of this study was to find influence of different types of food on growth and nutrition value of rotifer, *B. calyciflorus*.

Material and methods

Two green microalgae, *Chlorella* sp. And *Scenedesmus obliquus*, were obtained from Inland Waters Aquaculture Research Center, Anzali, Iran. They were initially developed through the semicontinuous culture method in duplicate runs (Richmond 1986) and then mass produced in 7-L plastic flasks under room temperature (25 ± 1 C) and continuous light provided by four fluorescent lamps of 40 W each; Zander culture medium was used throughout the cultivations (Miller et al. 1978), and the cultures were continuously aerated by a mini air pump. In this experiment the effect of *Chlorella* sp. and *S. obliquus* at constant concentration of 1.3×10^6 cells/mL on the growth of rotifer was investigated to find out the more suitable of the two algae. The fatty acid composition of the microalgae and rotifer samples was determined by applying direct methyl-esterification method (Howell 1995). Student t test was used for statistical evaluation of the differences among the food types.

Results

The population growth curves of the rotifer, *B. calyciflorus*, in relation to the algal species, *Chlorella* sp. and *S. obliquus*, are presented in Figure 1. The maximum density of the rotifer was significantly influenced ($P < 0.05$) by the food type; the maximum density reached 487 and 328 individuals/mL when fed *Chlorella* sp. and *S. obliquus*, respectively. In general, the rotifer population reached the highest peak in the seventh day at any food type. The rate of population growth (r) for *B. calyciflorus* was significantly affected by food type and was 0.61 ± 0.02 and 0.42 ± 0.01 for those fed *Chlorella* and *Scenedesmus*, respectively. The fatty acid composition of algae, *Chlorella* sp. and *S. obliquus*, and freshwater rotifer, *B. calyciflorus*, fed with each microalga determined. The *S. obliquus* has a large amount of linoleic acid (18:2n-6) and linolenic acid (18:3n-3) but do not have any of 20:1n-9, 20:2n-6, 20:3n-3, 20:4n-6, or 20:5n-3 fatty acids; its monounsaturated fatty acid (MUFA) content was also higher than polyunsaturated fatty acid (PUFA). The amount of n-3 and n-6 fatty acids in the *S. obliquus* was 9.58 and 13.01%, respectively. Linoleic, linolenic, and arachidonic acids in

Chlorella sp. was 11.50, 20.42, and 3.41%, and n-3 and n-6 fatty acids was 20.42, and 14.91%, respectively.

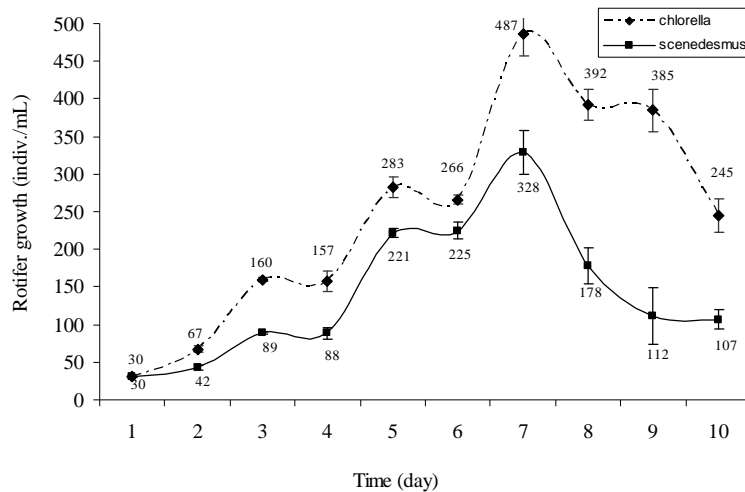


FIGURE 1. Population growth of rotifer, *B. calyciflorus* fed with microalgae, *Chlorella* sp. and *Scenedesmus obliquus* at 10 days.

Discussion and conclusion

Based on results obtained at standard conditions, the maximum density of the rotifer (478 individuals/mL) fed with *Chlorella* was higher than those fed on *Scenedesmus* (328 individuals/mL), which was in correspondence with the earlier report on *B. calyciflorus* and *B. patulus* (Flores-Burgos et al. 2003), except for the maximum density of the rotifers that were within the range of 50–200 individuals/mL. These differences might be because of (1) different strain of *B. calyciflorus* and (2) using aeration in balloons that probably affected the density of rotifer. While there is little evidence that *Chlorella* can develop anti-grazer morphological changes, some species of *Scenedesmus*, such as *S. quadricauda*, develop structures to deter grazing by zooplankton (Van Donk et al. 1999). However, in our experiments, we did not observe such grazer-induced morphological changes in *Scenedesmus* because (1) fresh algae were provided everyday and (2) *S. obliquus* species is not known to develop strong anti-grazer defenses (Lürling 2003). Thus, the low growth rate of rotifers could be because of factors other than those interfering with induced defense mechanisms by the algae. *Chlorella* gave the highest fatty acid content and higher PUFA and HUFA contents than *Scenedesmus*, which is similar to results of Isik et al. (1999). The higher content of HUFA and PUFA and specially the presence of arachidonic acid (20:4n-6) as essential fatty acids in *Chlorella* might have affected the growth and density of rotifer (Vanni and Lampert 1992; Lucia-Pavon et al. 2001). Our result showed that *Chlorella* sp. was better than *S. obliquus* as food for the rotifer, *B. calyciflorus*.

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THE PROMOTION OF GROWTH PARAMETERS AND FEEDING EFFICIENCY OF *Acipenser nudiventris* LARVAE BY USING OF PROBIOTIC BACILLUS VIA BIOENCAPSULATION OF *Artemia urmiana*

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Introduction

One of the pathways for the entry of bacteria, both pathogenic and probiotic, into the larvae of fish hatcheries is via live prey. As an inoculative mean for probiotic to digestive tract of larvae, live prey may be cultured and bioencapsulating with probiotics (Planas et al., 2004). Bacteria colonies the intestines of the larvae enter from the mouth opening (Hansen and Olafsen, 1999). The initial establishment of a micro flora in the larval stages depends, among other factors, on the micro biota associated with eggs and newly hatched larvae, micro algae, and live prey introduced into the system and water of the rearing system (Keskin et al., 1994). Live preys are important carriers of bacteria to the larval digestive tract (Blanch et al., 1997). Probiotics, live microbes that may serve as dietary supplements to improve the intestinal microbial balance, have received some attention in aquaculture (Irianto and Austin, 2002). *Artemia urmiana* predominantly one of the most live foods that using in larviculture of sturgeon fish. The present study was conducted to determine the effects of graded levels of the probiotic bacillus, in bioencapsulation of *Artemia urmiana* on the growth parameters and feeding efficiency of *Acipenser nudiventris* larvae. This study was done in center of Marjanii sturgeon culture of Iran, for 2 weeks.

Materials and methods

The probiotic bacilli were prepared from Protexin Co. (Iran- Nikotak). The five species of probiotic bacillus (*Bacillus licheniformis*, *B. subtilis*, *B. polymixa*, *B. laterosporus* and *B. circulans*) as bacterial blend under the commercial title of Protexin aquatic were used for bioencapsulation of *Artemia urmiana*. Three concentrations of bacterial suspension, 1×10^8 , 2×10^8 and 3×10^8 bacteria per milliliter (CFU/lit) were provided. The *Artemia urmiana* were bioencapsulated in three doses of bacterial suspensions for 10 h. at $29 \pm 1^\circ\text{C}$, in glass con with 1 liter of seawater (3.0% salinity) at a density of 2.0 g / liter with constant illumination and oxygenated through by setting air pump (Gomez-Gil et al, 1998). The bioencapsulated nauplii were used as a vector to carry probiotic bacillus to digestive system of *Acipenser nudiventris* larvae. Twelve fiberglass tanks (capacity of 50 liters) with three replicates for treatment and control were used. Healthy larvae of *Acipenser nudiventris* provided by the fish hatchery of sturgeon center of Marjanii (Iran). The density of fish larvae in per tank was 4-5 fish per liter. Initial weight of fish larvae was 27 mg and length 16 mm. Sturgeon larvae were fed based on the 30% of their body weight for six times a day with bioencapsulated *Artemia* nauplii in experimental treatments and unbioencapsulated *Artemia* nauplii in control treatment respectively. In the termination of experiment, fifty larvae from each tank were sampled and total weight and length of body were measured.

Results

The growth and feeding parameters of *Acipenser nudiventris* at the end of the feeding trial and mean values of feeding parameters were shown in table 1.

The results indicated that the probiotic bacillus significantly promoted final body weight, body length and specific growth rate (SGR %) in experimental treatments in comparison with control treatment ($p < 0.05$). While the condition factor (CF) weren't significantly increased ($p > 0.05$). The maximum body weight obtained in treatment of T3 (212.88 mg) while this parameter in control treatment was 179.33 mg. In experimental treatments the probiotic bacilli had positive and significant effects on the feed conversion efficiency (FCE %), Protein Efficiency Ratio (PER), Lipid efficiency ratio (LER) and energy efficiency ratio (EER) ($p < 0.05$). The best PER and LER obtained in T3. The FCR showed an inverse correlation with concentration of bacillus (CFU/ liter) of bioencapsulated suspension of broth and the minimum of this parameter was obtained in treatment of T4 (3.38). The relative food intake (RFI %) in experimental treatments (T1, T2 and T3) had significantly decreased in comparison with control treatment ($p < 0.05$). The maximum of RFI% obtained in control treatment (28.53%).

Table1. The changes of growth and feeding parameters in *Acipenser persicus* larvae in different treatments.

Treatment/Parameter	Control unbioencapsulated Artemia nauplii	T1 bioencapsulated Artemia nauplii by 1×10^8 CFU/l	T2 bioencapsulated Artemia nauplii by 2×10^8 CFU/l	T3 bioencapsulated Artemia nauplii by 3×10^8 CFU/l
Final body weight (mg)	179.33±19.60 c	194.40±22.63 b	198.78±18.43 b	212.88±24.19a
Final body length(mm)	32.06±2.46 b	33.03±3.03 a	33.26±2.46 a	33.85±2.92 a
SGR%	13.36±1.52 c	13.92±1.56 b	14.13±1.35 b	14.60±1.50 a
Condition factor	0.548±0.012 a	0.537±0.073 a	0.541±0.075 a	0.550±0.094 a
FCR%	4.10±1.07 a	3.78±1.02 b	3.62±0.81 bc	3.38±0.98 c
FCE%	25.96±5.46 c	28.24±6.091b	28.98±6.33 b	31.45±5.12 a
Relative food intake (%)	28.53±3.56 a	23.72±2.78 b	20.76±2.16 bc	19.96±1.86 c
Lipid efficiency ratio	1.198±0.22 c	1.312±0.23 b	1.350±0.20 b	1.461±0.21 a
Protein efficiency ratio	4.47±0.11 c	4.89±0.12 b	5.04±0.11 b	5.45±0.12 a
Energy efficiency ratio %	0.55±0.12c	0.59±0.013 b	0.60±0.08 b	0.66±0.12 a

Discussion and conclusion

This study highlights the effects of probiotic bacilli on the enhancement of feeding efficiency and growth parameters of *Acipenser nudiventris* larvae. *Artemia urmiana* is one of the most important live foods that were used as a vector to carry probiotics to digestive system of *Acipenser nudiventris* larvae. The best SGR and the highest body weight were obtained in T3. All the probiotic treatments resulted in feeding efficiency better than that of control treatment. Similar effects had been reported for other fishes to increase considerably with the use of probiotic bacilli by Gatesoupe (1991) in using *B. toyoi* on turbot (*Scophthalmus maximus*) and Swain et al. (1996) in Indian carps that improved the growth factors and feeding efficiency of carp. However, in trial T3, the sturgeon larvae were fed by bioencapsulated *Artemia urmiana* in suspension of 3×10^8 bacteria per milliliter, obtained the best body weight and SGR, which showed both of them could promote each other. Also *Bacillus subtilis* and *B. circulans* supplemented in diets of rohu (*Labeo rohita*) fingerlings showed that the final body weight and SGR significantly increased (Bairagi et al., 2004). Results of this study also showed that different concentration of probiotics could cause different effects on growth parameters and feeding efficiency. The present experiment indicated that the probiotic bacillus highly increase the growth performances and feeding efficiency in *Acipenser nudiventris* larvae.

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RIVER CRAB, *Procamburus clarkii*, BY-PRODUCT MEAL IN DIETS FOR THE RED PORGY (*Pagrus pagrus*): EFFECTS ON GROWTH AND FISH SKIN COLORATION.

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Red porgy, *Pagrus pagrus*, is one of the marine fish species candidates to the aquaculture diversification in the Mediterranean and Mid Atlantic coasts, which is characterized by a natural pink skin coloration being that an important quality parameter by its consumer acceptance. Fish are unable to synthesize carotenoids de novo and optimum skin coloration similar to wild specimens depend on the adequate carotenoids included in diets. Moreover this species have reported to require high protein dietary content. Studies on protein and carotenoid alternative sources are necessities for the sustainability of red porgy culture. Previous studies with crab meal inclusion in fish diets and other cultured aquatic species have shown their effectiveness at certain inclusion levels on growth, and also some other studies mainly in salmonids have demonstrated positive results on muscle pigmentation, related to the carotenoid content of these meals.

The following study was conducted to investigate the influence of a river crab meal from *Procamburus clarkii*, a by-product of the food industry, as an alternative ingredient in diets for the red porgy and its effects on fish growth and fish skin colour.

Triplicate groups of hatchery reared red porgy (*Pagrus pagrus*), 233g initial body weight, were kept indoors in grey circular fibreglass tanks and fed during 6 month with three diets: high quality fish meal and fish oil diet was used as a control (Diet C); fish meal protein in the control diet was replaced by either 10% or 20% protein from *Procamburus clarkii* meal (Diet RC10 and Diet RC20, respectively).

All diets were well accepted by experimental fish, finding no differences in feed consumption between treatment groups. Growth parameters and FCR did not differ among experimental groups. Those animals fed the crab meal based diets showed a significantly higher skin redness respect to that of the control fish, and similar to that of the wild specimens. For the crab meal based diets, increasing dietary inclusions of this ingredient were accompanied for an increment of the colour saturation, being the obtained value for the RC20 diet significantly higher than those for the RC10 diet.

Present results indicate the suitability of *Procamburus clarkii* meal as partial replacers of fish meal in diets for the red porgy. Dietary inclusion levels of 10% and 20% of the dietary protein from this meal have no detrimental effects on growth and feed utilization parameters respect to a fish meal based diet, with high improvements in fish skin redness and skin colour saturation by increased level inclusion.

EFFICACY OF “MAHI SEFID” (*Rutilus frisii kutum*) ARTIFICIAL AND SEMI ARTIFICIAL PROPAGATION METHODS

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Introduction

Propagation of *Rutilus frisii kutum* is a routine operation in southern part of Caspian sea to restocking.

One of main questions is that what is effect of propagation technique on some main criteria including fecundities, fertilization rate and hatching rate.

Material and method

Total length, weight, age, absolute and relative fecundity, fertilization percent and hatching rate were measured both for hatchery and field propagated brood stocks. then the results compared statistically.

Results

Statistical analysis for two groups showed that there were significant differences in most of factors measured (figures 1,2).

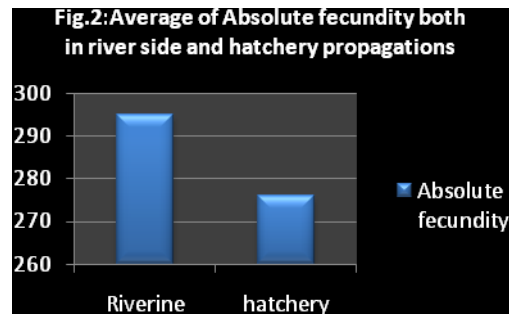
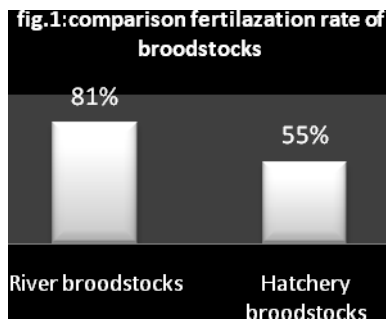




Fig.3: riverside site for semi artificial propagation



fig.4:hatchery view for artificial propagation

Discussion and conclusion

The quality of gametes undoubtedly is an effective factor on propagation (Azari,1981). So uncompleted broodstocks brought to hatchery have lower efficacy in terms of fertilization rate and hatching. Even though hatchery's broodstocks injected by pituitary extract but it seems size and age of broodstocks are more important factors in breeding because lead to higher rates of fertilization and hatching. Also stress caused by fish transport to hatchery is another reason for mentioned results (Vahabzadeh *et al.* 2006). According to these we'll offer some recommendations in main presentation.

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TOTAL LIPID, PROTEIN AND FATTY ACIDS CONTENT OF RAINBOW TROUT' FRY (ONCORHYNCHUS MYKISS) IN FEEDING WITH ARTEMIA NAUPLII, DECAPSULATED CYST AND FORMULATED FOOD

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Introduction:

The most interesting object of larviculture is attended to the best survival and growth rate of larvae (Abatzopoulos et al, 2002; Bengtson et al, 1991). Enzymatic efficiency intestine in larval stage is not much progressed. Synchronically this deficiency reforms with maturation of animal (Kolkovski, 2001). Importance of live food in larviculture is determined by both nutritional value and prompting the digestion ability of formulated food in intestine of larvae. Extensive digestion of food particles increases statistically growth rate and survival of larvae (Kolkovsk, 2001). The aim of this study is verifying the importance of Nauplii and decapsulated cyst of Artemia in diet of *Oncorhynchus mykiss* larval stage.

Material and methods:

According to proposal in first feeding of the 0.130 mg larvae in 5 treatment of food (100% Nauplii, 100% decapsulated cyst, 100% formulated, 50-50% Artemia nauplii and formulated food and 50-50% decaupsulated cyst with formulated food) were fed in 3 replicate for 21 days. At the end of 15 individual of each treatments were analyzed for fatty acids, protein and total lipid.

Results:

The protein and fat contents in fish tissue and summary of n-3 and n-6 at the end of experiment were summarized in table 1. Results and its statistic analysis revealed that the fries' of rainbow trout even in larval stage do not need to live food for digestion of any formulated food particles. Even comparing of fatty acids in fish bodies and profiles of diets show that, intestine enzymes of this animal even on Laval stage are able to digest any kind of food and don't need to other complement live food.

Discussion and conclusion:

The same rate of lipid and protein content in fries despite of different rate in diet were quantified in order to describe enzymatic proficiency of fish intestine of fries in food's piratical digestion. According to Leibovitz and

colleagues in 1987, Salmon fishes requires to 35-40% protein and 15-20% fats and even with significance differences between protein and fat contents in fries with different diet feeding these variation was not noticeable. Compare to the low rate of EPA and DHA in Artemia nauplii and decapsulated cyst (not showed) and the high rate of these two fatty acids in fries revealed that the anabolism of these fatty acids in salmon fishes. But these two fatty acids contents comparing between the treatments don't show any digestion proficiency in live diet feeding. Moreover the variable nutrition value in n-3 and n-6 fatty acids comparing among the combination's food with unique diets demonstrated a complex equation in fatty acid anabolism. Overall as conclusion these results shows that the fry's of *Oncorhynchus mykiss* approximately because of enzymatic intestine ability don't need to any additional digestive to digestion of food particles. But survival and growth rate larvae in feeding by live food can be reason of this expensive diet.

Table1. Total protein, total fat and some classes of fatty acids percentage (of all fatty acids) in fish tissue in feeding with 5 feeding diet

Diet	(n-3) fatty acids	(n-6) fatty acids	DHA+EPA	Total protein	Total fat
100% Formulated food	%4.84	%22.74	%3.6	62.3±0.2 a	18.15±0.12 a
100% Decapsulated cyst	%9.04	%45.49	%1.38	64.4±0.11 b	18.77±0.15 b
100% Artemia Nauplii	%10.65	%37.22	%1.2	62.8 ±0.21 c	18.09±0.2 a
50-50% formulated food/decapsulated cyst	%8.095	%16.71	%2.33	63.8±0.19 d	17.97±0.24 a
50-50% formulated food/Artemia Nauplii	%12.3	%12.34	%2.48	61.9±0.3 e	17.57±0.27 c

Value with the same superscript letters in the same row is not significantly different at the 5% level

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BIOPROCESSED CHICKEN INTESTINE WASTE AS A SOURCE OF FEED STUFF IN FORMULATED DIET FOR SHRIMP *PENAEUS MONODON* (FAB.)

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An investigation was made to assess the efficiency of bioprocessed chicken intestine added diets on growth responses and nutrient. Four Isonitrous (35% crude protein approximately) and isocaloric (4.0 Kcalg⁻¹ approximately) were formulated including 20% raw and bioprocessed chicken intestine waste. A particular bacterial strain (*Bacillus* sp.) isolated from the shrimp (*Penaeus monodon*) intestine having extracellular lipolytic, proteolytic and amylolytic activities was used for the bioprocessing for 24, 48 and 72 h. These diets were then evaluated on PL20 *Penaeus monodon* in 100 l capacity glass tanks under laboratory condition for a period of 30 days. During this period, the shrimps were fed with control and experimental diets thrice daily at *ad libitum*. The water quality parameters were maintained at their optimum level and the water quality parameters were maintained at their optimum level and the experiment was performed at 20 ppt salinity. The results indicated that the growth responses such as production consumption, SGR and FCR were varied much between control and experimental diets fed shrimps. The independent influence of feed quality on variation in carcass biochemical constituents was statistically highly significant ($P < 0.01$). The results on nutrient metabolism of *P. monodon* also showed dietary dependent variation. The pattern of muscle protein profile of *P. monodon* fed with experimental diets also shows marked variation.

Key Words: Intestinal microflora, Chicken intestine waste, bioprocessing, Shrimp.

NEW METHOD TO IMPROVE THE QUALITY OF NORTHERN PIKE EGGS OBTAINED BY HORMONALLY INDUCED OVULATION

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Introduction

Northern pike (*Esox lucius* L.) are the most characteristic freshwater piscivorous fish in Europe and play an important ecological role by controlling populations of various fish species in natural waters. Stocking northern pike fry in natural waters is necessary to augment existing populations. The required number of fry can only be produced in controlled hatchery conditions.

Since northern pike do not breed in captivity, ovulation is induced by hormonal treatment. The main disadvantage of this technique is the low fertilization percentage of the ovulated eggs.

The process of ovarian follicle maturation and ovulation for cold-water fishes, in which spawning is usually unsynchronized among females, is more prolonged under the influence of a gradual and extended increase in circulating gonadotropin (GtH). Natural spawning of northern pike normally occurs at water temperatures from 5 to 10°C, therefore they can be regarded as a cold-water spawning species. Although preovulatory GtH changes in northern pike have not yet been measured, it is likely that the pattern is similar to that of other species spawning in cold water.

Recently, it has been shown that administration of dried carp pituitary extract in a sustained release vehicle of Carbopol resin (CP) can produce a higher mean fertilization percentage and a less variable egg quality in northern pike than injection of pituitary in NaCl saline (Szabó, 2001). In the present study, these findings are evaluated at a large-scale hatchery production of northern pike.

Materials and methods

Experiments were carried out in Hungary at the Dinnyés Fish Hatchery and Farm, Dinnyés and at the Tempered Water Fish Hatchery and Farm (TEHAG), Százhalombatta. Experiments were conducted during the northern pike breeding seasons between 2002 and 2006. Over the five breeding seasons, eight spawning trials were performed.

In each trial females were randomly allocated to two treatment groups. The number of females in these groups varied between 10 and 54 over the five breeding seasons. The number of males used for fertilization procedures was approximately 20 percent of the number of the ovulated females.

In both treatment groups, females received an injection of a crude preparation of dried carp pituitary at a dose of 3.5mg.kg.⁻¹ body weight (BW). Pituitaries were administered in a vehicle of 0.7% saline for one group and in a 2.5% aqueous dispersion of Carbopol resin for the other. All injections were applied intraperitoneally at a volume of 0.5ml.kg.⁻¹ BW.

In order to ensure adequate sperm production, all males received a single injection of dried carp pituitary administered in saline at a dose of 3mg.kg.⁻¹ BW. The testes were surgically removed and sperm was obtained by squeezing the organs through cheesecloth. This required sacrificing the males but enhanced sperm yield.

In each trial, stripping of females was conducted on the fourth day after injection. Milt was obtained from the testes of 6-12 males (depending on the number of the treated females). The testes from different males were collected in one beaker. Milt extracted from this mixture of testes was used to fertilize the eggs from each female. After fertilization, eggs were placed into Zuger jars for incubation at 11±1.0°C. Fertilization

percentages were established 12 to 24 hours after fertilization, when eggs were in the morula stage. Fertilization percentage data from the CP and saline treatments were compared with a two-sample *t*-test.

Results

Over the five breeding seasons, more than 90 percent of the females ovulated in each group. In six out of eight trials, the mean fertilization percentage was higher for the group receiving carp pituitary in the CP vehicle (Table 1). With one exception, variation in fertilization percentage was relatively high for the saline group in each trial (Table 1). In contrast, carp pituitary injection in CP resulted in a less variable fertilization percentage. Moreover, based on an average of data from the eight trials during five breeding seasons, the mean fertilization percentage was significantly higher for the CP group ($76.4 \pm 7.74\%$) ($n = 8$) than for the saline group ($59.3 \pm 10.8\%$) ($n = 8$) (two-sample *t*-test, $t = -3.64$, $p = 0.003$).

Table 1. Number of ovulated females and mean (\pm SD) fertilization rates of northern pike eggs produced after intraperitoneal injection with a crude preparation of dried carp pituitary (3.5 mg/kg BW) in a 0.7% NaCl (saline) or in a 2.5% aqueous dispersion of Carbopol resin 971 P (CP). The *p* value refers to output from a two-sample *t*-test comparing CP and saline vehicles from each trial.

Trial	No. ovulated females		Fertilization rate (%)		<i>p</i> value
	saline	CP	saline	CP	
2002 ^a	46	27	64.8 \pm 15.20	79.6 \pm 9.70	0.03
2003 ^b	25	45	42.6 \pm 12.7	62.3 \pm 5.18	0.02
2004 ^a	25	12	51.9 \pm 8.6	73.5 \pm 3.3	0.01
2004 ^b	35	25	63.5 \pm 7.49	70.9 \pm 6.22	0.34
2005 ^a	10	25	63.6 \pm 15.4	86.5 \pm 4.55	0.004
2005 ^b	40	30	65.7 \pm 14.5	84.2 \pm 8.64	0.04
2006 ^a	23	42	47.4 \pm 22.7	74.8 \pm 8.24	0.005
2006 ^b	11	40	74.6 \pm 0.92	79.0 \pm 8.80	0.52

^aDinnyés hatchery, ^bTEHAG hatchery

Discussion

The efficiency of northern pike fry production via dried carp pituitary treatment delivered in a saline vehicle was low due to the reduced fertilization percentage. The low mean fertilization percentage of eggs after carp pituitary injection in saline resulted from variable fertility among females. The treatment increased the incidence of low fertilization percentages among individuals, rather than causing a general decrease in fertility of each fish. The heterogeneous extent of reproductive development among females at the time of a non-physiological induction of ovulation was probably a contributing factor. Administration of dried carp pituitary in a slow-release vehicle CP produced a higher mean fertilization percentage, possibly because the slower hormone action could optimally control ovarian follicle maturation and ovulation, even in females not fully prepared for propagation. These results suggest that in northern pike spawning in cold water, the gradual increase of the ovulation inducing hormone may be important for high quality eggs. According to these results from large-scale production, the new method could be suitable to have wide application for induced breeding of northern pike.

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MORPHOMETRIC ANALYSIS OF BODY-FORM VARIABILITY IN *Iranocichella hormouzensis*, THE IRANIAN CICHLID

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Abstract:

In this study, body-form variability in the trophically Iranian cichlid, *Iranocichella hormouzensis* investigated. Geometric morphometrics to assess and compare size, shape, and allometric patterns within and between dental morphs (distinguished by differences in pharyngeal bones and papilliform or molariform dentitions) have used.

Dental morphs exhibit different patterns of body-form variability. Within each morph, body-form varies between more fusiform ‘piscivores’ and deeper-bodied dietary generalists. However, papilliform individuals show a continuous distribution of body-forms, whereas molariform individuals exhibit a discontinuity.

Geometric techniques more clearly recognize discontinuities in shape and explanations for observed differences in body-form variability between dental morphs, concluding that the best explanation hinges on the relative importance of genetic and environmental factors in influencing body-form.

Key words: *Cichlidae*, allometry, ecomorphology, size, shape

NIGHT STOCKING FACILITATES NOCTURNAL MIGRATION OF HATCHERY-REARED ATLANTIC SALMON SMOLTS (*SALMO SALAR* L.)

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Introduction

Despite its popularity, artificial-rearing tends to produce fish that are poorly adapted to the natural environment, and have higher mortalities than their wild counterparts. Mortality of stocked salmonids can be particularly high during the first few hours post-release because of phenotypic mismatch, as well as behavioural and physiological deficits. Protocols developed for rearing and stocking of salmonids for restoration have traditionally mimicked commercial fish farming, but these may deviate considerably from natural conditions. For example, while wild smolts in temperate streams tend to migrate predominantly at night (Moore *et al.* 1998), stocking of hatchery-reared smolts for restoration purposes tends to be carried out during the day. The purpose of this study was to test whether night releases of juvenile Atlantic salmon smolts might foster nocturnal downstream migration and increase smolt survival compared with traditional day-time stocking.

Materials & Methods

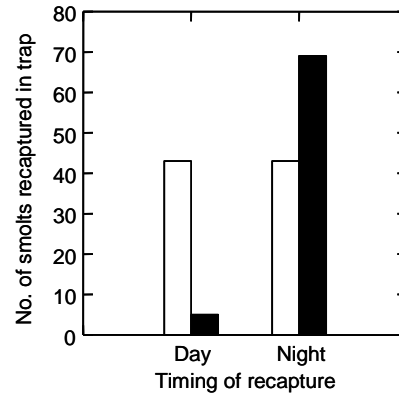
The study was conducted from 10 April to 10 May 2007 in the Taff Fawr, a tributary of the River Taff (South Wales, UK). One month before stocking, about 20000 one year old smolts were divided into four identical 5-m diameter GRP tanks and separately batch-tagged in the snout using coded wire tags. On 17 April 2007, 1750 salmon smolts were randomly selected from one of the four experimental tanks, transported by vehicle and released at 08:00 hr at the stocking site. This was regarded as a day release (batch 1). Later on the same day, a second batch of 1750 salmon smolts was randomly selected from a different tank, transported to the same stocking site and released at 19:30 hr (batch 2, night release). Night and day releases were repeated 6 days later in reversed order: 1750 salmon smolts from a third tank were released on 23 April 2007 at 19:30 hr (batch 3, night release), followed by a final release of 1750 salmon smolts from the remaining fourth tank on 24 April 2007 at 08:00 hr (batch 4, day release). A fyke net fitted with a live box and covering the whole width of the stream was placed 2 km downstream of the stocking site for bank-to-bank trapping. Following each release, the fyke net was fished every 6 hr for three consecutive days, at 12:00 hr and 18:00 hr (considered day recaptures), and at 00:00 hr and 06:00 hr (considered night recaptures). After three days, the number of smolt recaptures decreased sharply and the fyke net was fished once per day at 09:00 hr until May 10. One in every 10 smolt recaptures was sacrificed (2-phenoxy-ethanol overdose) to recover the microtag and determine the timing of release. The fork length (L_F), wet weigh (W_T), condition factor (C_F) and sex of these recaptures were also determined.

Results

A total of 7000 salmon smolts were stocked during the four experimental releases, and 1550 were recaptured in the trap (22.1%). Of these, 513 smolts were recaptured during the day (33%) and 1037 smolts during the night (67%) indicating a strong nocturnal

behaviour ($P < 0.001$). Timing of release had no significant effect on the number of smolts recaptured, which were similar for day and night releases ($P = 0.481$), but had a strong effect on nocturnal behaviour. Analysis of recapture times indicated that the majority of smolts moved downstream within 24 hr of release, and most (89%) had migrated within 3 days. There were significant temporal differences in movement patterns between night and day releases ($P = 0.002$). A much higher proportion of smolts migrated during the night when they were released at night (93%) than when they were released during the day (50%; Fig. 1; $P < 0.001$).

Fig. 1. Effect of timing of release on extent of nocturnal behaviour of hatchery-reared Atlantic salmon smolts released during the day (open square □) and during the night (closed square ■), based on the screening of 10% of microtagged smolts at the trap.



Discussion & Conclusion

Comparisons between day and night releases indicate that the timing of stocking can have a significant effect on downstream migration patterns of hatchery-reared Atlantic salmon smolts. When stocked in the evening (but not during the day) hatchery-reared smolts moved almost exclusively during the night, mimicking the behaviour of wild smolts (Jonsson *et al.* 1991). This may be advantageous if smolts can reduce the impact of predation by migrating during the night, or are better able to recover from stress caused by transport and handling (Iversen *et al.* 1998). The benefits of night stocking might be particularly relevant when releasing salmonid smolts near estuaries, where mortality caused by diurnal predators is thought to be highest (e.g. Dieperink *et al.* 2001), and also during the critical first few hours following release, when smolts are thought to be most vulnerable (Jepsen *et al.* 2006). Our study suggests that altering the timing of release to coincide with the natural time of smolt migration may provide a crucial acclimatisation period and facilitate nocturnal smolt passage.

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WORLD STURGEON AQUACULTURE, AN OVERVIEW

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The over-exploitation of natural and enhanced sturgeon stocks for caviar production and habitat deteriorations has led to drastic declines in the natural stocks. As a consequence, IUCN in 1997 listed all commercially utilised sturgeon species world-wide on Annex II of the CITES regulations, thus requiring internationally agreed quotas for trade in order to promote protection.

Demand for caviar on export markets is estimated to be in the range of 500 to 3,000 t annually. The high price level of this product continues with further gradual increases.

The feasibility of aquaculture production of sturgeon caviar therefore seems to become attractive and possible, and was already predicted since 1995 (Logan et al. 1995), and has gained increased shares on the world market.

Russia, Iran, the European Union, China and USA are among the major producers and consumers, but also entities in other countries and outside of the natural range of sturgeons are increasingly contributing to the production.

The present total output of about 80-100 t of caviar from aquaculture is now already exceeding the legal caviar yield from fisheries by four times (2006), - included Aquaculture - supported by ocean ranching.

The development of small experimental ventures mainly focused on the production of meat and stocking material for recreational purposes in the early 1990s are outlined.

Further the future trends and the potential for large scale production of caviar will be discussed on the basis of various information sources, taking into account the uncertainties and opportunities of these relatively new branch of aquaculture.

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AMINO ACID AND FATTY ACID COMPOSITION IN VIABLE AND UNVIABLE EGGS OF SENEGALESE SOLE (*Solea senegalensis*)

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Introduction

Separation of eggs into floating and non-floating is a common practice in aquaculture in order to separate viable (floating) from unviable eggs (non-floating). The energetic reserves contained in the egg are essentially due to the maternal contribution. The free amino acid pool of marine fish eggs originates during final oocyte maturation, when the hydrolysis of some yolk proteins to free amino acids creates the major part of the osmotic potential needed for water influx (Thorsen and Fyhn 1996).

During fish embryogenesis free amino acids are used as a substrate for protein synthesis but are also the main energy substrates (Fyhn 1990). Fatty acids are also important during this stage as energy substrates, as membrane structural components and also as metabolic precursors (Rainuzzo et al. 1992, Vásquez et al. 1994).

The objective of this study was to compare the fatty acid and free amino acid content of viable and unviable eggs in order to identify differences between both fractions, contributing to more knowledge on egg viability.

Material and Methods

Egg samples were collected throughout the spawning season of a Senegalese sole (*Solea senegalensis*) broodstock group adapted to captivity. The eggs were separated into viable and unviable based on their buoyancy in seawater (37 ppt). From both fractions (viable and unviable) egg samples were collected and frozen at -80°C.

At the end of the spawning season, egg samples resulting from spawnings with a high viability and hatching rate (over 80 and 95 %, respectively) were taken together. Samples of viable and unviable eggs were analysed for free amino acid and fatty acid content after freeze-drying.

Fatty acid methyl esters (FAME) were prepared using the method developed by Lepage & Roy (1986) modified by Cohen et al. (1988). The separation of the different FAME was carried out in a gas chromatograph following the conditions previously described by Bandarra et al. (2006). Samples were analysed for free amino acid content through HPLC, using the Pico-Tag method (Waters, USA) as described by Cohen et al. (1989).

Data from viable and unviable eggs were compared using t-tests with $p < 0.05$ as a significance level.

Results and discussion

Fatty acid content was significantly higher in unviable than in viable eggs (103 ± 10 and 74 ± 7 mg/g dry weight, respectively). These differences were essentially due to a higher content of saturated and monounsaturated fatty acids in unviable eggs. These may be due to a higher use of saturated and monounsaturated fatty acids in viable eggs, since these are used as energy sources during fish embryogenesis (Tulli and Tibaldi 1997). When the results are expressed as a percentage of total fatty acids, almost no differences were found between viable and unviable eggs. Therefore, the fatty acid content does not seem to be a good tool to help differentiating viable from unviable eggs.

Regarding free amino acids, their content was significantly lower in unviable than in viable eggs (260 ± 8 and 551 ± 20 $\mu\text{mol/g}$ dry weight, respectively). A high free amino acid content may be important to ensure egg's viability, since during Senegalese sole embryogenesis free amino acids are the main energy substrates (Parra et al. 1999). The content of each amino acid was more or less two times higher in viable than in unviable eggs, with the exception of methionine and phenylalanine. Methionine content was seven times higher in viable than in unviable eggs, while on the contrary, phenylalanine content was two times higher in unviable than in viable eggs. As a consequence, the free amino acid profile was similar between viable and unviable eggs, with the exception of methionine and phenylalanine. Free phenylalanine content was found to decrease during Senegalese's sole egg stage (Pinto et al. 2007). Taken together, these results may suggest an important use of phenylalanine during Senegalese sole embryogenesis. Free methionine content was found to be stable during Senegalese's sole egg stage (Pinto et al. 2007). The present results suggest that high methionine content seem to be important for egg viability.

Therefore, differences between viable and unviable eggs rely more on their free amino acid content than in their fatty acid content. Further analyses of these results together with other parameters are necessary in order to identify possible egg quality markers in Senegalese sole.

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INFLUENCE OF DIETARY PHOSPHOLIPIDS ON EARLY ONTOGENY OF FISH

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Introduction

Contradictory results have been published concerning the dietary lipid requirement in fish larvae. A number of authors reported poor larval growth associated with high dietary lipid content (Izquierdo et al, 2000). Besides, the optimal lipid concentration was determined around 25% of diet dry matter for sustaining larval development and growth in the European sea bass *Dicentrarchus labrax* (Zambonino-Infante and Cahu, 1999). It appeared that good growth and survival were associated with the incorporation of phospholipids in diet, and a negative effect of high dietary neutral lipid levels on larval growth was suggested (Morais et al, 2007). During the last years, studies were undertaken in different fish species to understand 1) in which extent dietary phospholipid really positively affects larval development, growth and survival, 2) in which extent, and by which molecular mechanisms, its composition in highly unsaturated fatty acids (mainly EPA and DHA) is responsible for appropriated larval development.

Effect of dietary phospholipid on fish larval growth and survival

An experiment was conducted by feeding European sea bass larvae with isolipidic compound diets, including an increasing concentration of phospholipid, supplied as soya lecithin, and concurrently a decreasing level of neutral lipid. It appeared that a dietary phospholipid concentration of 9 to 12% of diet dry matter led to the best development of sea bass, considering growth, survival, onset of digestive enzymes and skeleton formation. The same isolipidic diet incorporating only 3% phospholipid led to a quasi total mortality of larvae at day 40 (Cahu et al., 2003). A low occurrence of lower jaw malformation and spinal malformation, scoliosis, lordosis, was associated to the highest dietary phospholipid levels. The global beneficial effect of phospholipid was in part attributed to the efficient digestion of this nutrient by fish larvae since early stages. Indeed, phospholipase synthesis is accurately regulated in response to dietary phospholipid content. In contrast, response of pancreatic lipase to neutral lipid content is not linear. Similar improvement in growth, survival and onset of global digestive activity by dietary phospholipid was also observed in pike perch *Sander lucioperca* (Hamza et al, 2008). Furthermore, Geurden et al (1998) suggested that phosphatidylcholine has a growth promoting effect and phosphatidylinositol prevents deformity in carp *Cyprinus carpio*.

Effect of HUFA level in dietary phospholipid on fish larval development

The dietary highly unsaturated fatty acids can be provided by neutral lipid (cod liver oil) or phospholipid (marine lecithin). Experiment conducted in sea bass (Villeneuve et al, 2005) and in cod (Wold et al, 2007) showed that larvae used EPA and DHA more efficiently if they are present in phospholipid. A dietary concentration of 1 to 3% of EPA+ DHA provided by phospholipid was showed to be optimal for fish larval development. Higher level, 5%, led to depressed growth and very high occurrence of skeletal deformities, affecting mainly the vertebral axis of the fish. The negative effect on larval morphogenesis was associated with a down regulation of retinoid acid receptors, RAR α , RAR β , retinoid X receptor RXR. These nuclear receptors are transcription factors for several genes involved in tissue differentiation and organogenesis

and bone synthesis such as bone morphogenetic protein (BMP4). Furthermore, EPA+DHA supplied in neutral lipid source were inefficient to support growth and development of sea bass.

Conclusion

Phospholipid is determining for larval growth and development. A supply of phospholipid as soya lecithin totally devoid in HUFA promotes growth (on condition that HUFA are supplied by other sources). But phospholipid is also the most efficient form for supplying HUFA. As a result, an excess in dietary HUFA, only twice the optimal value, supplied by phospholipid leads to high deformity occurrence in fish larvae.

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Ultraviolet Technology

UV in Aquaculture

How Does Ultraviolet Work?

Ultraviolet energy causes permanent inactivation of microorganisms by disrupting DNA (the reproductive material) so that it is no longer able to maintain metabolism or reproduce.

The maximum effectiveness occurs between 240 and 280 nm, depending on the organism. The Hanovia medium pressure Arc Tube produces these wavelengths in abundance. The most effective wavelength occurs at 265 nm.

UV permanently inactivates all bacteria, spores, viruses and protozoa (including Cryptosporidium and Giardia oocysts).

Stressed animal stock is more vulnerable to infection from a host of pathogenic species. UV can assist with the elimination of these pathogens.

Application for UV

- ▶ Tank Water
- ▶ Feed Water
- ▶ Process Water
- ▶ Odour Abatement
- ▶ Effluent Disinfection



Most Efficient

- ▶ Bacteria, viruses, moulds, spores are all inactivated by UV.
- ▶ Treatment is effectively monitored and fully automated
- ▶ Permanent accurate treatment records can be produced, so all treatment can be traced and the applied dose demonstrated
- ▶ UV works instantly; no contact tank is required
- ▶ UV is effective against all fish, seal, penguin and whale pathogens and will de-activate all water borne pathogens
- ▶ Several fish pathogens eg., VHS, IPN, IPA, UDN, PKD, Furunculosis and Vibrio are destroyed at a UV dose of 60-90mJ/cm²



Superior to Alternatives

- ▶ Chlorine and ozone are becoming less acceptable because of harmful by-products and handling problems
- ▶ UV is an environmentally friendly way to eliminate bacteria etc, without chemicals
- ▶ UV is the most cost-effective method of water disinfection, requiring minimal servicing
- ▶ UV is simple and automatic. The only consumable is electricity
- ▶ No contact tanks are needed with UV so space requirement is modest.
- ▶ UV is a simple and inexpensive plant, which fits into existing buildings
- ▶ Low capital, operational and maintenance costs

No Detrimental Effects

- ▶ UV has no effect on taste, odour or pH
- ▶ UV leaves no residue
- ▶ Overdosing is not possible

Safety

- ▶ No hazardous chemicals are required
- ▶ No toxic by-products are produced
- ▶ Earth leakage detection as standard

Experience

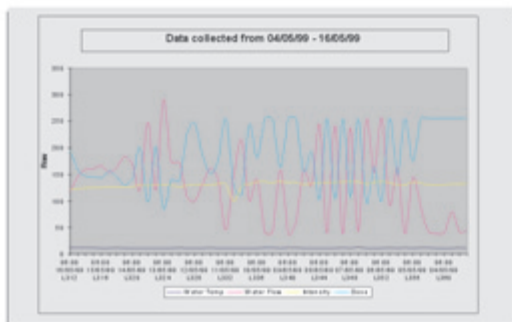
- ▶ Hanovia has over 75 years experience in UV.
- ▶ 40,000 installations worldwide.

Powerful Arc Tubes-single Arc Tube per Chamber

- ▶ Arc Tubes are specially designed and manufactured by Hanovia
- ▶ Hanovia's Arc Tubes are the most powerful for water treatment
- ▶ One monitor per single Arc Tube is the only concept that can allow effective, meaningful monitoring
- ▶ Up to 400m³/hr can be treated with a single Arc Tube
- ▶ Single Arc Tube design requires minimal maintenance
- ▶ Arc Tube replacement is quick and simple
- ▶ Temperature independent
- ▶ Crossflow range treats up to 10,000m³/hr per system

Constant Wattage Power Supplies

- ▶ Designed and built by Hanovia, this type of power supply should not be confused with inferior alternatives
- ▶ Output variation of <1.5% is guaranteed, even when input voltage varies by 15%
- ▶ With inferior power supplies, the necessary minimum UV dose would not be maintained in the event of a power dip, e.g. when an adjacent pump starts
- ▶ Automatic restart on power failure
- ▶ Power supply can be flow paced



Data Logging

- ▶ Applied UV dose can be demonstrated and adequacy of treatment proved using the data logs
- ▶ National or international standards demonstrated
- ▶ Any fault or event is date and time stamped

Controls

- ▶ Treatment is achieved by UV dose. This is computed from the UV intensity measured by the monitors, the water flow rate and the on line measured transmittance
- ▶ Power to the Arc Tube can be varied to ensure that the desired dose is obtained at all times, while keeping running costs to a minimum
- ▶ Entire system can be controlled locally or remotely, providing continuous and precise management information to the central control
- ▶ System will automatically switch to standby unit when required
- ▶ UV dose and lamp intensity can be data logged



Water Quality

- ▶ UV disinfection can be designed for almost any water, and is therefore not restricted to high quality borehole or surface waters
- ▶ Proper design of the UV chamber takes into account the light absorbed or scattered by dissolved and suspended materials: a test of the UV transmittance of the water is always carried out by Hanovia prior to making a proposal
- ▶ An optional automated wiping system is used for keeping the quartz surface free of deposits so that UV effectiveness is maximized
- ▶ An on line Transmittance Monitor can measure changes in water quality and adjust dose accordingly

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GROWTH PERFORMANCE AND SURVIVAL OF ASIAN SEABASS (*LATES CALCARIFER* BLOCH) JUVENILES REARED IN FRESHWATER AND FED GRADED LEVELS OF SALT INCORPORATED DIETS

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Introduction

The Asian seabass (*Lates calcarifer* Bloch) is a carnivorous, euryhaline marine species which is being reared under intensive conditions in fresh and brackish water in re-circulating systems and earthen ponds. Harpaz et al. (2005) found significantly better growth, survival and feed conversion ratio in Asian sea bass when adding 4% salt (NaCl) to the diet. Beneficial effects of dietary NaCl have been reported in a few fish species: common carp and mrigal (Nandeesh et al. 2000), rohu (Gangadhara et al. 2004) and gilthead sea bream (Appelbaum and Arockiaraj 2008). In this communication, the effect of prepared salt rich diet on growth performance and survival of Asian seabass juveniles grown in freshwater is reported.

Materials and Methods

Experimental setup: The indoor experimental setup consisted of fifteen rectangular rearing tanks each of 100-L capacity. The tanks were grouped into 5 separate systems each consisting of three rearing tanks connected to one common water-cleaning unit, of 100-L, filled with volcanic gravel and strongly aerated water, which served as a biological filter. All systems were filled with de-chlorinated freshwater. Water from the cleaning unit entered each rearing tank at the rate of 3 liters per minute. Thirty percent of the de-chlorinated freshwater was replaced daily in each system to compensate for losses from evaporation and sludge removal. Oxygen levels in the rearing tanks were maintained above 4 ppm. Water temperature was maintained at $28\pm 1^\circ\text{C}$ using thermostatically controlled electric heaters.

Experimental fish: Fifty-four-day-old juveniles (\bar{X} = 0.18g) of Asian seabass, produced via induced spawning ("Maagan Michael Hatchery", Israel), were used for the 56 days experiment. Fish were evenly distributed in each of the 15 rearing tanks at a stocking density of No. = 70.

Experimental diets: Five different salt rich diets were prepared by grinding and re-pelleting a commercial feed (protein 45%, lipid 14%, fiber 2.4% and ash 9.5%; "Shivuk" Company, Israel). Salt was added to the diets before re-pelleting. This salt was obtained by evaporating brine that is produced during desalination of brackish geothermal water (TDS of 13.7 ppt), originated from a deep well located in the Israeli Negev desert (Table 1). The prepared pelleted diets were oven-dried at 60°C for 6 hours and stored in an air tight container. Fish were hand-fed *ad libitum* three times daily. Fish in system 1 were fed the control without added salt; fish in system 2 were fed the 8% salt added diet; fish in system 3 were fed the 10% salt added diet; fish in system 4 were fed the 12% salt added diet; and fish in system 5 were fed the 14% salt added diet.

Observation and statistics: Representative samples ($N_r=30$) of fish from all tanks were weighed in a digital weighing balance every two weeks and their growth performance calculated. Survival and feed conversion ratio were monitored daily. The growth and survival data were analyzed using one-way ANOVA and Tukey's Multiple Range Test (Zar 1984).

Results

Fish fed the 8% salt rich diet attained the highest growth rate ($P<0.05$) followed by those fed 10% rich diet, and the control diet. Diets with 12% and 14% salt promoted the lowest growth rates (Table 2). Fish receiving diets with 8% salt showed a significantly better feed conversion ratio (FCR) and protein efficiency ratio (PER) as compared to the other treatments. An inverse relationship was noticed in survival, the higher the salt incorporated in the diet, the lower the survival rate.

Table 1: Composition of salt added to the experimental diets

Salts	Units	Others parameters	Units
Chloride	40880 ppm	Alkalinity (measured as calcium carbonate)	22 ppm
Sodium	22600 ppm	Electric conductivity (micromhos/cm/25)	98200 mmho
Sulfate	7481 ppm	Hardness (measured as calcium carbonate)	14700 mg/l
Calcium	2339 ppm	Bicarbonate (measured as HCO ₃)	26 ppm
Magnesium	2152 mg/l	Ammonia	24 ppm
Potassium	540 ppm	Nitrite	2 ppm
Boron	33 ppm	pH	7.6
Fluoride	32 ppm	Total dissolved matter	79020 ppm

Table 2: Growth performances of Asian sea bass juveniles fed graded levels of salt incorporated diets for 8 weeks

	Control diet	8% Salt rich diet	10% Salt rich diet	12% Salt rich diet	14% Salt rich diet
Initial weight (g)	0.18	0.18	0.18	0.18	0.18
Final weight (g)	3.62 ^b ±0.42	4.96 ^b ±0.29	3.65 ^b ±0.511	2.30 ^c ±0.17	1.97 ^d ±0.45
Weight gain (g)	3.44	4.78	3.47	2.12	1.79
Average weight gain (%)	172.0	239.2	173.9	106.1	89.5
Feed conversion ratio (FCR)	1.98	1.45	1.96	3.12	3.65
Protein efficiency ratio (PER)	1.25	1.72	1.27	0.79	0.68
Specific growth rate (% d ⁻¹)	0.99 ^b	1.24 ^a	1.0 ^b	0.64 ^c	0.52 ^d
Survival (%)	88.5	94.2	91.4	83.8	80.4

Numbers with different superscript alphabet are significantly different at P < 0.05 level by one-way ANOVA and Tukey's Multiple Range Test

Discussion

Dietary salt has been found to improve fish growth and food conversion efficiency in several species: eel (Arai et al. 1974), rainbow trout (MacLeod 1978), common carp and mrigal (Nandeesh et al. 2000), rohu (Gangadhara et al. 2004) and gilthead sea bream (Appelbaum and Arockiaraj 2008). In this study, an improvement in growth rate and FCR was recorded in fish fed the 8% salt rich diet, but higher salt incorporation diets reduced both growth and survival rates. MacLeod (1978) reported that the addition of excessive salt to the diet could have an adverse effect on food intake, digestion and/or absorption, because of the changed gastric/intestinal environment and may even have pathological effects, ultimately leading to growth reduction. No such effects were detected with all tested diets in this experiment.

Conclusion

Based on the results of this study, it is concluded that the addition of 8% salt to the pelleted feed for Asian seabass *L. calcarifer* juveniles reared in freshwater is advantageous towards their growth and survival rates.

Acknowledgement

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EFFICACY OF DIETARY NUCLEOTIDES SUPPLEMENTATION ON THE IMMUNE RESPONSE IN ATLANTIC SALMON (*SALMO SALAR*). EFFECTS ON SALT WATER TRANSFER AND VACCINATION.

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² Aquatic Health Chile S.A, 1013, Puerto Varas, Chile.

Introduction

In aquaculture, there are stages in that coincide one or more periods of stress like management, vaccines and diseases. In these periods and periods of high needs of cellular replication because there are rapid grow, transporting fry, etc., makes it reasonable that oral supplementation with nucleotides have an effect in growth promoter and/or promoter of health..

Research on dietary nucleotides in fishes has shown they may improve growth in early stages of development, enhance larval quality via broodstock fortification, alter intestinal structure, increase stress tolerance as well as modulate innate and adaptive immune responses. Fishes fed nucleotide-supplemented diets generally have shown enhanced resistance to viral, bacterial and parasitic infection.

The purpose of this study was to investigate the beneficial effects of the nucleotides supply (NUCLEOFORCE SALMONIDS[®]) on the immune response of salmon challenged with *Piscirickettsia salmonis*.

Materials and methods

1100 Atlantic Salmon (*salmo salar*) of 21 g were distributed in 10 tank. 50% of fish were vaccinated with a commercial SRS vaccination and the other 50% received a placebo (saline solution). The diets were 0 ppm of nucleotides (control group), and three diets including 300, 600 and 1200 ppm of Nucleoforce Salmonids[®] respectively.

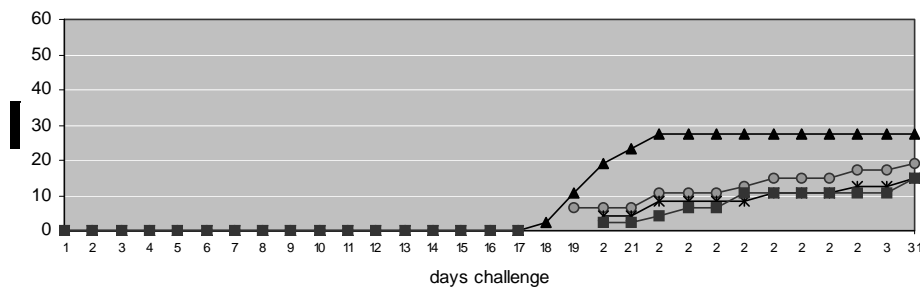
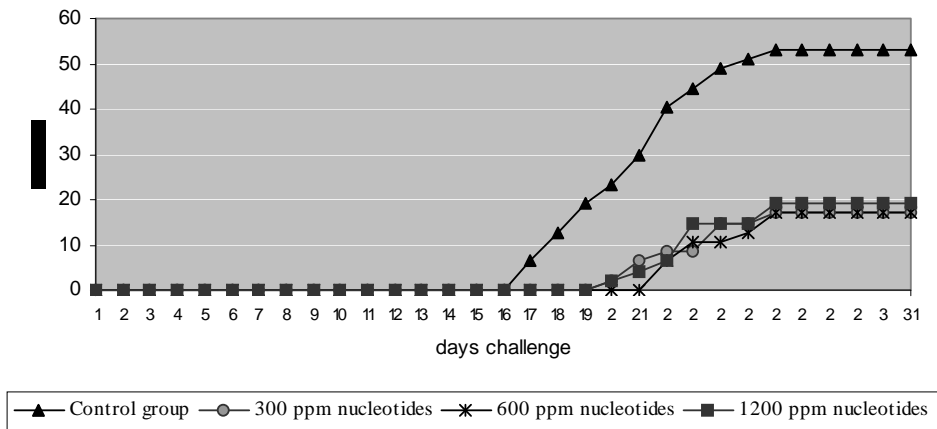
The fish were kept in 100% of fresh water until the day 41. Starting the day 42 began to incorporate sea water to each of the ponds until take up 100% sea water the day 60. After 10 days took place the challenge. Prior to challenge the lethal dose was calculated like LD₅₀ with 220 animals from the same batch of Atlantic salmon collection. Once calculated LD₅₀ there was the challenge and is controlled mortality for 30 days.

Results

Lower mortality was experienced after the challenge with the all doses of Nucleoforce Salmonids[®] respect to the control group when the fish were not vaccinated. In vaccination, the results showed the same tendency but with lower values of mortality. To evaluate the results applied we used the criteria for evaluating vaccines, % RPS (relative percentage of the survival).

Figure 1. Mortality with challenge against *Piscirickettsia salmonis* in Atlantic Salmon (*salmo salar*).

a) Placebo



b) Vaccination

Table I. RPS index; percentage on survival.

RPS	Control	dose nucleotides: 300 ppm	dose nucleotides: 600 pm	dose nucleotides: 1200 ppm
Placebo		60 %	64%	64%
Vaccinators	48%	64%	72%	72%

Conclusion

These results suggest that Nucleoforce Salmonids® promote an improvement in health and development of the immune system. This product that is not a vaccine are performing in terms of survival after a challenge even better results than some existing vaccines on the market.

SUBSTANTIAL GENETIC VARIATION IN RESISTANCE TO KOI HERPESVIRUS (KHV) IN COMMON CARP

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Introduction

The common carp is the third most important farmed freshwater fish species in the world. Eastern European carp gene banks have been responsible for the selective improvement of carp for intensive and semi-intensive pond culture in Europe and their dissemination worldwide. Several serious disease problems such as Koi herpesvirus (KHV), erythrodermatitis (atypical *A. salmonicida*) and septicaemia (*A. hydrophila*) threaten carp farming in many countries. Selection in carp has tended to develop high performing, but inbred strains for crossbreeding. The inclusion of disease and stress resistance as traits within breeding programmes will require knowledge on genetic parameters such as heritability and covariation with other traits. Hence, the objective of this study is to quantify additive genetic variance for KHV resistance.

Materials and methods

Fish used in a challenge test experiment for KHV resistance were from four different strains provided from a live gene bank of common carp (Gorda et al., 1995). There were two strains (Duna and Amur), which are native in the Danube and Amur rivers, and two strains representing landraces subjected to selective breeding (Tata and Szarvas 15). These four different strains were selected based on known origin and their documented breeding history in order to obtain the possible widest genetic differences between the strains. A diallel crossing design of the four carp strains was used to produce full-sib and paternal and maternal half-sib family groups for each of the 10 cross combinations (four purebred strains and their six crosses). In total, 96 full-sib families were created, and 91 of them were tested for KHV resistance, where each family consisted of ~20 individually PIT-tagged fish. Challenge-testing with KHV was conducted using cohabitants, in two separate tests. The tests and recording of dead fish lasted for approximately one month, and final accumulated mortalities were 92 and 94%, respectively. During challenge-testing, dead fish were recorded on a daily basis, and both tests were run until cumulative mortality reached a plateau. In the genetic analysis, challenge-test survival was defined as survived/dead for the entire testing period. A preliminary analysis showed no significant heterosis effect on KHV resistance, and this effect was therefore omitted in the final model. Challenge-test survival were analysed using a GLMM probit model using REML (Gilmour et al., 2006):

$$\Pr(S_{ijklm} = 1) = \Phi \left(\mu_i + \sum_{j=1}^4 \left(\frac{1}{2} (c_{jk} + c_{jl}) * STRAIN_j \right) + dam_k + sire_l \right)$$

where S_{ijklm} = survival in KHV challenge-test, μ_i = overall mean of challenge-test i (1 or 2), $STRAIN_j$ = fixed effect of parental strain j (Szarvas 15, Amur, Duna, Tata), c_{jk} = genetic contribution of strain j to dam k (0 or 1), c_{jl} = genetic contribution of strain j to sire l (0 or 1), dam_k = random additive genetic effect of dam k , and $sire_l$ = random additive genetic effect of sire l .

Results

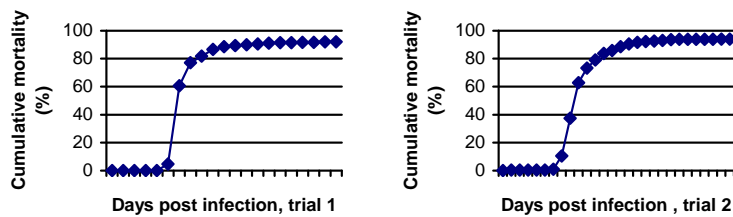


Fig. 1. Cumulative survival rates by days post infection for KHV for the two challenge-tests.

Substantial between-strain variation in survival rates was observed, with expected survival rates being 0.0, 4.6, 7.7 and 6.6% for the purebred strains Szarvas 15, Amur, Duna and Tata, respectively. Further, large within-strain variation was estimated, resulting in a heritability on the underlying scale estimated to 0.79 ± 0.15 , which corresponds to a heritability of approx. 30% on the observed binary scale. The high heritability of KHV resistance can be explained by substantial observed differences between families, even though the overall survival rate was as only 6-8%. Among the 91 full-sib families tested for KHV resistance, 60 families were completely wiped out as a result of the infection, while mortality rates among the remaining 31 families varied from 5 to 45%, with an average survival of 17% across the two challenge-tests.

Discussion

To our knowledge there are no estimates of heritability for KHV resistance in common carps, but considerable variation in KHV resistance has been found for different strains and strain crosses (Shapira et al., 2005). Further, genetic variation has been estimated for a number of other traits, including disease resistance (Vandeputte, 2003). The estimated heritability for KHV resistance on the underlying scale was extremely high (0.79). However, overall survival rate was low (6%), which is unfavourable for accuracy of selection due to identical phenotypes for families with zero survival rates. With a diallel crossing design each sire and dam will, however, have more than one offspring group and thus a reduced probability of complete mortality for all offspring. There is still a need for further development of the challenge-testing protocol for KHV, i.e., aiming at a lower (or slower) overall mortality rate. Alternatively, mortalities may be recorded on an hourly rather than a daily basis. However, the latter method will favour use of a longitudinal rather than a cross-sectional model as in this study. This study only included purebreds and F1 crosses of the different strains, and the estimated additive genetic variance will thus be an indicator of within-strain genetic variability. However, as all these strains are likely to be inbred, both genetic variation and heritability are probably higher for a synthetic population based on crosses of these strains.

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Effect of Pre-icing on quality changes of iced rainbow trout (*Onchorynchus mykiss*)

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Introduction

Fish species are particularly sensitive to an oxidative changes during storage, and quality deterioration of this species is primarily caused by lipid oxidation. Time passed after catch and the temperature “history” of fish is considered to be the key factor determining the final quality characteristics of a fish product. Rainbow trout is mainly storage and transferred by ice that in some cases because lacking of ice, fish may spend several hours at ambient temperature, before icing. High ambient temperatures and long pre-icing periods may accelerate the deterioration of fish quality. There is limited information on the quality changes as a result of delays in icing that occur in rainbow trout. The objectives of this study were to investigate the effect of delayed icing on the quality deterioration of rainbow trout stored in ice, by using chemical assessment.

Material and methods

Fifty-four freshwater rainbow trout were harvested from a local aquaculture farm in North Iran in April 2006, and divided into three lots (18 fish in each lot). One lot was immediately iced after catch, and the remaining two lots after holding at ambient temperature (18-20°C) for 4 and 8h were iced in boxes (3±1°C) with outlet for water drainage. The fish to ice ratio was approximately 1:3 and the melted ice was replaced daily, as required, to maintain the ratio. At each sampling time (0, 4, 8, 12, 16 and 20 days), three randomly chosen fish were removed from ice lot. The fishes were skinned aseptically and minced/mixed and homogenized for the chemical analyses. The TVB-N content of rainbow trout was determined according to the method of Goudlas and Kontaminas (2005) and expressed as mg TVB-N per 100g rainbow trout flesh. Free fatty acids (FFA), peroxide value (PV) and thiobarbituric acid (TBA) were determined according to the Egan et al. (1997) method. Data for the different parameters were analysed using one-way ANOVA method ($p<0.05$). Comparison of means was performed using a least-significant difference (LSD) test.

Results

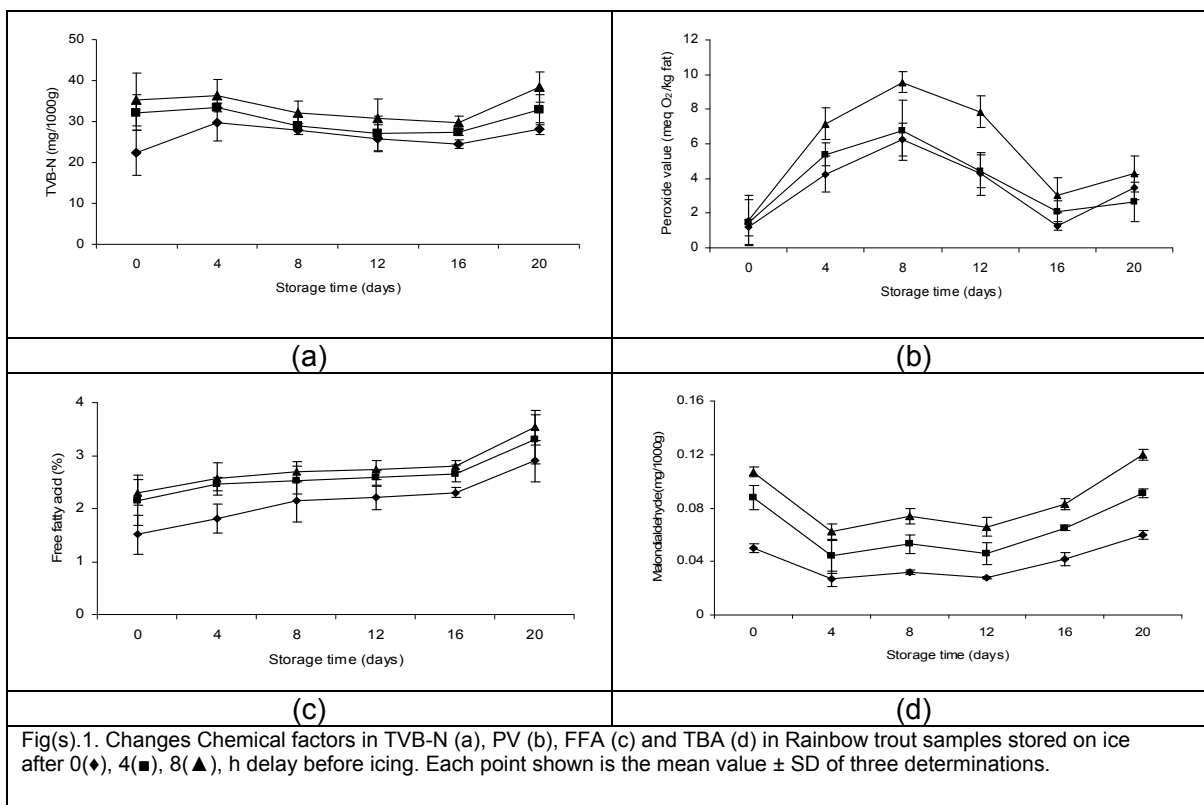
The changes in TVB-N, FFA, PV, and TBA for rainbow trout stored on ice after 0, 4 and 8h delay before icing are shown in fig. 1.

Discussion and conclusion

In this study, TVB-N concentration was significantly increased ($p<0.05$) by holding fish samples at ambient temperature for 8h on days 0 and 16 (fig. 1.a). The rate of accumulation of TVB-N during storage of fish on ice was also higher in samples iced after 4 or 8h, compared to those iced immediately. However, the level of 30-35 mg TVB-N/100g flesh is considered the limit of acceptability for ice-stored cold water fish (Connell, 1995). In the present study, the TVB-N level showed fluctuations during storage, indicating that TVB-N could not be a good indicator of rainbow trout quality, as also proposed by Dawood et al. (1986), and Özogul et al., (2006) for wild turbot. The release of FFA in samples stored at ambient temperature for 4 or 8h showed significant increase ($p<0.05$) on days 12 and 16 (fig. 1.b). It seems therefore that lipid hydrolysis is more rapid at the high ambient temperature than during storage on ice (Karungi et al., 2004). PV values were not significantly affected ($p>0.05$) by holding fish samples at ambient temperature for up to 8h (Fig. 1.c). However, the PV values were comparatively low in samples stored in ice immediately after catch than those kept at ambient temperature for 4 or 8h before icing. TBA values were found to be quite low for the

three different lots, however, the values of TBA for rainbow trout samples iced after 4 or 8h were significantly higher ($p < 0.05$) than samples iced immediately throughout the storage period (Fig. 1.d). Auburg (1993) reported that TBA values may not give actual rates of lipid oxidation since malondialdehyde can interact with other components of fish such as nucleosides, nucleic acid, proteins, amino acids of phospholipids and other aldehydes which are end-products of lipid oxidation.

The storage of rainbow trout in ice immediately after catch allowed a remarkably good maintenance of chemical quality; involving an extension of its shelf life as compared with samples iced 4 and 8h after catch. It is therefore recommended that fish be iced immediately after capture in order to slow down the mechanisms involved in quality loss.



Fig(s).1. Changes Chemical factors in TVB-N (a), PV (b), FFA (c) and TBA (d) in Rainbow trout samples stored on ice after 0(♦), 4(■), 8(▲), h delay before icing. Each point shown is the mean value \pm SD of three determinations.

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The Effect of Feeding History on handling and confinement stress response in one year old reared beluga (*Huso huso*)

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Abstract

The effect of 90-days maintenance-feeding period on the acute stress response of 45 one year old beluga, *Huso huso*, to handling and confinement were determined. The fishes were divided to three treatments including Control, High food ration (H>L) and low food ration (L >H).

Fishes were raised on an optimal feeding level of 4% of body weight per day during the experiment. The fishes in High treatment (H>L) was fed 4% of body weight per day for 60 days and food ration was reduced to 1% of body weight per days in the last month of experiment. The fishes in Low treatment (L>H) was fed 1% of body weight per day for 60 days and food ration was suddenly increased to 4% of body weight per days in the last month of experiment. All fishes were sampled at the end of experiment one time before exposure to stress and 3 times including half an hour, one hour and 3 hour after stress.

The results revealed that food ration had significant effects on the growth rate and food conversion values because fishes fed the high ration performing better than those on a lower level.

Prior to the application of the stressor, only plasma levels of triglycerides were lower in fish fed a low food ration at the last month of experiment (H>L). Feeding history Influenced the onset of the stress response with stressor-induced elevations of plasma cortisol, glucose and free fatty acids being higher in fish fed a high ration compared with those fed a low ration prior to sampling (H>L) .

These results suggest that feeding history through modification of the energy reserves can influence the onset of the acute stress response.

Keywords: Beluga; Stress; Feeding levels; starvation

EFFECTS of TAURINE on GROWTH for GILTHEAD SEABREAM (*Sparus aurata*).

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Present study has been focused on the effects of Taurine on growth of Gilthead Sea Bream (*Sparus aurata*).

Taurine is a water soluble amino acid. This amino acid has positive effects on human health. Existence of Taurine at cultured fishes as Gilthead seabream& sea bass is a discussion point. The aim of this study is to see the nutritional richness of one of the important culture species as Gilthead sea bream for Taurine. So see if nutritional value of cultured fishes is high enough or not. By the way we could give some results to the researchers for to compare cultured fish with wild ones.

Present study has been organized at nutrition & feeding labs of Ege University, Faculty of Fisheries. Initial weight of the fishes has been held around 100g. Fish were stocked in cylinder conic tanks. These tanks have 1 metric cube capacity. Stock density has been 50fish/tank.

Fish were fed with feed including 0,2% Taurine and 0% Taurine as control group. Feeding of the fishes has been adlibitum. Study has been triplicated. Biometric measurements have gathered. Water conditions have been as followed; water temperature 17-21 °C, ph 7-8, salinity %0 35-36. Results would be given in full text.

RIVER CRAB, *PROCAMBURUS CLARKII*, BY-PRODUCT MEAL IN DIETS FOR THE RED PORGY (*PAGRUS PAGRUS*): EFFECTS ON GROWTH, FEED UTILIZATION AND FISH SKIN COLORATION

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Introduction

Red porgy, *Pagrus pagrus* is one of the marine fish species candidates to the aquaculture diversification in the Mediterranean and Mid Atlantic coasts (Divanach et al., 1993; Kentouri et al., 1995) which is characterized by a natural pink skin coloration being that an important quality parameter by its consumer acceptance. Fish are unable to synthesize carotenoids de novo (Goodwin, 1984) and optimum skin coloration similar to wild specimens depend on the adequate carotenoids included in diets (Chebakki, 2001; Cejas et al., 2003; Kalinowski et al., 2004; 2005). Moreover this species have reported to require high protein dietary content. Studies on protein and carotenoid alternative sources are necessary for the sustainability of red porgy culture. Previous studies with crab meal inclusion in fish diets and other cultured aquatic species have shown their effectiveness at certain inclusion levels on growth (J. Toppe et al., 2005; E. Goytortua-Bores et al., 2006; H. Villareal et al., 2006), and also some other studies mainly in salmonids have demonstrated positive results on muscle pigmentation (John Spinelli et al., 1978), related to the carotenoid content of these meals. The following study was conducted to investigate the influence of a river crab meal from *Procamburus clarkii*, a by-product of the food industry, as an alternative ingredient in diets for the red porgy and its effects on fish growth and fish skin colour.

Material and methods

Triplicate groups of hatchery reared red porgy (*Pagrus pagrus*), 233g initial body weight, were kept indoors in grey circular fibreglass tanks and fed during 6 month with three diets: high quality fish meal and fish oil diet was used as a control (Diet C); fish meal protein in the control diet was replaced by either 10% or 20% protein from *Procamburus clarkii* meal (Diet RC10 and Diet RC20, respectively). Feed intake, fish growth, feed utilization and skin coloration parameters were evaluated throughout the experimental period.

Results

All diets were well accepted by experimental fish, finding no differences in feed consumption between treatment groups. Growth parameters and FCR did not differ among experimental groups. Those animals fed the crab meal based diets showed a significantly higher skin redness respect to that of the control fish, and similar to that of the wild specimens. For the crab meal based diets, increasing dietary inclusions of this

ingredient were accompanied for an increment of the colour saturation, being the obtained value for the RC20 diet significantly higher than those for the RC10 diet.

Discussion and conclusion

El presente trabajo muestra una evaluación preliminar sobre algunos parámetros de rendimiento de dietas para bocinegro conteniendo con este by-product de harina de cangrejo. De los resultados obtenidos se tiene que ambos niveles de inclusión utilizados, 10% y 20% son bien aceptados con valores de ingesta similares a la del control. El crecimiento de los animales no se vio afectado conforme se incrementó el contenido de la harina de cangrejo en las dietas. No son demasiados los estudios realizados sobre la utilización de harinas de cangrejo en dietas para peces y otras especies acuáticas de cultivo demostrando en parte de esos trabajos su efectividad a ciertos niveles de sustitución sobre el crecimiento (J. Toppe *et al.*, 2005; E. Goytortua-Bores *et al.*, 2006; H. Villareal *et al.*, 2006).

Desde el punto de vista de la coloración de los animales, ambos niveles de harina mejoraron notablemente el aspecto y color de la piel de los animales respecto de aquellos alimentados con la dieta control. Los crustaceos son conocidos por ser ricos en pigmentos carotenoides mayoritariamente astaxantina, (Lee, 1990; Guillou *et al.*, 1995; Felix-Valenzuela *et al.*, 2001) demostrándose una vez más la idoneidad del uso de estos pigmentos para esta especie, mayoritariamente astaxantina esterificada, en las dietas para esta especie (Chebbaki, 2001; Cejas *et al.*, 2003; Kalinowski *et al.*, 2004; 2005).

Present results indicate the suitability of *Procamburus clarkii* meal as partial replacers of fish meal in diets for the red porgy. Dietary inclusion levels of 10% and 20% of the dietary protein from this meal have no detrimental effects on growth and feed utilization parameters respect to a fish meal based diet, with high improvements in fish skin redness and skin colour saturation by increased level inclusion.

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PRESENCE OF PROTOZOAN PARASITES *Bonamia exitiosa* AND *Bonamia ostreae* IN EUROPEAN FLAT OYSTERS, *Ostrea edulis* L., COMING FROM NATURAL BEDS OF THE ADRIATIC SEA.

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Introduction

Ostrea edulis is the flat oyster widespread along the Italian coasts, in particular in the Manfredonia Gulf (Apulia region) that represents an important site of oysters production where *O. edulis* natural beds and *Crassostrea gigas* experimental farming subsist.

In the past years, during a flat oysters sampling in Italy, the presence of *Bonamia* like microcell parasites, was highlighted by light microscopy and ultrastructural studies. On the basis of these data a new sampling of *O. edulis* from Manfredonia Gulf was carried out during 2007. At present, methods for the eradication of Bonamiosis are not available, so in the European context, it is very important to know the affected areas of different *Bonamia* species.

The aim of this study has been to investigate the existence of microcell parasites in flat oysters (*O. edulis*) coming from natural beds in the Adriatic Sea based on histological, molecular and ultrastructural analyses as well as to confirm and to characterize the presence of *Bonamia* sp. in the sample previously collected.

Materials & Methods

Flat oyster samples (*Ostrea edulis*) were collected from molluscs shipping plant and fished from different natural beds in the Manfredonia Gulf in the months of February, May, July, September and November 2007 (n=150/month). Moreover, one sample, embedded in paraffin block, coming from a previous sampling in the Manfredonia Gulf was processed for the molecular studies (Tiscar et al., 1991). Each oyster was opened and several heart imprints were conducted on a glass slide and stained using a commercial kit (Hemacolor®, Merk). Sections of tissue including gills, digestive gland, mantle and gonad were fixed in formalin 10% buffered phosphate. Suspected samples were processed for paraffin histology and stained with hematoxylin and eosin. Gill fragments from each oyster were fixed in 95% ethanol and from suspected samples genomic DNA was extracted. From the extracted DNA the partial small subunit ribosomal DNA (SSU rDNA) and ITS1 region were amplified, using respectively the *Bonamia* sp. specific primer Bo-BoAS (Cochennec et al., 2000) and ITS For-8 and ITS Rev-8 primers (Corbeil et al., 2006). Amplified DNA fragments were sequenced. One positive sample was cloned and PCR-RFLP with Bgl I and Hae II enzymes was carried out. Moreover two positive samples were processed for transmission microscopy electron (TEM).

Results

The molecular studies confirmed the existence of *B. ostreae* in the Manfredonia Gulf from the 1991. Moreover three oysters of the new sampling, presented by the cytology and histopathology approaches, nucleated elements (2-3 µm diameter) freely or in the haemocytes cytoplasm. The ultrastructural study and molecular analysis confirmed, in two samples, microcells belonging to *B. exitiosa* group, and in one sample the occurrence of *B. ostreae*.

Conclusions

The studies carried out in the flat oysters coming from the Manfredonia Gulf highlighted the presence of protozoa belonging to the genus *Bonamia*.

The molecular study showed strong identities with *B. ostreae* in one sample and in the oyster preserved in paraffin block, thus confirming the existence of this species in Italy particularly in the Manfredonia Gulf since 1991 (Tiscar et al., 1991). Furthermore the molecular characterization conducted on other positive paraffine embedded samples coming from the Northern Adriatic Sea (Tiscar et al., 2002) showed the same relationship to *B. ostreae*. Moreover, the ultrastructural study and the DNA sequence analysis validated, in two samples from Manfredonia, the occurrence of microcells belonging to the *Bonamia exitiosa* group, thus corroborating the first report of this exotic pathogen species in the European flat oysters (Abollo et al., 2008).

New epidemiological data are necessary in order to know the real diffusion of *Bonamia* spp in the European waters and to avoid the spread of the pathogen. Moreover, further studies need to be carried out on the Adriatic *O. edulis* in order to explain the parasite-host interactions developed in different environmental conditions than oceanic waters

Nucleotide sequence data are available in the GenBank under the Accession No. EU598800 and EU672891.

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COMPARATIVE STUDY OF DIETARY L-CARNITINE SUPPLEMENTATION IN DIPLOID AND TRIPLOID RAINBOW TROUT (*Oncorhynchus-mykiss*)

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Introduction

The triploid trout are sterile and therefore generally considered for aquaculture as a means to prevent declines in flesh quality associated with sexual maturation. Moreover, its use minimize the risks of genetic losses from wild populations in case of cultured fish might escape from the aquaculture facilities. However, feeding trials have shown that triploid salmonids have lower growth performances and survival than the diploid counterparts (Maxime, 2008). In addition, they give the appearance of being chronically stressed. L-carnitine, a multi-physiological, bioactive and pollution-free additive, is known to act as a growth-enhancer and appears to positively affect the fish resistance to stress, improving growth and flesh quality. The aim of this study was to evaluate and to compare the effects of dietary L-carnitine supplementation on growth performance and lipid metabolism of diploid and triploid rainbow trout (*Oncorhynchus mykiss*) under chronic and acute stress condition.

Materials and Methods

A 60-day feeding trial was conducted using diploid (29.5 ± 0.7 g) and triploid (31.7 ± 0.5 g) juveniles (3 tanks/treatment, 34 fish/tank). Fish were hand-fed twice a day on three isoproteic (45%) and isoenergetic (16.5kJ/g) diet, with 40, 250 or 630 mg L-carnitine/kg diet. Throughout the feeding trial, fish were subjected to two different stress conditions: a chronic stressor (overcrowding of 50 kg/m³) and an acute repetitive stressor (once a week net-handling combined with a 1 min air exposure). At the end of the trial, growth performance, body (liver and muscle) composition and selected plasma parameters were determined.

Results

There was no significant difference in weight gain between diploid and triploid fish, although the diploids did appear to be lagging behind the triploids (Table 1). Daily growth index (DGI) and protein efficiency ratio (PER) were slightly higher in fish fed 630mg L-carnitine when compared with the other dietary groups, but values were not statistically different ($p > 0.05$). Voluntary feed intake (VFI) was significantly different between ploidy types and L-carnitine levels. Fish fed 250mg L-carnitine had higher feed conversion ratio (FCR) than fish fed 630mg L-carnitine ($P < 0.05$). Survival was significantly higher in the diploid groups (88%) compared with the triploid groups (62%).

Table 1. Growth performance and feed utilization of diploid and triploid rainbow trout fed the experimental diets (* P<0.05; ** P<0.01; *** P<0.001; NS - Not Significant).

	Diploid			Triploid			ANOVA		
	LC-40	LC-250	LC-630	LC-40	LC-250	LC-630	LC	Ploidy	LC x Ploidy
FBW (g)	94.01 ± 1.39	91.25±4.20	97.11±2.58	94.83±1.56	97.29±1.83	100.80±2.79	**	**	NS
DGI (%/d)	2.60±0.02	2.56±0.13	2.65±0.12	2.52±0.06	2.53±0.08	2.65±0.04	NS	NS	NS
VFI (%)	1.93±0.04	1.98±0.04	1.91±0.10	1.87±0.03	1.88±0.05	1.77±0.02	*	***	NS
FCR	1.04±0.01	1.07±0.06	1.02±0.07	1.04±0.03	1.05±0.06	0.95±0.01	*	NS	NS
PER (%)	2.17±0.03	2.14±0.11	2.19±0.16	2.17±0.05	2.18±0.12	2.34±0.01	NS	NS	NS

Dry matter and lipid content in liver were higher in diploid trout than the triploid trout (P<0.03). In muscle, only the dry matter content was higher in diploid trout than the triploid trout (p<0.03) (Table 2).

Table 2. Liver and muscle composition (% wet weight) of diploid and triploid rainbow trout fed the experimental diets (* P<0.05; ** P<0.01; *** P<0.001; NS - Not Significant).

	Diploid				Triploid				ANOVA		
	Initial	LC-40	LC-250	LC-630	Initial	LC-40	LC-250	LC-630	LC	Ploidy	LC x Ploidy
Liver											
Dry matter	25.0	26.5±0.3	27.1±0.5	26.2±0.8	24.7	25.6±0.1	25.4±0.1	25.5±0.3	NS	***	NS
Protein	15.4	15.7±0.4	15.8±0.9	15.5±0.2	15.0	15.9±0.5	15.8±0.6	16.6±2.1	NS	NS	NS
Lipid	3.7	5.3±0.2	5.5±0.4	5.3±0.6	3.8	4.8±0.3	5.3±0.2	4.8±1.2	NS	*	NS
Muscle											
Dry matter	22.6	24.2±0.6	24.4±0.4	23.7±0.5	23.6	23.6±0.8	23.4±0.6	23.3±0.5	NS	*	NS
Protein	18.1	18.1±0.3	18.7±0.7	18.6±0.1	17.5	18.9±0.4	18.5±0.0	18.6±0.6	NS	NS	NS
Lipid	2.5	3.6±0.8	3.3±0.1	3.2±0.1	1.5	3.0±0.7	3.2±0.4	2.9±0.7	NS	NS	NS

Discussion and conclusion

Growth performances observed in this study is in the normal range observed for rainbow-trout of similar body size, in which the triploids grew a bit faster than diploids. In addition, there was an indication that the L-carnitine treatment had an effect, but discrete, on growth when compared with fish fed L-carnitine unsupplemented diet. Better growth rates were associated with lower FCR and VFI, which are indicative of better utilization of the nutrient ingested when L-carnitine is added to the diet. It is possible that the short duration of the acute and chronic stress conditions was not long enough for the beneficial effects of L-carnitine to be fully expressed in the growth performance of trout (Rodehutschord, 1995; Harpaz, 2005).

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GROWTH PERFORMANCE, MOLTING AND BODY COMPOSITION OF JUVENILE NARROW CLAWED CRAYFISH, *Astacus leptodactylus*, FED DIFFERENT LIPID LEVELS DIETS

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Introduction

Narrow clawed crayfish is one of the most important economic crustaceans in the world. We have decided to introduce of this species to Aquaculture Industry of IRAN. The first step for commercial crayfish cultivation is provision of adequate feed to ensure its biological requirements. Knowledge of the nutritional requirements of *Astacus leptodactylus* is necessary for the development of cost-effective diets that can be formulated with some flexibility in the choice of ingredients. However, limited information is available concerning nutritional requirements of this crustacean species. Dietary lipid provides both essential fatty acids and some of the energy needed for the metabolic processes of growth (D'Abramo et al.,1997), thus there is an interest in determining the optimal amount of dietary lipid for maximum growth. The present study was conducted to evaluate the effect of dietary lipid level on growth, molting and the proximate body composition narrow clawed crayfish reared under indoor condition.

Material and Methods

An array of 30 fiberglass tanks 60 l. supplied with flow-through and continuous aeration, was used as the experimental system sufficient for the number and size of the animals in each tank were provided. Water temperatures over the experimental period were $23 \pm 1.7^{\circ}\text{C}$ (mean \pm S.D.). The experiment was carried out over an 8-week period, including 10 days of acclimation. Five isonitrogenous formulated diets conforming to a five fat levels (4, 7, 10, 13 and 16%) were used in this study (table 1). Each of the treatments was assigned six replicates. Five narrow clawed crayfish were held in each of the tanks, with measurements of individual animals being pooled to provide a single value for each tank, which was regarded as the experimental unit for statistical analysis. Initial body weight of experimental animals as average measured 1.22 ± 0.58 g. Feed was offered two times a day (11:00 a.m, 17:00 p.m). Results were compared with one-way ANOVA and LSD test was used to compare differences among treatment means ($p \leq 0.05$).

Results

Growth:

Growth performance of juvenile *A. leptodactylus* fed the experimental diets are shown in Table 2. At the end of the trial, the crayfish offered diet containing 13% lipid showed the highest weight gain, specific growth rate performance and lowest food conversion ratio. Comparison of growth increment during trial period has been shown in Figure 1. In general, during test period gradually weight increased based on increasing of lipid in diet. Therefore, the diet 13% lipid was better than others. It is also the juvenile crayfish fed by the diet of 10-13% lipid in the addition sixth weeks internal of experiment period the growth level have seen more sustain.

Molting:

Molting displayed that increase in lipid content contributed to increased molting; the most and the least frequent molting were, respectively, observed in diets 16 and 4% and the

differences was significant ($P < 0.05$) (Table 2). Heavy variation of molting in 14-days intervals of the test period showed that the highest molting frequency occurred in the first and third two- weeks and in the eighth week the lowest molting frequency was observed (fig. 2).

Body composition:

The results relevant to the biochemical variation in the body showed in juvenile crayfish with scaling-up of lipid in diet the protein amount and the lipid in the test organism carcass also being enhanced, this phenomenon in a diet with 16% lipid reached to its peak (Table 2). Statistical test showed the differences between formulated diets were significant ($P < 0.05$). Therefore, results indicated that *A. leptodactylus* are required about 13% lipid in the diet.

Table 2: Growth and Body composition of *A. leptodactylus* fed with diets of different levels of lipid in 8-weeks feeding trial

Diets	4 %	7 %	10 %	13 %	16 %
Growth indices					
WG (%)	15.9 ± 2.28 ^b	18.11 ± 1.78 ^{bc}	23.6 ± 2.35 ^{ac}	25.78 ± 1.52 ^a	22.4 ± 1.84 ^{ac}
SGR(%/day)	0.23 ± 0.029 ^b	0.26 ± 0.02 ^{bc}	0.33 ± 0.03 ^{ac}	0.37 ± 0.02 ^a	0.32 ± 0.02 ^{ac}
FCR(g/g)	5.25 ± 0.54 ^a	4.43 ± 0.74 ^{ab}	4.06 ± 0.70 ^{abc}	2.68 ± 0.47 ^{cd}	3.11 ± 0.28 ^{bd}
ADG (mg/day)	2.84±0.41 ^c	3.23±0.32 ^{bc}	4.21±0.42 ^{ab}	4.60±0.27 ^a	3.82±0.29 ^{abc}
Molting	1.23±0.18 ^c	1.57±0.2 ^{bc}	1.67±0.23 ^{ac}	1.83±0.17 ^{ab}	2.20±0.19 ^a
Protein (%)	36.43 ± 0.44 ^b	36.81±0.58 ^b	37.58±0.46 ^{ab}	37.81±0.22 ^{ab}	38±0.23 ^a
Fat (%)	0.47±0.09 ^a	0.73±0.07 ^b	0.81±0.06 ^b	0.65±0.11 ^{ab}	0.78±0.1 ^b

SE ± Mean, Values in any row with different superscript are significantly different ($P < 0.05$).

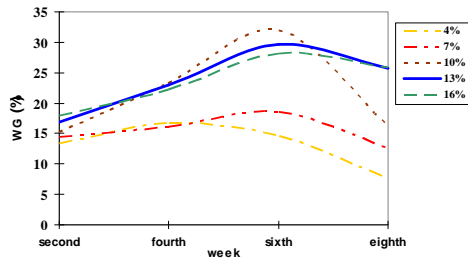


Figure 1. Mean of weight gain juvenile *A. leptodactylus* fed different lipid levels of diets

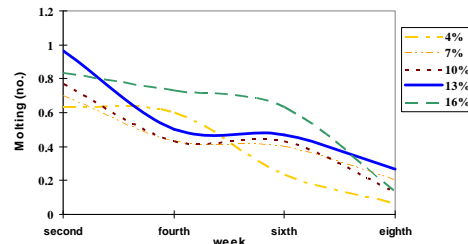


Figure 2. Mean of molting number of juvenile *A. leptodactylus* fed with different lipid levels diets

Discussion

Growth of crustacean is due to an increase in weight gain at molt and molting frequency (Sheen and Wu, 1999). The present study clearly indicated that narrow clawed crayfish fed with 10-13% lipid diet had significantly higher weight gain than those from the low lipid level treatments. Although, several studies have indicated that high dietary lipid levels depress crustacean weight gain (Davis and Robinson, 1986; Sheen, 1997), however, this decreased growth rate did not occur in *P. monodon* (Sheen et al., 1994) and in *A. leptodactylus* in this study. Past nutritional studies with crustacean species indicated that the optimal dietary lipid level ranges from 0 to 10% (Davis and Robinson, 1986; Sheen, 1997). Sheen and Wu (1999) indicated that diets containing lipid levels ranging from 5.3 to 13.8% are required for mud crabs. The upper dietary lipid requirement of the narrow clawed crayfish is higher than that of the other crustacean species. Hernandez et al. (2000) reported significant differences in growth of juvenile redclaw, *Cherax quadricarinatus*, fed diets with varying lipid levels under laboratory culture conditions. Protein and lipid accumulate showed clearly effect of diet on body composition of animals. In totally, we may conclude that this crayfish can effectively utilize high dietary lipid, and the recommended dietary lipid level for optimum growth was 13%.

SPINY LOBSTERS DO WELL IN SEA-CAGES: SEA-BASED LOBSTER *Jasus edwardsii* ON GROWING IN NEW ZEALAND

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The spiny red rock lobster (*Jasus edwardsii*) is the third-biggest seafood export earner in New Zealand with exports from the wild fishery valued at just under (\$NZ) 100 million in 2006. Consequently, there is significant interest in farming wild caught *Jasus edwardsii* pueruli and on-growing them through to a marketable size.

Following several attempts to on-grow pueruli in land-based facilities the focus on lobster aquaculture research in New Zealand has switched from land to sea-based on-growing utilising specifically designed sea-cages.

Following experimental scale sea-cage on-growing, and in conjunction with commercial partners, NIWA have successfully run commercial scale sea-cage on-growing trials, rearing *Jasus edwardsii* pueruli from wild caught pueruli through to a marketable size of 200-250g in 2-3 years. These trials culminated in the presentation of sea-cage on-grown lobsters to politicians and restaurateurs. Following this commercial success NIWA has continued research into sea-cage design and the development of an artificial lobster diet to improve the economic viability of lobster on-growing in sea-cages.

This poster describes sea-based lobster on-growing research in New Zealand and its possible applications in other countries.

PROTECTION OF SEA BASS (*Dicentrarchus labrax*) AGAINST *Vibrio anguillarum* O1 AFTER IMMERSION WITH AQUAVAC VIBRIO VACCINE AND A SECOND DOSE VACCINATION WITH AQUAVAC VIBRIO ORAL.

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Vibriosis is a bacterial disease of salt-water and migratory fish caused by the bacterium *Vibrio anguillarum*. The severity of Vibriosis has increased proportionately with the development and expansion of fish farming world-wide. Today, Vibriosis has a global distribution with epizootics on all continents and in a wide range of fish species. The host range of Vibriosis includes both cultured and wild fish and the disease may occur at any stage of the farming cycle of sea bass.

Prior to the introduction of immunization, the most common method employed to control Vibriosis was treatment of diseased fish with antibiotics and antimicrobial chemicals. These substances are commonly administered as feed additives or in bath treatments. Whilst antibiotic treatment can be effective in controlling mortality it is preferable to avoid the need for it, because of the risk of increased bacterial resistance and residues in the flesh of the fish.

In order to evaluate the performance of AquaVac* *Vibrio* vaccine in sea bass, a study has been conducted to study the protective immune response against *Vibrio anguillarum* O1 when administered by immersion, as well as the response after using AquaVac *Vibrio* Oral as second dose vaccine.

Sea bass (*Dicentrarchus labrax*), of average size 1g were vaccinated by immersion for 30 seconds with AquaVac *Vibrio* vaccine (Dilution 1:10). Control sea bass were mock vaccinated by immersion in water for 30 seconds. At 14 days (231 degree days), 28 days (467 degree days), and 3.5 months (1,948 degree days) post-vaccination 50 fish from each group were intraperitoneally challenged with *V. anguillarum* O1.

At 3.5 months post immersion vaccination the remaining fish were orally vaccinated with AquaVac *Vibrio* Oral vaccine administered for 10 days. At 28 days after oral vaccination, both groups were challenged with *V. anguillarum* O1.

The results demonstrated that sea bass vaccinated by immersion are fully protected after 28 days. The protective effect of the vaccination was reduced at the 3.5 months challenge point but was fully restored (100% protection) after a second dose vaccination with AquaVac *Vibrio* Oral. Details of the study will be presented.

*AquaVac is a registered trademark and is the property of Intervet/Schering-Plough Animal Health or any of its subsidiaries, affiliates or licensors and is protected by copyright, trademark, and other intellectual property laws.

DETERMINATING THE LETHAL CONCENTRATIONS (LC_{50/96h}) heavy metals (Lead, Zinc and Cadmium) on *Acipenser nudiventris* fingerlings

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Introduction

Acipenser nudiventris is one of the most important species of Caspian sea sturgeon, according to permanent struggles to protect stocks which conducted reproducing more than 100000 fingerlings and releasing them to rivers ended Caspian sea, so their catching has declined, due to decreasing their stocks for some reasons. One of the fundamental and effective factors in destruction of aquatic communities in long-term, is the over increasing industrial effluents contain various compounds of heavy metals that enter into aquatic systems. Thus, this study analyzed the acute toxicity of heavy metals like lead (Pb), zinc (Zn) and cadmium (Cd) that having more importance in aquatic systems, because they exist in a large quantity in industrial effluents and having high toxicity as to aquatic organisms on *Acipenser nudiventris* fingerlings (1-3g), aim to determine the 50% lethal concentration (LC₅₀) in 96 hours.

Materials and Methods

To determine the effects of acute toxicity LC₅₀ 96h of the heavy metals Pb, Zn and Cd on *Acipenser nudiventris* fingerlings, have been used fingerlings of artificial reproduction of Marjani's Sturgeon Reproduce and Cultivate organization (Gorgan, 2005). So, were transferred some of them to veniro and for adaption to condition they were feeded with *Daphnia* (5-7 days). To catch the results, the experiments were carried out in 20 lit aquariums (10 fingerlings for each aquarium) with static condition based on O.E.C.D method with 5 treatment, 3 repetition and 1 blank. During experiment water physico-chemical factors such as PH, hardness were respectively 6.7 – 8, 60-100 (CaCO₃) mg/lit. Also, the water Temperature was 24 ± 1 c and dissolve Oxygen was measured higher than 7 mg/lit. Achieving final results (LC₁₀, LC₅₀ and LC₉₀ in 24, 48, 72 and 96 hours), analyzing carried out on the base of Probit method (Finny, 1971) to determine maximum allowable concentration (MAC) value of lethal concentration in 96 hours divided to ten (TRC, 1984) and degree of toxicity also. The fish actions and behaviours have been watched carefully.

RESULTS

Finally, after early experiments Pb concentration were determined 70-78 mg/l. Then based on experiments LC₁₀, LC₅₀, LC₉₀ of Pb in 24, 48, 72 and 96 hours were measured. LC₅₀ in 96h of Pb were measured 73/82 and MAC value of Pb determined 7.382 mg/l. Analyzing obtained results modified that 15-30 mg/l concentration of Zn can be tested. LC₁₀, LC₅₀, LC₉₀ in 24, 48, 72 and 96 hours were measured and also, LC₅₀ in 96h of Zn were measured 21/58 and MAC value were determined 2/158 mg/l. Obtained results maintained that Cd concentration range tested is 0/01-0/5 mg/l. Then LC₁₀, LC₅₀ and LC₉₀ value of Cd were measured, LC₅₀ in 96h of Cd were measured 0/08 and MAC value of Cd were determined 0/008 mg/l. Fish behaviour are different against heavy metals concentration. *Acipenser nudiventris* fingerlings, As in high toxic elements concentration, react fast moving permanently till being weakened, tired and near to death. While in low concentration, during first hours, there were no obvious reactions, then gradually faint. The main effect of such toxins is Nervous system disorder, other external signs are: imbalance, spiral swimming, curvature spinal column, raise eyes, exophthalmia, blood in gills, skin darkening, gill and fins especially tail fin destruction. Of course, the

same results collected by Mirzai ,(2004), Alinezhad(2004) , Zamini(1996), Barak(1990) and Mance (1990).

Discussion

On the base of obtained results, aim to determine acute toxicity of heavy metals on 50% *Acipenser nudiventris* fingerlings(1-3g),the LC50 value of Pb,Zn and Cd in 96 hours (in 4days), were respectively 73/82,21/58 and 0/08mg/l. So MAC value of Pb,Zn and Cd,which is called NOEC(no observed effect concentration) would be 7/38,2/15 and 0/008mg/l.Also these metals LOEC(lowest observed effect concentration) which is called ,other words, LC10 in 96 hours were determined respectively 69/64,13/99 and 0/006 mg/l. Results showed the toxicity ranking of heavy metals as: Cd>Zn>Pb. Infact high toxicity belongs to Cd and perhaps, Zn and Pb low toxicity is due to their reactions with water salts especially CaCo3. As a result , Pb high concentration in natural aquatic systems especially in sea sediment, due to combination with Manganese Nadols do not make any effect on fish (Esmaeel Sari, 2002,Sanai, 1996). Studies on sturgeon fingerlings presented that the LC50 value of Pb,Zn and Cd in 96 hours for *Acipenser Stellatus* were 120/61,8/65 and 5/1mg/l and for *Acipenser persicus* 128/4, 9/7 and 4/1mg/l(Mirzai,2004).So,comparing mentioned researches and this study, acknowledged *Acipenseridae* species sensitivity as following:
Acipenser nudiventris > *A.Stellatus* > *A.Persicus*"

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A FOLLOW-UP PATHOLOGICAL SURVEY OF DISEASES OF COBIA (*Rachycentron canadum*) AND RED DRUM (*Sciaenops ocellatus*) AQUACULTURE FROM THE BAY OF CAMPECHE, MEXICO.

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More than 20 years ago, aquaculture was introduced in Campeche as an attempt to diversify the productive activities of fishermen and in-land rural communities located close to water bodies. Taking into account the vast coastal resources of the State, government also prompted aquaculture developments aimed to promote a whole new industrial activity. During the 90's and the early years of the new millenium, Tilapia and shrimp (*Litopenaeus vannamei*) culture received significant support and attention, but production stumbled with a very high competitive market at the international trade. Industrial production was never attained.

With the most important fisheries stock almost depleted, aquaculture has become nowadays an indispensable activity for many communities that still depend on aquatic resources. However, the very narrow margin profits have impeded these communities achieving economic self-sufficiency. A species with a more competitive margin profit was needed.

In 2003, cobia was introduced to Isla Arena, a small coastal fishermen village at the north of the State of Campeche. One family received the joint support of the government and an entrepreneur, funding a company named "Ixoye Marinos, S. A. de C. V.". Their experience was meant to be assessed in order to test the suitability of cobia and red drum culture giving the social, economic and environmental conditions of the bay of Campeche.

So far, they have closed 5 culture cycles of cobia and 2 of red drum (*Sciaenops ocellatus* introduced in 2005) with marginal and variable profits. However, marine culture with these species has expanded to other 4 communities along the coast.

Our research started in 2007 and our aim was to determine the diseases affecting the culture of cobia and red drum. In a period of 6 months we sampled fish with clinical symptoms of disease and we have found that cobia was affected by monogeneans (*Benedenia* sp.) with a 100% prevalence, followed by bacterial systemic infections by *Enterobacter cloacae* (80%), *Vibrio vulnificus* (10%) and the unconfirmed presence of *Mycobacterium* sp. (35%). An average of 40% of cobia seems to be affected by nutritional imbalance where the predominant lesion observed by histopathology was seroidosis. With respect to red drum, parasitic isopod occurred with a prevalence of 50%, while systemic *E. cloacae* was 40% followed by presumptive *Mycobacterium* sp (8%). No signs of nutritional imbalance were detected in red drum during the sample period.

Although there are several management practices that need to be improved, the impact of diseases is probably having a negative effect on the profitability of the

culture. At the moment we are researching on parasitic and bacterial profilaxis and treatment as part of the management practices improvement.

EFFECT OF REPRODUCTIVE PERFORMANCE OF FEMALE ON FERTILIZATION , EYEING , HATCHING AND SURVIVAL RATES TO YOLK SACK RESORPTION STAGE IN RAINBOW TROUT (*oncorhynchus mykiss*) BROODSTOCK

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Abstract

Rainbow trout is only species of rearing cold water fish in Iran that the different of rearing center propagate these fish every year.

In the propagation process of this fish interfere different factors that quality and quantity of female broodstock and their eggs are more important. For this target in the propagation season at 2008 , is studied the effect of reproductive performance of female on fertilization , eyeing , hatching and survival rates until absorption of yolk sack stage in rainbow trout .

For this study 3 groups of female broodstock (3,4 and 5 years old) are fertilized with contemporary male fish (4 years old). The results showed that the 5 years old female fish with 1764 gr for their mean of body weight and 53.04 cm for mean of their total length had 98% , 98% , 96% and 94.5% respectively for fertilization , eyeing , hatching and survival rates .

The present study demonstrated that the best result was estimated in 5 years old female because of their eggs quality (such as size) and more fecundity .

Keywords : rainbow trout – fertilization rate – eyeing rate