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ScienceDirect
Aquaculture 264 (2007) 197–204
Aquaculture
www.elsevier.com/locate/aqua-online

Effect of weaning age and diet on pikeperch larviculture

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Received 6 February 2006; received in revised form 6 December 2006; accepted 11 December 2006

Abstract

The effects of weaning age and diets on survival, cannibalism, deformity and growth were investigated in pikeperch post-larvae *Sander lucioperca*. In a first experiment, fish were fed *Artemia* nauplii after hatching and then divided, on days 12, 19 and 26 post-hatch, into groups receiving *Artemia* nauplii as control or artificial diet. Significant differences were observed on survival, cannibalism, deformity and growth performance between the different weaning age and control groups. The best growth (mean weight gain = 380.8 mg) with the lowest mortality (48.1%) and lowest deformity rate (11.9%) but high cannibalism (36.7%) was obtained in larvae weaned at day 19 post-hatch, whereas the lowest growth (mean weight gain = 218.9 mg) with the highest mortality (68.6%), high deformity (22.3%) and low cannibalism (13.8%) was obtained in fish weaned at day 12 post-hatch. The highest survival but with highest deformity, mainly incomplete mouth development, was observed in control group that was fed *Artemia* nauplii only. In a second experiment, 19-day old post-larvae were fed different larval feeds (formulated for marine or freshwater fish species) during 18 days and performances (survival, growth, cannibalism, resistance to osmotic stress test) were compared to fish fed standard or HUFA + vitamin C enriched *Artemia* metanauplii. The best growth was obtained in fish fed *Artemia* metanauplii (final mean weight = 301.5 and 372.7 mg, in standard and enriched *Artemia* groups, respectively), while the feeds formulated for freshwater fish species resulted in better growth (final mean weight = 176.6 and 230.8 mg) than those formulated for marine species (final mean weight = 123.8 and 144.5 mg). The highest survival, growth and resistance to saline stress as well as the lowest deformity were found in fish fed HUFA + vitamin C enriched *Artemia* metanauplii. Significant differences of ascorbic acid content in fish were observed among the dietary treatments, ranging from 17.5 ± 6.4 to 62.5 ± 8.3 μg fish dry matter^{-1}. Highly significant correlations were achieved between dietary ascorbic acid content and the ascorbic acid content in larval carcass ($R^2 = 0.91$) or the reduction of larval deformity ($R^2 = 0.75$).

Keywords: Pikeperch; *Sander lucioperca*; Weaning; Survival; Cannibalism; Deformity; Growth; *Artemia* nauplii; Ascorbic acid

1. Introduction

New species are needed to diversify European freshwater aquaculture. Several candidate fish species have been investigated, and pikeperch *Sander lucioperca* (previously named *Stizostedion lucioperca*) is considered among the most promising species for possible intensive culture in Europe, even if large commercial fisheries for pikeperch in the Swedish coast of the Gulf of Bothnia, in the eastern part of the Baltic Sea, as well as in inland lakes of Poland (Skrzypczak and Mamcarz, 2005) are susceptible to compete with fish produced in aquaculture. Indeed, pikeperch is a relatively fast growing species in temperate freshwater, living in most of the large rivers and lakes of continental Europe and of high

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doi:10.1016/j.aquaculture.2006.12.034

economic value (Hilge and Steffens, 1996). Although newly-hatched pikeperch larvae are available from some local fish hatcheries, stable mass production of fry and intensive culture of fingerlings using artificial feed are not practised yet in Europe (Kestemont and Mélard, 2000).

Primary investigations on the biology of pikeperch as well as on its rearing methods have been conducted by several authors (Klein Breteler, 1989; Mani-Ponset et al., 1994; Schlumberger and Proteau, 1996; Ruuhijarvi and Hyvarinen, 1996; Hilge and Steffens, 1996). Relevant studies have demonstrated that pikeperch larvae can be successfully reared from both live food and formulated feed, but, except a recent study of Ostaszewska et al. (2005), both survival and growth were generally poor when larvae were fed compound diets since initial feeding (Ruuhijarvi et al., 1991). Moreover, some important factors influencing the success of larval rearing of pikeperch, such as the occurrence of morphological deformities and cannibalism, have not been investigated yet.

The aim of the present study was to investigate the optimal weaning age of pikeperch and the effects of different diets (live and dry diets) on survival, growth, cannibalism, deformity and stress resistance of larvae.

2. Materials and methods

2.1. Experimental facilities and fish

Ten thousand pikeperch (10-day post-hatching, first fed *Artemia* nauplii from hatching onwards) were obtained from a private hatchery (Viskweekcentrum Valkenswaard, The Netherlands) and transported to the experimental fish culture station (FUNDP, Namur, Belgium). Breeders were stocked in earthen ponds and sampled just before spawning induction by hormonal treatment. After spawning on nest, incubation and hatching, and yolk sac resorption, 3-day old larvae were fed a mixture of sieved zooplankton (mainly rotifers) collected from ponds and *Artemia* nauplii before transport from the private hatchery to the experimental station.

Upon arrival, the larvae were acclimated in a 1.5 × 1.5 × 1 m fibreglass tank in well water at 16–17 °C. Following acclimation, the larvae were distributed in a recirculating system including 18 rectangular plastic tanks (20 L water volume, light blue walls) specially adapted for larval rearing (Kestemont, 1995), a bio-filter and a UV treatment. The dissolved oxygen in recirculating water was maintained within 7.4–8.6 mg L^{-1}, the total ammonia and nitrite in rearing water were kept below 0.02 mg L^{-1} and 0.2 mg L^{-1}, respectively. The flow rate in each tank was approximately 0.4 L min^{-1} with a slight aeration. A fluorescent light fixture (40-W tube, white colour, 100 lx at the water surface) was suspended above experimental tanks and the larvae were subjected to a constant photoperiod (LD 10 h:14 h) throughout the experiments.

2.2. Experiment 1: determination of optimal weaning age

Experiment 1 was conducted with 11-day old larvae (mean initial weight = 3.1 mg). Twelve groups of 100–120 fish were randomly divided into the larval rearing tanks to provide a triplicate of three weaning age treatments and a control group. Water temperature was kept at 20.0–21.2 °C. Newly-hatched *Artemia* nauplii (EG grade, INVE, Dendermonde, Belgium) were used as live preys. BioKyowa FFK B-400 feed was used as the weaning feed to replace the live food *Artemia* nauplii. The experimental treatments were initiated on day 12 post-hatch. Three weaning ages were applied on days 12 (W12), 19 (W19) and 26 (W26) post-hatch. The weaning procedure consisted of decreasing the proportion of *Artemia* nauplii while increasing the proportion of dry feed (*Artemia* nauplii:dry feed in a ratio of 75:25, 50:50, 25:75 and 0:100%) within 4 consecutive days. Control groups were fed with *Artemia* nauplii from first feeding to the end of the experiment. All groups of larvae were fed at 1–1.5 h interval throughout the day from 8:30 am to 6:30 pm manually, 7 days a week. Feeding levels were fixed at 0.3–0.5 g $tank^{-1}$ day^{-1} for FFK, and approximately 500–600 *Artemia* nauplii $fish^{-1}$ day^{-1} was targeted for the control group. Each tank was cleaned twice a day and dead fish were counted and checked under binocular microscopy to find out the cause of death (cannibalism, non-feeding), or the presence of malformations (skeletal or jaw deformities). Uneaten food and faeces were siphoned out daily. At the beginning of the experiment, 30 larvae and, at the end of experiment, all larvae were weighed and checked individually for the normality and deformation under microscope.

2.3. Experiment 2: effects of dietary treatment

Experiment 2 was conducted with 19-day old larvae (mean initial weight = 8.1 mg) at 21.2–23.0 °C. Before the onset of experiment, the larvae were first-fed *Artemia* nauplii as described for Experiment 1. Larvae were randomly distributed into 18 larval rearing tanks at the density of 13 fish L^{-1} (260 larvae per tank). Six experimental treatments were tested in triplicate: two diets formulated for marine fish larvae (MW1 = Seabream Initial, Nippaï Shrimp Feed, Japan, MW2 = Marinco,