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WEANING OF JUVENILE PIKEPERCH (*SANDER LUCIOPERCA* L.) FROM LIVE FOOD TO ARTIFICIAL DIET

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Abstract

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The aim of the experiment was to test two methods of juvenile pikeperch weaning from live food to artificial diet: variant 1: 8 days co-feeding with dry feed and frozen chironomids, followed by dry feed feeding and variant 2: two days feeding with frozen chironomids, followed by dry feed feeding. 1560 individuals of juvenile pikeperch with mean initial total length (TL) 2.540 ± 0.04 cm, weight (W) 0.181 ± 0.01 g and condition factor (K) 1.107 ± 0.03 from a earth pond were randomly distributed into 4 plastic tanks in a flow water system. The study was performed at stocking density of 6 ind.l^{-1} in double repeat.

The weaning success was evaluated after 20 day rearing period. In the variant 1 there was achieved significantly higher survival rate (mean 52.95%) in comparison with the variant 2 (mean 26.80%). The values of specific growth rate, body weight and body length are better in variant 1 than in variant 2, respectively: 2.184%/0.502%; 0.487 ± 0.02 g/0.377 ± 0.02 g; 3.711 ± 0.07 cm/3.356 ± 0.05 cm.

Key words: pikepech, weaning, dry feed, survival, body weight, stock density

Introduction

Pikeperch (*Sander lucioperca)* like other species from the *Percidae* family gets hardly accustomed to artificial feed (Zakes, 2007). This is one of the most important technological stages of its intensive farming, as the period of transition from live food to artificial feed is considered critical (Kestemont et al., 2007). The good performance, both with regard to growth and survival, largely depends on the chosen method for transition from live food to artificial diet.

In most cases, pikeperch conversion from live food to artificial feeding is done at the advanced juvenile stage, after rearing for about 30–40 days in earthen ponds (Zakes and Demska-Zakes, 1996; 1998; Szkudlarek and Zakes, 2002; Molnar et al, 2004; Bodis et al., 2007; Baranek et al., 2007; Zakes, 2012). This approach is substantiated, having in mind that immediately after incubation, the size of larvae is very small and functionally, they are not prepared for feed consumption. The enzyme system of many fish species, including the pikeperch, differs significantly between juvenile and adult fish (Zakes, 2012). Hamza et al. (2007) demonstrated that the transition of pikeperch to artificial feed before the 15th day of age was associated with disturbed alimentary morphological structures and enzyme systems development. Kestemont et al. (2007) presumed that after the 19th day post hatching, larvae were able to utilise the nutrients from artificial feed. The development of the stomach and its glands occurs between post hatching days 15 and 30 (Ostaszewska, 2005).

Different techniques are used for adaptation of the pikeperch from live food to artificial feed. Bodis et al. (2007) tested the direct conversion to artificial feed and feeding a mixture of feed with different benthos and zooplankton organisms (chironomid larvae, tubifex, daphnia, with gradual reduction of their dietary proportions). Kestemont et al. (2007) have initially tried feeding *Artemia* nauplii to pikeperch followed by attempts to conversion to artificial diet on post hatch days 12, 19 and 26. Zakes and Demska-Zakes (1998) used zooplankton (*Daphnia magna* and *Moina branchiata*) and trout starter diet, whereas Baranek et al. (2007)

evaluated two alternatives for transition to artificial feed – either direct or conversion with an intermediate stage of co-feeding artificial feed and chironomids. The same researchers outlined that moist and semi-moist food was appropriate for feeding of larvae whereas Brown et al. (1996) used such diet with success in the conversion of *Perca fluviscens* to artificial feed. Grozea et al. (2012) have fed fish with *Artemia* and artificial feed with gradually increasing the proportion of the latter. In some cases, minced fish meat was employed in the initial conversion (Molnar et al., 2000; Altun et al., 2008) or mixture of tubitex and dry feed (Molnar et al., 2004b). At some extent, the results from the cited experiments are inconsistent, and sometimes even contradictory.

The purpose of this study was to compare two methods for conversion from live food to artificial feed in advanced juvenile pikeperch through evaluation of main production traits – growth, survival and condition coefficient. So far, similar studies have not been performed at a national scale and no publications on the problem are available.

Material and Methods

The experiments were conducted in the experimental base of the Institute of Fisheries and Aquaculture in Plovdiv. For the trial larvae, obtained from natural reproduction in a pond were used. The larvae was transported to the aquarium hall, where the average measures of their initial length (TL, cm), body weight (BW, g) and condition coefficient were defined. The measurements were taken after anaesthesia with clove oil at a dose of 0.03 $ml.l^{-1}$.

The experiments were performed in flow water tanks. Groundwater with a temperature of 12°C was used, heated and aerated before entering the experimental tanks. Aeration was done by means of compressor and heating – with electric heaters. Throughout the experiment, relatively constant water temperature and dissolved oxygen were maintained: 22.0 ± 0.5°C and 7.2 ± 1.4 $mg.l^{-1}$ respectively. The complete water exchange in the tanks was every hour.

The study was performed at a stocking density of 6 $individuals.l^{-1}$ in two replications: Variant 1 – tanks 1 and 2 and Variant 2 – tanks 3 and 4. For that purpose 1520 advanced juvenile pikeperch with initial body length (TL) 2.540 ± 0.04 cm; initial body weight 0.181 ± 0.01 g and condition factor 1.107 ± 0.03 were used.

The duration of the experimental period was 20 days. The period before full transition to artificial food feeding was 10 days for Variant 1, and 2 days for Variant 2.

After the distribution of fish in tanks and 2-day fasting in order to their adaptation to the new rearing conditions and activation of feed ingestion behaviour, two variants of feeding were applied. In this experiment, frozen chironomids and starter feed for trout, produced by the Scretting company were used. The protein content of pellets was 52%, and fat content – 16%.

In variant 1, the following schedule was applied: day 1–2 – 100% chironomids; day 3–4 – mixture of chironomids and feed at a ratio of 75:25; day 5–6 – mixture of chironomids and feed at a ratio of 50:50; day 7–8 – mixture of chironomids and feed at a ratio of 25:75; from day 9 onward – only dough-like feed.

In variant 2, during the first two days after the fasting period the pikeperch received only chironomids, and thereafter, an immediate transition to 100% artificial dough-like feed was done. The feeding was *ad libitum*, from 8.00 AM to 10.00 PM. Tanks were cleaned by means of siphon procedure twice a day. Dead fish were counted and removed in the morning and in the evening.

At the end of the experiment the fish body weight and length, specific growth rate and condition coefficient were defined. Survival rate was defined by the formula:

$$S = 100 \times (LC/LS),$$

where S – survival rate,%;
LC – number of fish at the end of the experiment;
LS – number of fish at the beginning of the experiment.

For the assessment of the specific growth rate the following formula was used:

$$SGR – 100 \times (InBW2 – InBW1)/D$$

where SGR – specific growth rate, (%/day);
BW1 – the average body weight at the beginning of the experiment, (g);
BW2 – the average body weight at the end of the experiment, (g);
D – the period of the experiment (days).

The condition coefficient at the beginning and the end of the experiment was calculated by the formula:

$$CF = 100 \times (BW \times TL^{-3})$$

where CF – coefficient of Fulton (condition coefficient);
BW – body weight (g);
TL – body length (cm).

Results and Discussion

The size of fish at the time of their transition from live to artificial food is considered a key factor (Zakes, 1999). In most cases, it is recommended that fish should weigh more than 0.3 g and have more than 3 cm body length. Our experiment has been performed with fish of relatively smaller size than that used in similar studies (Molnar et al., 2004b; Ba-

ranek et al., 2007; Bodis et al., 2007; Policar et al., 2013). At the same time Zakes (2012) outlines that the conversion from live food to artificial feed could be performed with smaller fish which, if successful, would increase the efficiency of the mixed system – for initial farming of larvae in ponds followed by transfer in tanks for adaptation to artificial feed.

The use of clove oil for anaesthesia of fish at a dose of 0.03 mg.l^{-1} facilitated at a significant extent the manipulations related to measurements. Fish tolerated well this concentration and recovered rapidly from anaesthesia after being placed in clean water.

The adaptation of fish to chironomid larvae in both variants occurred as early as the first day. Most fish attacked the food in the water volume; some were feeding at the bottom. Single pikeperch did not react to food and ignored it.

In variant 1, feeding with mixture of chironomids and trout feed with gradual increase of artificial feed proportion did not influence the feeding activity of fish. The chironomid/feed mixture was accepted very well and attacked by some fish that tore the dough-like feed. A minor part of the feed on the bottom was consumed by the fish but the other remained. In general, fish were reluctant to eat the feed that fell on the bottom, only few accepted it.

After two days on chironomid feed, the fish from variant 2 responded to the artificial diet, but their feeding activity was reduced. More fish refused to eat as compared to the fish number in variant 1. After repeated offering of dry pellets, fish accepted them less willingly and exhibited a lower activity than when dough-like feed was given; that is why, this method for feed preparation and offering was used throughout the experimental period.

During the experiment, cannibalism was observed, specific for the farming of the species (Zakes, 1997; Baranek et al., 2007; Policar et al., 2013). In most cases, the larger and more aggressive fish attacked the smaller and weaker ones and even if the latter are not swallowed, they could be injured, stressed and consequently perished. Cannibalism was more frequently observed in variant 2 compared to variant 1.

The survival of fish is the main parameter showing the efficiency of transition from live to artificial diet and is largely variable according to the different studies (Zakes, 1997; Zakes, 1999; Szkudlarek and Zakes, 2002; Ljunggren et al., 2003., Molnar et al., 2004a; Molnar et al., 2004b; Baranek et al., 2007; Wedekind, 2008). Most commonly, a higher mortality rate is observed in the beginning of the conversion period, principally caused by hunger and aggression – injury and cannibalism.

In our experiment, a higher survival rate was detected in variant 1 vs. variant 2 (Table 1) with similar values for both replications – 53.6% and 52.3% for tank 1 and tank 2 respectively. In variant 2, the survival rates of both replications were also similar but substantially lower (26.0% for tank 3 and 27.6% for tank 4) compared to variant 1. The average survival rate for variant 1 was 52.95%, and for variant 2 – 26.80% i.e. there was a 1.97-fold difference in favour of the former variant. The experimental data confirmed the more difficult adaptation and higher mortality rate in fish under variant 2 conditions.

According to Bodis et al. (2007) the pikeperch tolerates well the stress associated to live to artificial diet conversion. Our observations provided proofs that fish were not stressed by manipulations in tanks related to daily cleaning, changing filters, removal of dead fish etc. Immediately after the manipulations, fish accepted food normally, without behavioral deviations.

With respect to growth, the performance in variant 1 was statistically significantly better than that in variant 2 ($p = 0.00001$). The pikeperch increased their initial weight of 0.181 ± 0.01 g almost 2.7 times, and the average weight from the two replications was 0.487 ± 0.02 g. In variant 2, the increased was about 2 times with average weight from the two replications 0.377 ± 0.02 g. The same tendency was observed for initial and final body length. In variant 1, body length increased from 2.540 ± 0.04 cm to 3.711 ± 0.07 cm, whereas in variant 2 the average final length was 3.356 ± 0.05 cm. The difference between the variants was in agree-

Table 1

Results from rearing of pikeperch juveniles at two different feeding schemes

Parameters	Measure	Variant 1		Variant 2	
		Tanks		Tanks	
		1	2	3	4
Stoking density	ind.l^{-1}	6	6	6	6
Final body weight	g	0.433 ± 0.02	0.542 ± 0.02	0.397 ± 0.02	0.357 ± 0.01
Final body length	cm	3.560 ± 0.07	3.863 ± 0.07	3.413 ± 0.06	3.300 ± 0.03
Condition coefficient, K	–	0.942 ± 0.02	0.936 ± 0.02	0.988 ± 0.02	0.986 ± 0.02
Survival rate	%	53.6	52.3	26.0	27.6

ment with the results of other researchers having tested the mixed feeding of pikeperch in the period of transition from live to artificial feed (Bodis et al., 2007).

The two variants differed also with regard to the specific growth rate which was 2.184% for variant 1 and 0.502% for variant 2, demonstrating a better growth rate of fish fed the mixed diet compared to those fed artificial diet.

The comparison of the condition coefficient values showed higher values in the beginning of the experiment for both variants (1.107 ± 0.03), when fish were fed entirely on live food in the earth pond. The condition coefficient in variant 2 was higher than in variant 1 (P = 0.0001).

Conclusions

The results from the both experiments demonstrated that the transition of pikeperch from live food to artificial diet could be done successfully at a weight and body length of fish 0.181 ± 0.01 g and 2.540 ± 0.04 cm respectively.

The two tested methods of conversion from live to artificial diet could be successfully used when culturing pikeperch juveniles in tanks. Better performance was obtained with the gradual transition with stepwise reduction of live food proportion in the daily ration (variant 1). The average survival rate in variant 1 at the end of the experiment –52.95% vs 26.80% in variant 2 allowed recommending the first alternative for the fish farming practice.

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