SHORT COMUNICATION

PIKE-PERCH FARMING IN RECIRCULATING AQUACULTURE SYSTEMS (RAS) IN THE KALININGRAD REGION

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Abstract

Pike-perch (*Sander Lucioperca* L.) is considered as one of the most valuable food fishes native to Europe. Low fat content (1–2%), highly assimilable protein and a delicate flavour makes pike-perch meat is highly valued by dieticians. Currently, pike-perch available on the market are usually caught by fishers, mainly from Eastern Europe. However, breeding technology is still low, only a few countries (such as Denmark and the Netherlands) have established production. According to predictions of increasing consumption and environmental degradation it'll be necessary to develop reliable technology of pike-perch reproduction as a potential for aquaculture development.

Nowadays, in the EU is actively developing aquaculture in fully "recirculating" systems where water is largely reused. It is known as Recirculating Aquaculture Systems (RAS). In the EU, only the fish which is reared in the RAS may be considered as an eco-friendly product. And food safety concerns are led to the fact that some consumers are willing to pay a premium prices for safe and eco-friendly products, making such cultivation technology more profitable.

The objective of this article is to provide an overview of the current status of pike-perch farming in the Russian Federation with a focus on quality of fish, which is produced in environmentally friendly way by using the RAS technology. We researched the growth features of various pike-perch generations reared experimentally in a local fish hatchery and established the possibility of introducing this species to the market in the Kaliningrad Region.

Keywords: pike-perch, RAS, weight gain.

Introduction

Nowadays, aquaculture is a highly dynamic sector of agriculture. This fact can be illustrated by data of American analytic company "Transparency Market Research" report about aquaculture market development. According to company prediction, aquaculture market production in 2019 will be valued at US$ 195.13 billion. Towards the end of 2015 the volume of aquaculture production presumably to exceed the amount of fish caught, and fishery will cease to be the main source of fish and seafood supplies for human consumption (Transparency Market Research, 2013).The strong environmental restrictions to minimize pollution from hatcheries and aquaculture plants in Northern European countries have sparked a rapid technological development of recirculating aquaculture systems (RAS). The RAS enables to create optimal conditions for farmed fish at all stages of the production process and control the health of farmed fish. The highest possible outcome of fish products per unit area is common to the system in particular. That is a compromise with regard to intensive production and environmental sustainability at the same time (Bregnballe, 2010). Pike-perch (*Sander Lucioperca* L.) is a new species for cultivation in the RAS. This fish is characterized by rapid growth, early maturation and high breeding performance, complemented by excellent taste of meat (Хрусталев, Дельмухаметов, 2010). Thanks to its low fat content (usually 1–2%) and highly assimilable protein, pike-perch meat is highly valued by dieticians and suitable for baby food production (Мукатова, Гайворонская, 2010). The proportion of the unsaturated fatty acids is high and the proportion of the omega-3/omega-6 (n-3/n-6) fatty acids (3:1-4:1) might help to develop the ideal level in the human body (Molnár et al., 2009). Pike-perch is usually sold frozen as gutted whole fish, fillets with skin or skinned fillets. The fillets are usually sold in the following weight categories: 120–170 g, 170–230 g, 230–300 g, 500–800 g, >800 g. This species is less frequently sold fresh, e.g. whole fish, whole gutted fish, fillets with skin and skinned fillets (FAO, 2009). Pike-perch successfully cultivated in the RAS by several European companies (Philipsen, 2008; The David Suzuki Foundation, 2008). However, according to accumulated experience, breeding technology is still poor and only few countries (such as Denmark and the Netherlands) have established production. In Russia, pike-perch farming was conducted during the Soviet times. It was a traditional pond aquaculture, and the fish reared on such fish farm cannot be considered as eco-friendly product nowadays. Recently, in the Kaliningrad region we have made some attempts on pike-perch cultivation in the RAS. During the period from 2007 to 2013 we are managed to form brood stock and develop methods of work with a pike-perch from juvenile to commodity output in a closed system. This is the first Russian experience of pike-perch cultivation in the RAS. The growth of pike-perch in natural reservoirs has been studied appreciably well, but the growth in artificial conditions was not detailed or comprehensive enough. Our goal was to study the growth features of pike-perch at different stages of cultivation process. We researched the growth features of various pike-perch generations reared experimentally in a local fish hatchery. We provided an overview of the current status of pike-perch farming in the Russian Federation with a focus on quality of fish, which is produced in environmentally friendly way by using the RAS technology.

Materials and Methods

The objects of the study were a pike-perch of different generations. The research work was carried out on an experimental RAS at the KMP Aqua Ltd. (Svetly, Kaliningrad region) and industrial RAS at the TPK Baltpticeprom Ltd. (Kaliningrad), during the period from 2007 to 2013. Both plants consisted of biofilters (loaded by pelleted polyethylene), mechanical filters and UV lamps. At different stages of cultivation, the fish were distributed in tanks with volume from 700 L to 7000 L. Oxygen levels in the tanks were maintained by Atlas Capco GX11FF air compressor.

Scheme of the plant is presented on Figure 1.

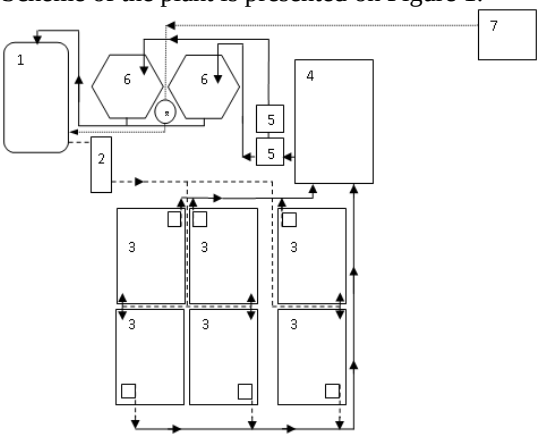

Figure 1. Scheme of the plant of industrial RAS at the TPK Baltpticeprom LLC

1 – degasser, 2 – UV lamps, 3 – tanks, 4 – mechanical filter, 5 – pumps, 6 – biofilters, 7 – air compressor, 8 – oxygenator. —— water output, ------- water input

Such type of plant can be considered as environmentally friendly. There are no any harmful emissions and we had a full control of outputs and effluents.

Oxygen levels in the tanks were maintained above 125% of saturation. The volume of daily replaced water was 10%.

Aller Aqua (Christiansfeld, Denmark) recipes: Aller Futura, Aller Trident, Aller Bronze and Coppens MariCo Focus (Helmond, Netherlands) feeds are used for feeding. All recipes of Aller Aqua are contain raw materials ensure an excellent amino acid profile for good metabolism. The composition includes fish meal, fish oil, wheat, vegetable oils, vitamins and mineral supplements. Aller Futura additionally includes krill meal, while Aller Bronze contains soy flour. Coppens MariCo Focus is a high protein low fat grower with a high proportion of fish meal, additionally includes vitamins and minerals.

Daily ration was changing in accordance with the feed consumption. Estimation of feed conversion ratio (FCR) was performed per months by the equalation:

$$FCR = \frac{Feed\ consumption}{Body\ weight\ gain} \quad (1)$$

Temperature maintenance of water in the tank was maintained by heating panels in the plant placement. To characterize the efficiency of cultivation has been chosen the index of weight gain as the most convenient and commonly used in aquaculture (Купинский, 2007). Sample size during the control analysis was 1% of the total fish amount in a tank.

Results and Discussion

To date, we have received a third generation of pike-perch which has been farmed under the RAS conditions. At cultivation of brood stock we have achieved the weight of fish in 1–1.3 kg in 34 months period. Weight gain velocity of subsequent pike perch generations was higher than that expected for the first generation due to optimization of biotechnological techniques, especially the feeding regime (Fig. 2).

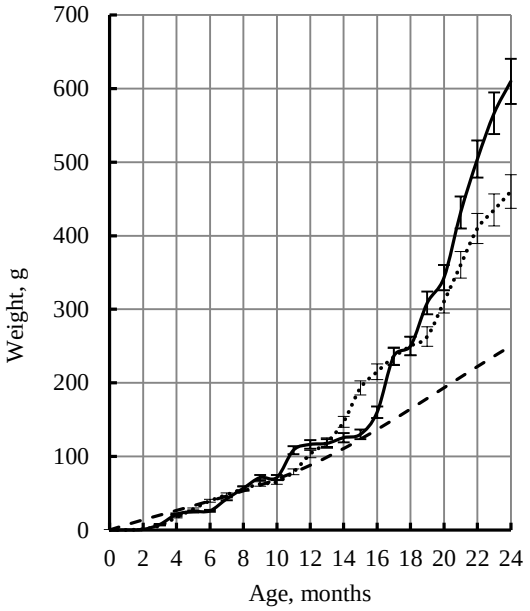

Figure 2. Increase in weight of first and third generations of pike-perch farmed in RAS, and growth of pike-perch in Curonian lagoon during the first two years of life (Голубкова, 2003; Domarkas et al., 2008)

····· First generation, —— Third generation, ------- Curonian lagoon

By the end of the second year of cultivation the pike-perch of third generation reached the weight of 600 g, while the first generation was 460 g. It can be easily seen that the marked differences in the growth rate of pike-perch could be traced from the age of 12–18 months, in particular for its disclosure completeness of growth potency at this age.

During the growing period of third generation, the economical consumption of nutrients to weight gain has been noted. Comparing these data with pike-perch growth from the Curonian Lagoon, it should be emphasized that the growth rate of cultivated pike perch was 2.5 times higher than that of natural pike perch inhabiting the Curonian Lagoon, suggesting the feasibility of cultivation.

The reason why the growth rate of the third generation were higher is optimization of biotechnological techniques, especially the feeding regime as well as a

continual and careful updating of feeding norms in accordance with specific conditions (temperature, oxygen concentration, and configuration and operational features of the RAS, etc.).

The feed conversion ratio was below or close to 1.0, thus made a quite effective feeding of the third generation in the described period. This is also can be attributed to the use of high quality feed (Coppens MariCo Focus) at the last stages of cultivation. A high ratio of protein, energy and low fat contend in the feed is reflected in a higher growth rate of fish, which correspond to lower values of feed conversion ratio. The feed containing 10–12% fat is perfect (Schulz et al., 2007) for the pike-perch.

The survival rate of various pike-perch generations from larvae to market size fish was about 56%, which is comparable and sometimes exceeds the results obtained by European fish farmers (Хрусталев, Дельмухаметов, 2010).

Fishes were produced without hormones, antibiotics, etc., which can be considered as eco-friendly product, especially noting that we had a full control of outputs. Usage of extruded feeds (Aller Trident, Aller Bronze) had no harmful effect on the body composition of fish.

The cost price for product was 3.5 euros per kg. Despite this fact, the first batch of product (3.000 kg) was sold in January–February of 2014 very quickly, which indicates a high consumer demand. It should be noted that the consumer demand for pike-perch can increased and depends on fishing ban periods and freezing period.

Thus, in the third generation of cultivated pike-perch we have achieved better disclosure of growth potency as compared to the first generation, to ensure higher results in the future.

Conclusions

The main feature of this research in the fact that the cultivation of pike-perch in a closed aquaculture system held in the Russian Federation for the first time. As the results showed, the feasibility of cultivation is very high, that allowing the use our biotechnology in the future.

Despite this fact, there is not a fully perfected technique with larvae and fry, especially in survival rate. Terms of pike perch cultivation to market size should be reduced and selected more optimal feed regime for the rearing of marketable fish, and the production must be made cheaper. All these issues will be perspective areas of consideration for the further research.

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