1. Abstract

Yellow perch is an ecologically and economically important species of fish in the Midwestern United States. Production from wild capture, however, has decreased due to declining populations in the Great Lakes. In aquaculture, the survival of larval fish during the first month post hatch is less than 15–20%. Factors resulting in the poor survival of yellow perch larvae may include poor quality of nutrition of newly hatched sac-fry and physiological challenges.

This preliminary study investigated the effects of different incubation temperature regimes (high, control and low temperature regimes) and water salinity (freshwater and 5 ppt [5 g/L] salinity) on the quality of yellow perch embryos. The different water temperatures led to three hatching time periods including 8 days, 11 days and 14 days for the high, control and low temperature regime, respectively. Evaluation was based on the size of oil drop, yolk sac and embryo, as well protein contents of embryos. Results showed that embryos incubated with the low temperature regime had significantly smaller embryos (P<0.05) but the size of yolk sac and oil drop was similar among the three water temperature treatments. Embryos incubated at 5 ppt salinity water hatched earlier with smaller embryos but larger yolk sac compared to those incubated in freshwater conditions. The oil drop size was not influenced by salinity. The current results suggested that the low temperature regime during hatching period resulted in smaller embryo. The low salinity water advanced the hatching time and also help to reserve more yolk protein in the embryo but with smaller embryo size. This may be critical for the survival of yellow perch larval when they are transferred from endogenous to exogenous nutrients, and thus lead to different survival of yellow perch larvae. These studies will help to understand the hatchability and larval survival of yellow perch larvae to test this hypothesis.

2. Introduction

Many species of fish raised in aquaculture, including yellow perch, show a high mortality rate in the embryo and larval stages. This is due to nutritional and environmental conditions, as well as the sensitivity of eggs and larvae to fungus and disease. In order to decrease mortality of fish larvae during early life stage, it is important to optimize hatchery management practices such as water treatment and nutrient requirements for the target species. This is critical for developing healthy fingerlings for the aquaculture industry. Different chemicals such as formalin, hydrogen peroxide, and salt are commonly used in hatcheries for treating embryos to limit fungal or bacterial growth. Compared with other chemicals, salt is more cost effective and has a lesser environmental impact. However, it is not known if salt has any impact on yellow perch embryos, especially on nutrient storage. In addition, temperature is one of the important factors influencing embryo development and survival. The current body of research on yellow perch embryo development is still very limited.

Thus, the objective of this study is to determine the impacts of low salinity water and temperature on yellow perch embryo based on physical size and endogenous nutrient storage.

3. Methods

Two Water Treatments in Flow-through Aquaculture Systems:

- Freshwater and 5 ppt (5 g/L) Salt

Three Temperature Regimes

- In each regime the temperature was increased from 13°C to 16°C, but over a different span of time:
  - High Temperature (HT): Incubation temperature was increased within 8 days when the embryos were fertilized
  - Cool Temperature (CT): Incubation temperature was increased from within 11 days when the embryos were fertilized
  - Low Temperature (LT): Incubation temperature was increased within 14 days when the embryos were fertilized

4. Results

Fig 1: Fertilized Egg Ribbons for Incubation. Ribbons were later moved to separate tanks for individual treatments.

Fig 2: A sample of embryo images. From left to right, day 0, day 3 and day 7. Each day samples of the developing embryos were collected and photographed using a microscope.

Fig 3: A macro was developed for use in ImageJ to measure the areas of the oil drop, yolk, chorion, and total egg.

5. Discussion and Conclusion

- The process of osmoregulation costs energy. The larger yolk sac may suggest that the saltwater treated embryos required less energy/protein during development under the conditions of low salinity environment. The large yolk sac may carry more endogenous nutrients to support larval survival before they can feed on exogenous nutrients. This warrants future investigation.

- Temperature did not have any apparent impact on the size of the oil drop or yolk sac during the 7 days of incubation, but the embryos were smaller in the low temperature treatments. With the current results we do not know if lower temperatures impacted the endogenous nutrient storage of the embryos before they are hatched.

- At this time it is still not known how the differences in salinity concentration or temperature impact larval post-hatch. Further research is needed to analyze the nutrition composition of larve to see if greater yolk sac reserves at the time of hatch impact later growth and development.

- Further research is needed to understand the effects of different temperature and salinity regimes on the hatch time and hatch rate of embryos. Additionally, microbial analysis will help to understand the impact of salt treatments on fungal and bacterial infections of developing embryos.

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References