Effect of Different Salinity Levels on the Fertilization and Hatching of *Heterobranchus bidorsalis*

R.C.A. ORJI, C.N. NNADI, G. ONYIKE
and J. OGBONA

Abstract

The success of induced spawning for the production of fish seed depends on many factors which affect hatchery conditions. This paper discusses the results of an investigation on the effects of six different levels of salinity on the fertilization and hatching of *Heterobranchus bidorsalis* eggs. The results indicate that spermatozoa of *H. bidorsalis* can survive under a wide range of saline concentrations, with survival increasing with an increase in salinity from 0 to 0.4% and then decreasing as the level of salinity increases. Survival was optimum at 0.4% saline concentration.

Introduction

Ever since the development of aquaculture, the search has been on for fish species with potential for pond culture. Some species that have successfully adapted to pond conditions in Africa are the African catfish (*Clarias gariepinus*) (Hogendoorn and Vismans 1980), *Heterobranchus longifilis* (Micha 1973), *H. bidorsalis* (Ayinla et al., in press) tilapias, *Heterotis niloticus* and a host of others. However, only the tilapia species can breed in ponds without human intervention (Harvey and Hoar 1979). Consequently, induced spawning becomes the major source of fish seed production for the majority of species.

However, induced spawning has its limitations, and as a result fish farmers encounter shortages of fingerlings with which to stock their ponds, in spite of the many hatcheries in different areas. Success in raising and caring for an animal is directly related to how much is known about how the animal functions in its environment. Therefore, it is essential to examine the existing hatchery conditions and operation, particularly in the important pre-hatching phase because an error at this stage can lead to total mortality.

Failure in fertilization and hatching during induced spawning may not always be due to maturity stage of the fish. Since it is ascertained before inducing spawning, it may also be due to environmental and other physicochemical factors such as salinity.

Saline solution has been used for storing and preserving isolated animal cells. In induced spawning of fish, saline solution is used not only as a carrier of pituitary homogenates, but also as a preservative for the milt. However, too little or too much saline concentration has a lethal effect on the cells. Up to now, the salt concentration used in various hatcheries in Nigeria is based on trial and error. In view of the low fertilization and hatching encountered in the hatcheries in Nigeria, a study was undertaken to determine the best saline concentration for optimal performance of milt and eggs in the fertilization and hatching processes. *H. bidorsalis* was chosen for the study due to difficulties encountered in artificial fertilization.

Materials and Methods

Eggs and milt were collected from pairs of gravid broodfish, adopting the method of Woynarovich and Horvath (1980). Prior to this, acetone-dried carp pituitary was used at a dosage of 7 mg/kg to induce maturation and ovulation in the gravid broodfish, as suggested by Nwadukwe et al. (1993).

Five different saline levels (0.2%, 0.4%, 0.6%, 0.8% and 1.0%) were prepared by dissolving 0.2, 0.4, 0.6, 0.8 and 1.0 g sodium chloride in 100-ml distilled water, respectively. Distilled water was used as 0% salinity medium. Eggs were obtained by stripping the female broodfish after a latency period of 10 hours. The eggs were distributed among six dishes and the prepared milt was added and mixed thoroughly for fertilization. Milt was collected by sacrificing the male broodfish and dissecting the testes. Six concrete hatchery tanks, each 1.5 x 1.5 m in size were used for incubation and hatching of the eggs. One hundred and fifty eggs from each treatment were transferred to hatching nets installed in each of the tanks and filled with water to a depth of 10 cm. During the period of incubation, an electric air pump was used to ensure adequate oxygenation of the water.

Analysis of variance (ANOVA) was used to determine whether there was any significant difference in fertilization and hatching due to different salinity levels.

Results and Discussion

Fertilization of eggs was 25%, 35%, 70%, 45%, 37% and 21% in 0%, 0.2%, 0.4%, 0.6%, 0.8% and 1% saline solutions, respectively, indicating that although fertilization could take place without saline solution, performance was better when the saline solution is used (Fig. 1).

As indicated in Fig. 2, the rate of successful hatching was 15% in 0% saline, 25% in 0.2% saline, 62% in 0.4% saline, 42% in 0.6% saline, 28% in 0.8% saline and 12% in 1% saline solutions. ANOVA indicated significant difference between the treatments at 0.05 level of probability.

The results of this investigation indicated that spermatozoa of *H. bidorsalis* can survive under a wide range of saline concentrations with survival increasing with increase in salinity from 0 to 0.4% and then decreasing with subsequent increase in salinity. Survival is optimum at 0.4% saline concentration.

Nwadukwe et al. (in press) reported good fertilization and hatching using 0.9% saline concentration for *H. longifilis*. It is possible that lower salinity might have given a better result. The lower salinity tolerance might be based on the fact that *H. longifilis* is a freshwater fish and higher saline concentration would probably result in the shrinkage of the sperm cells due to osmotic effect. Freshwater fish live in a hypotonic environment but the skin and mucus greatly reduce water permeability. When the sperm cell is not protected by the fish skin, an isotonic medium must be provided to extend the cell's life span, increasing the need for increased salinity.

Green and Ezeilo (1978), outlined normal saline as 0.9% in de-ionized water for mammals, 0.75% for land invertebrates and 0.64% for amphibians. When looking at the position of fish in relation to amphibians and mammals in the evolutionary ladder, it is plausible that the normal saline for freshwater fish should fall within 0.4-0.6% which is in line with the results of this investigation. Further investigations involving concentrations of 0.45%, 0.5% and 0.55% need to be carried out to further pinpoint ideal salinity.

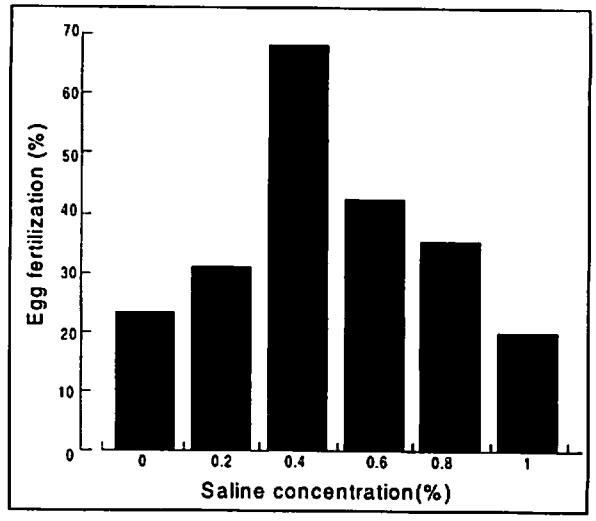

Fig. 1. Fertilization in H. bidorsalis *at different salinity levels.*

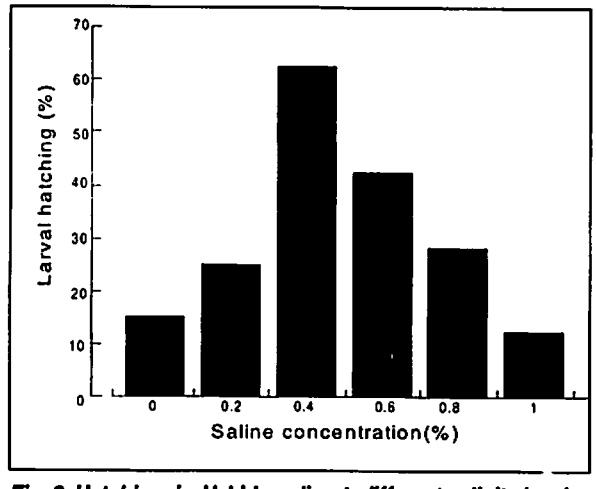

Fig. 2. Hatching in H. bidorsalis *at different salinity levels.*

References

Ayinla, A.O., A.A. Adeyamo and G.A. Oladosu. Growth and survival of fry of African catfish species - *Clarias gariepinus* and *Heterobranchus bidorsalis*. (In press).

Green, J.H. and G.C. Ezeilo. 1978. Introduction to human physiology. Oxford University Press, Ibadan.

Harvey, B.J. and W.S. Hoar. 1979. The theory and practice of induced breeding in fish. IDRC Tech. Pap. 21, 48 p.

Hogendoorn, H. and H.H. Vismans. 1980. Controlled propagation of African catfish, *Clarias gariepinus*, artificial reproduction. Aquaculture 21:39-53.

Micha, J.C. 1973. Études des populations piscicoles de l'Ubangi et tentatives de sélection et d'adoption de quelques espèces à l'étang de pisculture. Notes docum pêche pisculture centre. Tech. Forest Trop. 1973:1-11.

Nwadukwe, F.O., O.A. Ayinla and N.J. Abbykalio. Effects of various doses of acetone-dried carp pituitary extract and season of propagation of *H. longifilis*. (In press).

Woynarovich, E. and L. Horvath. 1980. The artificial propagation of warm water fin fishes - A manual for extension. FAO Fish. Pap. 201, 183 p.

R.C.A. Orji, C.N. Nnadi, G. Onyike and J. Ogbona are from the Department of Fisheries Technology, Michael Okpara College of Agriculture, P.M.B. 7267, Umuahia, Nigeria.