INCUBATION TEMPERATURE AFFECTING GROWTH OF JUNDIÁ (*RHAMDIA QUELEN*) (TELEOSTEI, HEPTAPTERIDAE) DURING EMBRYONIC AND LARVAL PERIODS

M. Forgati[1], C.V. Maiolino[1], K.L. Azevedo[1], A. M. Rodrigues-Galdino[1], A. F. Silva[1], J.D. Mikos[2], P.C. F. Carneiro[3], L. Donatti[1] & F.S. Rios[1]

[1]Universidade Federal do Paraná, Departamento de Biologia Celular. Centro Politécnico, Caixa Postal 19031, CEP 81531-990. Curitiba, PR.[2]Pontifícia Universidade Católica do Paraná, Setor de Piscicultura, Caixa Postal 129, 83010-500, São José dos Pinhais, Paraná.[3]EMBRAPA Tabuleiros Costeiros, Caixa Postal 44, 49025-040,Aracaju - SE.

INTRODUCTION

Fish early life history is marked by a series of crucial developmental events. These can affect developmental controls resulting in phenotype alterations (Johnston et al., 1996; Adriaens & Verraes, 2002). Temperature is a critical factor in determining growth rate, affecting the developmental timing, size at hatching, efficiency of yolk utilization and formation and function of key tissues and structures (Kamler, 1992). Rapid growth rates are a characteristic of fish early life history (Kamler, 1992). In commercial fish culture systems, economics usually claim that culture organisms be grown to harvestable size as quickly as possible. Considering this, elevated temperature is frequently used to accelerate the rate of early fish development (Peterson et al., 2004). Jundiá (*Rhamdia quelen*) is a teleost native from South America that can survive over cold winters and grow fast in the warm summer (Barcellos et al., 2002). The mean water temperature in South Brazil, where the most extensive culture of silver catfish exists, is within the 15-30ºC range (Chippari-Gomes et al., 1999). This species has been causing a great deal of interest among researchers and fish culturists all over Brazil. Studies carried out in the last years with this species have pointed its great potential for aquaculture (Carneiro *et al*., 2003). The aim of this study was examine how incubation temperature affects overall development and growth from fertilization through the larval period of jundiá and establish of optimal thermal culture for this species.

MATERIAL AND METHODS

Mature males and females of jundiá were induced to reproduce through hypophysation. Six replicate chambers were used for each of four constant temperatures: 24ºC, 26ºC, 29ºC and 32ºC. Each chamber consisted of a 1.3L flowthrough incubator and each set of chambers was maintained in a 100 L tank. Dissolved oxygen was monitored by an YSI - 55 (Hexis) Oximeter and kept at >6 mg/L and <7 mg/L by controlling aeration. The eggs were gradually adapted to each test temperature. Approximately 3000 fertilized eggs were placed into each chamber.

Embryos were sampled every 30 min during the first 19 hours, and thereafter in intervals of one hour. The experiment was concluded when all of viable eggs at each temperature had hatched. Samples of embryos were pipetted carefully from each chamber and fixed in 4% Paraphormaldeyde in 0.1M PBS at 4ºC. Preserved eggs were analyzed in a Zeiss Axiophotâ light microscopy. Images from six embryos from each sample were taken and measured using a computerized morphometry system (Sigma Scan, Jandel Scientific, v. 3.0). The traits measured were: embryo surface area, embryo shape factor (roundness), embryo length (from segmentation period), yolk cell surface area, and yolk cell shape factor (roundness). Photomicrographs of live embryos were acquired with a Sony digital camera on a Quimis light microscope. Developmental stage was determined using criteria set out in Rodrigues-Galdino (2006).

Statistical analyses were conducted using the GraphPad Instat (GraphPad, v. 3.0). The normal distribution of variables was tested using the Bartlett's test for homogeneity of variances. Statistical comparisons were performed by ANOVA followed the Tukey-Kramer multiple comparisons test. Data were expressed as means ± SEM and $P < 0{\cdot}05$ was considered statistically significant.

RESULTS AND DISCUSSION

Typically, growth rates were directly proportional to incubation temperature throughout the embryonic period (Ojanguren *et al*., 1999; Cook, et al., 2005; Martell *et al*., 2005). In the present study, the hatched larvae presented similar yolk cell surface area, indicating that the total yolk

consumption were comparable in all temperatures. However, the final size of hatched larvae was different according to the incubation temperature. During cleavage period, *R. quelen* embryos maintained in 32ºC presented the smallest (P<0.05) yolk cell surface area, but the biggest (P<0.05) surface area occupied by the blastomeres. These results indicates that the cell metabolism was higher at 32ºC leading to an accelerating growth at expenses to faster consumption of the yolk. On the other hand, in the blastula period the yolk cell surface area was similar (P >0.05) in the embryos incubated in all temperatures. Nevertheless, the surface area of blastulas maintained in 26ºC was the largest (P<0.05), while that in 24ºC was the smallest (P<0.05). As the development continues (segmentation and pre-hatching periods), the embryos incubated at 26°C presented better growth rates and yolk conversion, reaching the largest length (P<0.05) using the lowest (P<0.05) amount of yolk. In contrast, the embryos incubated either in 24ºC than in 32ºC achieve areas and lengths smaller than that incubated in intermediate temperatures. In 29ºC, the hatched larvae were shorter than those in 26ºC, but they presented similar areas in both temperatures. This occurs because the roundness of 29ºC-larvae was greater (P<0.05) than in 26ºC-larvae. According to Martell *et al*. (2005), overall developmental rate was sequential with and directly proportional (2-3-fold increase) to incubation temperature while the time spent in each developmental stage was inversely proportional to temperature. Larger embryos tended to be produced at lower temperatures but this pattern reversed following hatch, as larvae from higher temperature groups grew more rapidly than those from other temperature groups. In the haddock (*Melanogrammus aeglefinus*), larvae from all temperatures (2-10ºC) achieved a similar length upon complete yolk absorption (Martell et al., 2005). However, similar to *R. quelen*, *Ophiodon elongates* achieve larger lengths when incubated in intermediate temperatures (6-15ºC) (Cook, et al., 2005). The results of the present study suggest that 26ºC is the better temperature to *R. quelen* embryos incubation. Even so, more investigations related to malformations as well as about larval development are needed.

BIBLIOGRAPHIC REFERENCES

ADRIAENS, D. & VERRAES, W. 2002. Na empirical approach to study the relation between ontogeny, size and age using geometric morphologies. In: Topics in Functional and Ecological Vertebrate Morphology. (Aerts, p., D'Août, k., Herrel, A. & Van Damme, R., eds.) pp. 293-324. Shaker Publishing.

BARCELLOS, L. J. G., WASSERMANN, G. F., SCOTT, A. P., WOEHL, V. M., QUEVEDO, R. M., ITTZE'S, I., KRIEGER, M.H. & LULHIER, F., 2002. Plasma steroid concentrations in relation to the reproductive cycle of cultured male *Rhamdia quelen*. *Journal of Fish Biology* **61:** 751- 763.

CARNEIRO, P. C. F., MIKOS, J. D., SCHORER, M., OLIVEIRA-FILHO, P. R. C. & BENDHACK, F. 2003. Live and formulated diet evaluation through initial growth and survival of jundiá larvae, *Rhamdia quelen*. *Scientia Agricola* **60:** 615-619.

CHIPPARI-GOMES, A. R., GOMES, L. C., BALDISSEROTTO, B. 1999. Lethal temperatures for Silver Catfish, *Rhamdia quelen*, fingerlings. *Journal of Applied Aquaculture* **9:** 11- 21.

COOK, M.A., GUTHRIE, K.M., RUST, M.B. & PLESHA, P.D. 2005. Effects of salinity and temperature during incubation on hatching and development of lingcod *Ophiodon elongatus* Girard, embryos. *Aquaculture Research* **36** : 1298-1303.

JOHNSTON, I. A., VIEIRA, V. L. A. & HILL, J. 1996. Temperature and ontogeny in ectotherms: muscle phenotype in fishes. In: Phenotypic an Evolutionary Adaptations of Organisms to Temperature (Johnston,I. A. & Bennett, A. F., eds.) pp. 153- 181. Cambridge: Cambridge University Press.

KAMLER, E. 1992. Early Life History of Fishes: An Energetics Approach. London: Chapman & Hall.

MARTELL, D. J., KIEFFER., J. D.& TRIPPEL, E. A. 2005. Effects of temperature during early life history on embryonic and larval development and growth in haddock. *Journal of Fish Biology* **66:** 1558-1575.

OJANGUREN, A. F., REYES-GAVILA, F. G. & MUÑOZ, R. R. 1999. Effects of temperature on growth and efficiency of yolk utilisation in eggs and pre-feeding larval stages of Atlantic salmon. *Aquaculture International* **7:** 81-87.

PETERSON, R. H., MARTIN-ROBICHAUND, D. J. & HARMON, P. 2004. Influence of incubation temperature on body movements of Atlantic cod (*Gadus morhua* L.) embryos and on size at hatch. *Aquaculture Research* **35:** 453-457.

RODRIGUES-GALDINO, A.M. 2006. *Estágios do*

desenvolvimento embrionário e larval do jundiá (Rhamdia quelen) (Siluriformes, Heptapteridae). Monografia, Universidade Federal do Paraná.