

EMBRYONIC AND LARVAL DEVELOPMENT OF JAPANESE ORNAMENTAL CARP *CYPRINUS CARPIO* (LINNAEUS, 1758)

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Abstract

The aim of this paper is to describe the development stages of the embryo and most important aspects of larval period at Japanese ornamental carp. Thus, has been characterized seven broad periods of embryogenesis - the zygote, cleavage, blastula, gastrula, segmentation, pharyngula and hatching, respectively. These divisions highlight the changing spectrum of major developmental processes that occur since fertilization to hatching. Stages subdivide the periods and their names are based on morphological features, generally readily identified by examination in microscopy of the live embryo. In the conditions of maintaining water temperature around 22°C, the embryonic development lasted 50 hours. During larval period, the main aspects were following: yolk resorption, body pigmentation and completed organogenesis, filled with gas of the swim bladder, fins differentiation, the appearance of active body movements and start of the exogenous feeding.

Key words: *Cyprinus carpio*, morphogenesis, embryogenesis, larval development

INTRODUCTION

There is no sufficient information on the early development of the ornamental Japanese carp. So it is necessary to undertake proper study to characterize its various stages of embryonic and larval development to understand the biological clock of this specie. Life starts with the unification of male and female gametes. As soon as the egg is fertilized by a sperm, the zygote is formed and embryonic development starts and ends up at hatching. The hatchlings further undergo organogenesis and appear as like as their parents, thus end the larval stages. Egg development in the ovary is maternally derived and is predetermined in the ovary but its genetics complex is determined at the very instant of fertilization [1]. In this paper, embryonic and larval developments of ornamental Japanese carp were examined. Female fish used for egg production and the hormones using for the egg production

mentioned in the text, and then fertilization phase which is the first foundation of the creature and some environmental factors affecting this process are described. In this context, after the fertilization formation of freshwater fish, the embryonic developmental stage, fertilized egg, cleavage, morula, blastula, gastrula, embryonic body formation, optic vesicle and auditory vesicle formation, blastopore closing, tail formation and hatching stages were examined. In the period of larval development after hatching, until the end of the yolk sac absorption period (pre-larvae) and subsequently until the end of metamorphosis (post larval) formations are shown [2].

MATERIAL AND METHODS

The research was carried in the Experimental Station from the Department for Aquaculture and Fishing, the Faculty of Food Science and Engineering. Mature and healthy koi carp breeders (600 – 800 g), one female and two males, were selected according to sexual dimorphism for the

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breeding experiment. Seven days before being subjected to reproduction, the breeders were separated by sex, in a recirculating system consisting of four tanks. The females are usually easier to identify, as the belly of a mature female is generally larger, whereas the male remains streamlined and more torpedo shaped. Breeders were weighed and doses calculated: 3 mg/kg body for females and 2 mg/kg body for males. For both sexes, the pituitary extract was prepared with saline water and was applied in a single dose. After the injection, the breeders were reintroduced in the recirculating system.

The next morning at 8.30, the collection of the seminal products was made. To extract sexual elements, the breeders were immobilized in a relatively oblique position, head up and genital orifice oriented toward the collecting bowl, while smoothly massaging their abdomen. The handling of the breeders was done without anaesthesia, being facilitated by wrapping them in a damp cloth.

Eggs were collected in a plastic vessel and fertilized using the Vraski "dry method" [3]. The incubation took place in a Zug-Weiss incubator. Egg samples were taken every 30 minutes after fertilization. The description of the developing stages was made by examining live specimens under a Holland microscope and taking microphotographs (developmental stages of eggs and larvae - fig. 1 and 2). [4]. The larvae were fed pellets three times a day (at 8 and 12 a.m. and 4 p.m.) *ad libitum* after yolk.

RESULTS AND DISCUSSIONS

After fertilization the eggs swell. According to Stroband et al. 1992, 1995, Stevens et al., 1996, cited by Carine Stevens et al. (1998)[5], carp embryonic development is similar to the thoroughly studied by Kimmel et al. (1995) in the zebra-fish, *Danio rerio*. The embryonic development of the koi carp was divided into six periods [6]: zygote, cleavage, blastula, gastrula, segmentation, and pharyngula and hatching period. Each period is divided into more stages, presented in table 1. The cleavage was typically meroblastic and the first division (2-celled stage) occurred 40 minutes after fertilization, followed by the second cleavage, completed 50 minutes after fertilization. The 16-celled stage was reached an hour and 35 minutes after fertilization. Yolk invasion started 6 hours and 15 minutes after fertilization and completed 10 hours and 20 minutes after fertilization. The head and the tail of the embryo became distinguishable at the end of the gastrula stage. The notochord could be clearly seen 15 hours after fertilization, with 22 identifiable somites, the beginning of lens and heart formation being almost complete. 20 hours after fertilization, the caudal region detached from the yolk mass and became free.

In the final stage of the embryonic development, the growing embryo occupied the entire previtellic space; it exhibited frequent twitching movement by lashing the tail against the egg capsule.

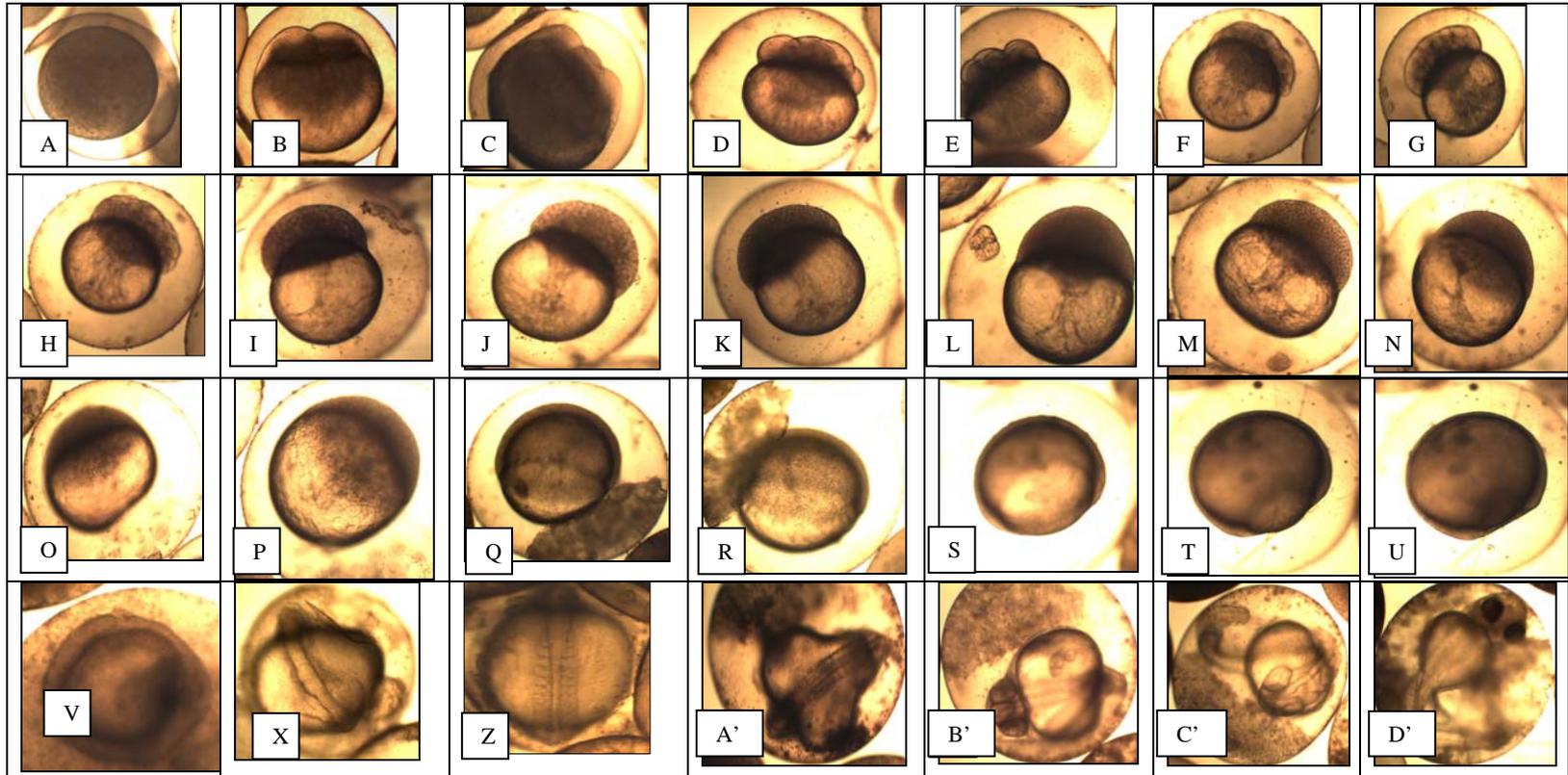


Fig. 1 The embryonic development stages A – zygote period; B – G- cleavage period; B – 2 blastomeres stage; C – 4 blastomeres stage; D – 8 blastomeres stage; E – 16 blastomeres stage; F – 32 blastomeres stage; G – 64 blastomeres stage; H – O – blastula period; H – 128 blastomeres stage; I – 256 blastomeres stage; J – 512 blastomeres stage; K – 1000 blastomeres stage; L – hight stage; M – oblong stage; N – sphere stage; O –dome stage; P – 30% epiboly stage; Q – U – gastrula period; Q -50% epiboly stage; R – germ-ring stagy; S – 75% epiboly stage; T – 90% epiboly stage (yolk plug); U – bud stage; V – A’ – segmentation period; V – the first somatic furrow; X – the optic primordium; Z – 14–19 somites stage; A’ – 20-25 somites stage; B’ – C’- pharyngula period; D’ – hatching period

After a few seconds pause, this movement suddenly culminated in a violent jerk breaking of the previtelline membrane and the hatchling emerged, tail first. Hatching occurred 50-58 hours after spawning and the hatchlings were transparent, characterized by the presence of an almost round yolk sac. The hatchlings

ranged between 2.7 and 2.9 mm in length and tried to hide in any refuge they could find. At this developmental stage, they have no swim bladder, mouth or vent. They breathe by absorbing oxygen through the fine blood capillaries that surround the yolk sac still attached to the gut.

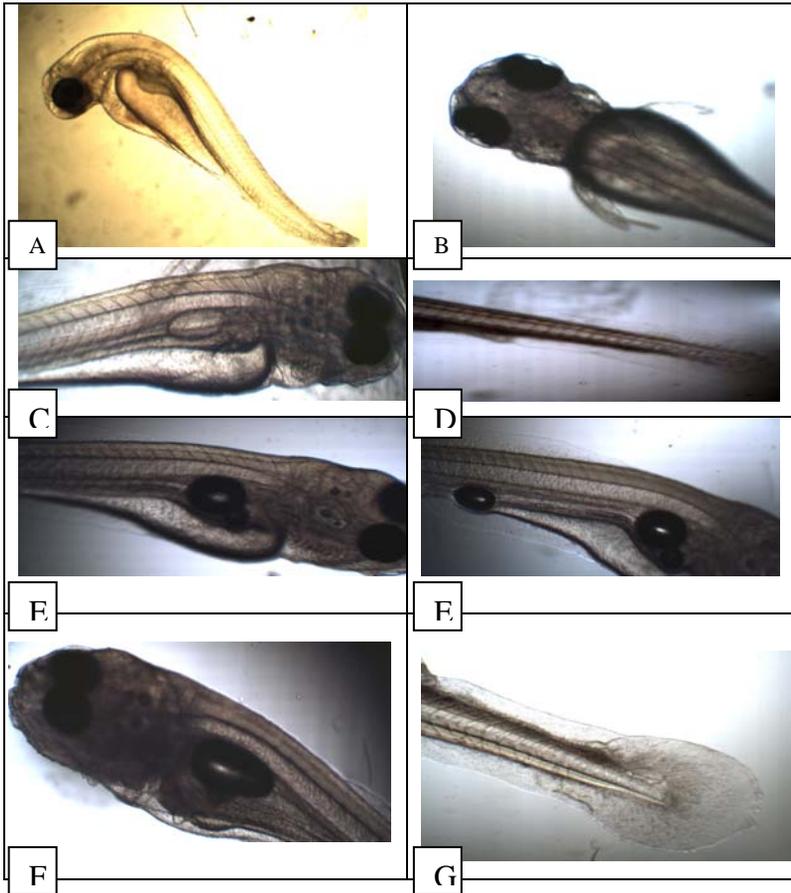


Fig. 2 The ornamental Japanese carp larvae

A - early larva; B - 2 days old larva; C,D - 3 days old larva; E, F - larva at 80 h after hatching; F,G - 7 days old larva

The head of the hatchling was noticed above the yolk sac and the brain was clearly visible. 6-8 hours after hatching, the fine folds were seen continuously around the tail. 2 days later, the hatchlings swam freely, and the next day, the larvae started exogenous feeding with pellets.

By day 3 the hatched larva has completed most of its morphogenesis, and it continues to grow rapidly. Prominent changes during the next days include the inflation of the swim bladder and the continued anterior-dorsal protrusion of the mouth.

CONCLUSIONS

A fundamental goal in population dynamic is to understand the processes that influence which individuals survive through to reproduction. Mortality schedules are closely linked to the life-history characteristics of the organism and its mode of reproduction.

This study provides a complete description on embryonic development at ornamental Japanese carp depending on temperature and the most important aspect regarding the early development larvae.

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