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Embryonic development of cobia, *Rachycentron canadum* (Linnaeus,1766) in controlled conditions

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Original Article

Abstract

Cobia, *Rachycentron canadum* has emerged as a global species for aquaculture in the recent past. Eventhough seed production of cobia is being practiced at many tropical countries, there is very little information on the embryonic development of the species. The details of fertilized eggs, cleavage, embryonic phases and newly hatched larva are documented with photographs. The experiments were carried out at a temperature range of 28.5-30°C. The average diameter of the freshly spawned eggs ranged from 1.1 to 1.2 mm. The time of different stages of development after fertilization is provided. The larva hatched out after 22 hours of fertilization. The total length of the larvae ranged from 2.2 to 2.7 mm. The newly hatched larva was without mouth opening and with a prominent oil globule. The description given in the paper can be made use of in the larval production of cobia in hatcheries.

Keywords: *Cobia, Rachycentron canadum, embryonic development, newly hatched larva.*

Introduction

Cobia aquaculture has been expanding in many tropical countries during the recent past mainly due to its fast growth rates and good meat quality. The success of cobia farming in Taiwan (Yeh, 2000; Su *et al*., 2000; Liao and Leano, 2005) has led to the rapid expansion of cobia farming throughout Southeast Asia, the Americas and Carribian regions (Benetti and Orhun, 2002; Kaiser and Holt, 2004; Schawrz *et al*., 2006,2007; Benetti *et al*., 2008; Nhu *et al*., 2010;2011). Realising the potential of cobia farming in India, the Central Marine Fisheries Research Institute (CMFRI) focused research attention on the broodstock development of cobia and the first successful spawning was obtained in March 2010 (Gopakumar *et al*., 2011). Literature on the embryonic development of cobia is rather scanty and hence a stage by stage description of the same along with photographs is presented in the paper.

Material and methods

Induced spawning was carried out in the selected broodstock fishes of cobia which were reared in sea cages at Mandapam, Tamil Nadu, India. The female showing intra-ovarian egg diameter of 700μ size with a migratory nucleolus stage were selected and administered with human chorionic gonadotropin (hCG – FERTIGYN, Unimed Technologies Ltd., Gujarat, India)

for induced spawning experiments at a dosage of 500 IU per kg body weight and at the rate of 250 IU per kg body weight for male. Human chorionic gonadotropin (hCG) was used for induction because it acts much faster, via direct stimulation of the gonad, in inducing FOM, spermiation and spawning. The spawning occurred at 39 hours after hormonal induction. The floating eggs were collected using 500 μ mesh and introduced in the incubation tanks of 5 tonne capacity each. The water temperature recorded in the incubation tank ranged from 27 - 29°C, pH: 8.2, and salinity 32-35 ppt. The fertilized eggs were regularly examined under the microscope for recording all the embryonic developmental stages. The microphotographs were taken using a trinocular microscope attached with a digital camera.

Results and discussion

The developmental stages of the embryo are presented in Fig. 1a–1p. The time of different embryonic stages after fertilization is given in Table 1.

Fertilized egg

Eggs were perfectly spherical, translucent, buoyant and non-adhesive. The diameter ranged from1.0 to 1.1 mm. Each egg had one conspicuous oil globule (Fig. 1a).

Cleavage

The first cleavage began at approximate 20 minutes after fertilization which resulted in two cells / blastomeres of equal size (Fig. 1b). The second cleavage was observed at about

Fig.1: Embryonic developmental stages of cobia

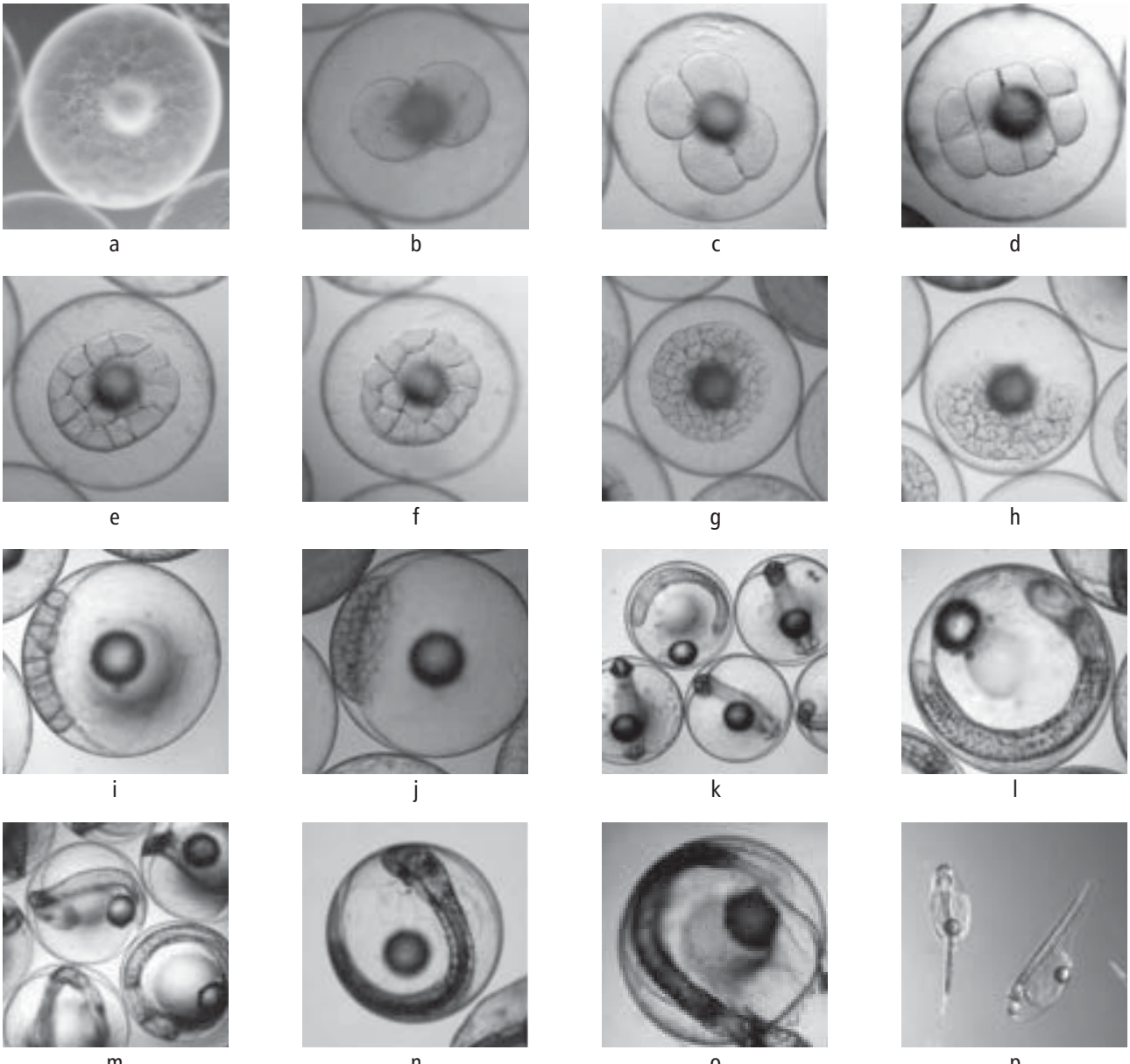

Table 1 Time of different embryonic stages after fertilization in cobia

Fig.No.1	Stage of development	Time after fertilization
a.	Fertilized egg	0:00 h
b.	2-cell stage	0:20 h
c.	4-cell stage	0:40 h
d.	8-cell stage	1:00 h
e.	16-cell stage	1:20 h
f.	32-cell stage	1:40 h
g.	64-cell stage (Morula)	2:30 h
h.	Blastula	3:15 h
i.	High-dome (high mound of cells before gastrulation)	4:30 h
j.	Early gastrula	7:00 h
k.	Late gastrula	13:00 h
l.	Bud	16:00 h
m.	Segmentation	18:00 h
n.	High-pec (dechorionated embryo)	20:00 h
o.	Hatching	21:00 h
p.	Newly hatched larva	22:00 h

40 minutes after fertilization resulting in 4 cell stage (Fig. 1c). Subsequent cleavage occurred approximately after one hour which resulted in 8 cells (Fig. 1d). The 16-cell and 32 cell stages were observed at 1 hour 20 minutes and 1hour 40 minutes, respectively (Fig. 1e and f).

The first 4 cleavages were synchronous resulting in the formation of 16 cells. At 5th cleavage, the first horizontal orientation of cleavage plane occurred and resulted in 2 tiers of cells (Fig. 1f). Cleavages after 32 cell stage were meta-synchronous resulted in a multi-tiered mount of cells and resulted in morula stage at about 2 hours 30 minutes after fertilization (Fig. 1g). The blastula stage reached after 3 hours 15 minutes after fertilization (Fig. 1h).

Gastrula

Gastrulation started with a high dome of blastoderm cells sitting on top of the yolk sphere (Fig. 1i). The high blastula stage was observed at 4 hours 30 minutes after fertilization. The blastoderm thins as it moves down the yolk until the eggs looks spherical (Fig. 1j). The gastrulation movements started 7 hours after fertilization and it continued up to 13 hours to reach late gastrula stage and the embryonic area was well marked (Fig. 1k).

Embryonic body formation

Organogenesis of the embryo became clearly distinguishable at about 16 hours after fertilization with the appearance of head and tail buds. The brain region began to form anteriorly while the tail bud at the posterior end. The pigmentation on the embryonic body was prominent at this stage (Fig. 1l). The cephalic vesicle, optic vesicles and eye rudiment could be identified at about 18 hours after fertilization (Fig. 1m). At about 20 hours after fertilization embryo started detaching from the chorion (Fig. 1n) and the hatching process started at 21 hours after fertilization (Fig. 1o).

Newly hatched larvae

At about 22 hours after fertilization, the larvae hatched out. The newly hatched larvae measured 2.2-2.7 mm TL (Fig. 1p). Larvae had large oval shaped yolk with an oil droplet at the posterior end. The mouth opening was not yet formed.

The present description of embryonic development of cobia is similar to those described for labrid fish, *Halichoeres poecilopterus* (Kimura and Kiriyama, 1993), *Dentex gibbosus*, (Palacios *et al*., 1994), dusky grouper, *Epinephelus marginatus* (Glamuzina *et al*., 1998), goldblotch grouper, *Epinephelus costae* (Glamuzina *et al*., 2000), gilthead sea bream, *Sparus*

Table 2: Timing and temperature of hatching in other marine fishes

Species of fish	Time until hatching (h)	Hatching temperature	Reference
Halichoeres poecilopterus	19	23.4 °C	Kimura and Kiriyama, 1993
Dentex gibbosus	35	20.0 °C	Palacios *et al*., 1994
Epinephelus marginatus	30	23.0 °C	Glamuzina *et al*., 1998
Epinephelus costae	24	25.5 °C	Glamuzina *et al*., 2000
Sparus aurata	53	18.5 °C	Kamaci *et al*., 2005
Gadus morhua	330	6.5 °C	Avery *et al*., 2009
Liza ramada	48	21.0 °C	Mousa, 2010
Labrus viridis	127	14.5 °C	Kozul *et al*., 2011
Rachycentron canadum	22	28.0 °C	Present study

aurata (Kamaci *et al*., 2005), Atlantic cod, *Gadus morhua* (Avery *et al*., 2009), thin lipped grey mullet, *Liza ramada* (Mousa, 2010) and green wrasse, *Labrus viridis* (Kozul *et al*., 2011). The timing and temperature of hatching in other marine fishes are given in Table 2. However, variations in time of different developmental stages after fertilization were noted. This may be due to the difference in the incubation temperatures. The detailed description of embryonic development of cobia in this communication will be of applied value in cobia hatcheries due to its aquaculture importance.

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