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

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Abstract

Cobia, *Rachycentron canadum* has emerged as a global species for aquaculture in the recent past. Even though seed production of cobra 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 cobra 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 cobra farming in Taiwan (Yeh, 2000; Su *et al.*, 2000; Liao and Leano, 2005) has led to the rapid expansion of cobra farming throughout Southeast Asia, the Americas and Caribbean regions (Benetti and Orhun, 2002; Kaiser and Holt, 2004; Schwatz *et al.*, 2006, 2007; Benetti *et al.*, 2008; Nhu *et al.*, 2010, 2011). Realising the potential of cobra farming in India, the Central Marine Fisheries Research Institute (CMFRI) focused research attention on the broodstock development of cobra and the first successful spawning was obtained in March 2010 (Gopakumar *et al.*, 2011). Literature on the embryonic development of cobra 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 cobra 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 from 1.0 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
Table 1: Time of different embryonic stages after fertilization in cobia

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

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 1 hour 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 metasynchronous 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

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

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


