Corresponding Author : Hye-Sung Choi, Tel : 055-641-2142, Fax : 055-641-2036, E-mail : hs1080@hanmail.net

Water quality and bacterial counts in hatchery of Rockbream, *Oplegnathus fasciatus*

**Hye Sung Choi**, Tae Seok Moon* and Young Chul Park**

*Aquaculture and Environment Institute, National Fisheries Research & Development Institute, Tongyeong, Gyeongnam 650-943, Korea
*Jeju Fisheries Institute, NFRDI, Jeju 690-192, Korea
**Inland Aquaculture Research Institute, NFRDI, Jinhae, Gyeongnam 645-806, Korea

To investigate the cause of the mass mortality during rockbream, *Oplegnathus fasciatus* seed production, the water quality and bacterial counts of sea water in breeding tanks was measured 20 days post the hatch. During breeding of rockbream fry, the environmental factors of water quality were detected as pH, ammonia COD, phosphate at the supply of the food organisms and the seawater.

pH was decreased from the 8.21 of the 1 day per hatch (dph) to 7.56 of the on the 7 dph. Ammonia was conversely increased 0.49 ppm of the 1 dph to 0.85 ppm of 10 dph. As the adding of the chlorella and the rotifer tanks, COD was increased the 3.3 times and 1.2 times than those of pre-adding respectively. The phosphate and the ammonia were also increased 1.7 and 2.3 times, with adding the chlorella respectively, which exceeded the second grade for sea water evaluation level, 0.015 ppm and 0.1 ppm respectively. Water quality was not improved by PSB (Photosynthetic Bacteria) treatment, which increased the value of COD in 1.7 times, phosphate in 2.7 times and ammonia in 1.4 times.

The number of the bacteria was also increased along the dph. According to the treatment of chlorella, the number of total bacteria increased in 1.4 times and those of *Vibrio* sp. 1.6 times.

The lethal concentration of ammonia was investigated that over than 10 ppm could killed the fry of rockbream within 28 hrs, but 40% in 2 ppm.

**Key words**: Rockbream, *Oplegnathus fasciatus*, Hatchery, Water quality, Bacterial counts

Corresponding Author : Hye-Sung Choi, Tel : 055-641-2142, Fax : 055-641-2036, E-mail : hs1080@hanmail.net
전하여 최근에는 민간양식업체에서도 돌돔의 종묘생산을 하고 있다. 그러나 현재까지 확립된 기술로는 종묘생산 초기단계에서 원인불명의 대량 폐사 현상이 발생하여 대량생산 계획에 차질을 가져오는 경우가 자주 일어나고 있다.

본 연구는 돌돔 종묘생산 과정에서 부화 후 20일 전후에 발생하는 대량 폐사 현상에 중점을 두고 그 원인과 관련이 있을 것으로 추정되는 사육수질의 영향과 일반 세균수를 조사하여 그 결과를 분석하였다.

재료 및 방법

본 조사는 돌돔 종묘생산 시기인 6월 1일부터 6월 30일까지 약 30일간에 걸쳐서 경남 통영시 신양읍 소재 해산 어류 종묘배양장에서 사육 중인 돌돔 지어, 사육 해수 및 자연 해수를 대상으 로 하였다.

사육수질 조사

사육수질의 측정은 국립수산진흥원 해양오염 및 적조조사 지침 (1985)의 방법에 따라 실시하였으며 돌돔 사육수의 수온은 현장에서 수온봉상 온도계로 측정하였으며, 염분은 현장에서 채취 한 해수를 염분계 (minisal 2000, CANADA)로 측정하고 %로 표시하였으며 pH는 Dms-digital pH/ION meter (Model Dp-135)를 사용하여 측정하였고 암모니아농도 (NH₄-N)는 Indophenol법에 의해 비색 정량하였다.

Table 1. Process of rockbream, Oplegnathus fasciatus fry production in pilot scale hatchery

<table>
<thead>
<tr>
<th>Days after hatching (day)</th>
<th>Water supply in rearing tank</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>No</td>
</tr>
<tr>
<td>11-23</td>
<td>0.5 cycle/day</td>
</tr>
<tr>
<td>24-29</td>
<td>0.7 cycle/day</td>
</tr>
<tr>
<td>After 30</td>
<td>1.0 cycle/day</td>
</tr>
</tbody>
</table>

세균조사

세균수의 조사는 Muroga 등 (1987)의 방법에 따라 평판배지도말법에 의해 조사하였다. 즉, 300 ml 면균 용리병에 사용수를 체수하여 실험실에서 10배 단계회석법을 사용하여 총균수는 Marine agar 2216e (DIFCO, USA) 평판배지에, 비브리오균수는 TCBS (DIFCO, USA) 평판배지에 접종한 다음 25°C에서 48시간 배양한 후 세균수를 구하였다.

사육방법

일반적으로 돌돔 초기 사육 방법은 Table 1과 같이 주어의 크기가 매우 작아 부화 후 10-14일 간은 환수를 하지 않으나 이후부터는 수심을 증가시키켜 사육 방법을 실시하고 있어 이러한 사육 방법이 폐사와 관련이 있을 것이라는 가정하에 사육 수질과 사육수의 세균 수를 조사하였다.

암모니아 농도별 돌돔 폐사 시험

사육수의 암모니아농도가 돌돔사육 대량 폐사에 미치는 기초 조사를 위해 상법에 따라 염화 암모늄 (NH₄Cl)으로 해수의 암모니아 농도를 단계별 조절하여 부화 후 5일일 돌돔의 폐사율을 조사하였다.

결과 및 고찰

돌돔 사육수의 수질 변화

돌돔 부화 경과 일수별 수질 변화는 Fig. 1과
같이 pH는 3일 와 21, 9일 7.56으로 감소하였으며 암모니아는 3일 0.49 ppm, 12일 0.85 ppm으로 증가하였다가 이후 감소하였다. 이것은 돌돔 종묘 생산시 일반적으로 1일 전후에 환수를 시작하므로 해수 교환에 유해에 영향을 미친 것으로 판단된다.

Table 2에서와 같이 돌돔 재어 사육수는 수조내 클로렐라를 청가 하기 전의 COD가 0.69 mg/l에서 청가 후 2.26 mg/l로 3.3배 증가하였다. 그리고 로티어 청가 후에는 약 1.2배 증가하여 클로렐라 청가가 로티어 청가보다 사육수의 COD 변화에 영향을 줄 것으로 나타났다. 인산염과 암모니아는 클로렐라 청가 전에 각각 0.06, 0.22 ppm이던 것이 청가 후 각각 0.10, 0.51 ppm으로 1.7배, 2.3배 증가하였다. 그러나 로티어 청가 후에는 뚜렷한 변화가 없어 클로렐라 청가가 사육수질의 변화가 큰 영향을 미치는 것으로 판단된다. 또한 사육수의 영양열은 국립수산진흥원

Fig. 1. Variation of water quality on the days after hatching.

**Table 2.** The effect of the food organisms supply in the breeding tanks seawater quality of rockbream, *Oplegnathus fasciatus*

<table>
<thead>
<tr>
<th>Division</th>
<th>W.T(℃)</th>
<th>Salinity (%)</th>
<th>pH</th>
<th>COD (mg/l)</th>
<th>PO-P (ppm)</th>
<th>NH-N (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorella</td>
<td>Before</td>
<td>23.5</td>
<td>33.81</td>
<td>8.13</td>
<td>0.69</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>After</td>
<td>23.5</td>
<td>33.87</td>
<td>8.22</td>
<td>2.26</td>
<td>0.10</td>
</tr>
<tr>
<td>Rotifer</td>
<td>After</td>
<td>23.5</td>
<td>33.88</td>
<td>8.21</td>
<td>2.59</td>
<td>0.08</td>
</tr>
</tbody>
</table>

**Table 3.** The effect of the change cycle per day on the breeding seawater quality of rockbream, *Oplegnathus fasciatus*

<table>
<thead>
<tr>
<th>Change the quality of seawater (Cycle/day)</th>
<th>W.T(℃)</th>
<th>Salinity (%)</th>
<th>pH</th>
<th>COD (mg/l)</th>
<th>PO-P (ppm)</th>
<th>NH-N (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>23.5</td>
<td>32.50</td>
<td>8.14</td>
<td>3.85</td>
<td>0.45</td>
<td>2.43</td>
</tr>
<tr>
<td>0.5</td>
<td>24.0</td>
<td>33.27</td>
<td>8.08</td>
<td>3.00</td>
<td>0.22</td>
<td>2.15</td>
</tr>
<tr>
<td>1.5</td>
<td>23.5</td>
<td>33.80</td>
<td>8.03</td>
<td>1.12</td>
<td>0.06</td>
<td>0.25</td>
</tr>
</tbody>
</table>
(1985) the heayomel and fraction was the result of a pH
II ammonium ion was 0.48 μg/ml (0.015 ppm).
and COD 0.1 ppm were found in the water samples.
and COD 1.7 ppm were lower than before the treatment.
and COD 2.7 ppm were found in the water samples.
and COD 1.4 ppm were found in the water samples.
and COD 1.2 ppm were found in the water samples.
and COD 2.3 ppm were found in the water samples.
and COD 1.6 ppm were found in the water samples.
and COD 0.2 ppm were found in the water samples.
and COD 1.4 ppm were found in the water samples.
and COD 1.1 ppm were found in the water samples.
and COD 0.48 ppm were found in the water samples.
and COD 0.1 ppm were found in the water samples.
and COD 0.54 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 1.69 ppm were found in the water samples.
and COD 0.54 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 0.20 ppm were found in the water samples.
and COD 2.19 ppm were found in the water samples.
and COD 8.01 ppm were found in the water samples.
and COD 3.355 ppm were found in the water samples.
and COD 23.5 ppm were found in the water samples.
and COD 23.5 ppm were found in the water samples.
and COD 33.64 ppm were found in the water samples.
and COD 8.19 ppm were found in the water samples.
and COD 23.5 ppm were found in the water samples.
and COD 8.19 ppm were found in the water samples.
and COD 2.71 ppm were found in the water samples.
and COD 2.71 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
and COD 2.44 ppm were found in the water samples.
Table 6. Bacterial counts of rockbream, Oplegnathus fasciatus breeding seawater by after hatching

<table>
<thead>
<tr>
<th>Days after hatching</th>
<th>Bacterial counts (cfu/mL)</th>
<th>Change seawater (cycle/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Vibrio sp.</td>
</tr>
<tr>
<td>2</td>
<td>$1.5 \times 10^4$</td>
<td>$4.0 \times 10^3$</td>
</tr>
<tr>
<td>7</td>
<td>$1.5 \times 10^4$</td>
<td>$3.4 \times 10^3$</td>
</tr>
<tr>
<td>8</td>
<td>$4.0 \times 10^4$</td>
<td>$4.2 \times 10^3$</td>
</tr>
<tr>
<td>10</td>
<td>$2.3 \times 10^4$</td>
<td>$5.0 \times 10^3$</td>
</tr>
<tr>
<td>12</td>
<td>$5.1 \times 10^4$</td>
<td>$8.0 \times 10^3$</td>
</tr>
<tr>
<td>14</td>
<td>$1.6 \times 10^4$</td>
<td>$1.0 \times 10^3$</td>
</tr>
<tr>
<td>16</td>
<td>$1.1 \times 10^4$</td>
<td>$2.0 \times 10^3$</td>
</tr>
<tr>
<td>23</td>
<td>$2.0 \times 10^4$</td>
<td>$2.7 \times 10^3$</td>
</tr>
<tr>
<td>29</td>
<td>$1.4 \times 10^4$</td>
<td>$3.8 \times 10^3$</td>
</tr>
</tbody>
</table>

Table 7. The effect of ammonia concentration on the tank water quality of rockbream, Oplegnathus fasciatus hatchery

<table>
<thead>
<tr>
<th>Concentration of ammonia</th>
<th>WT (°C)</th>
<th>Salinity (%)</th>
<th>pH</th>
<th>DO (mg/L)</th>
<th>NO$_2$-N (ppm)</th>
<th>NO$_3$-N (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>21.6</td>
<td>34.56</td>
<td>7.80</td>
<td>5.53</td>
<td>0.01</td>
<td>0.08</td>
</tr>
<tr>
<td>50</td>
<td>21.8</td>
<td>34.31</td>
<td>7.87</td>
<td>5.81</td>
<td>0.01</td>
<td>0.08</td>
</tr>
<tr>
<td>10</td>
<td>22.2</td>
<td>34.11</td>
<td>7.98</td>
<td>5.74</td>
<td>0.01</td>
<td>0.06</td>
</tr>
<tr>
<td>2</td>
<td>22.8</td>
<td>33.96</td>
<td>8.02</td>
<td>6.12</td>
<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>1</td>
<td>28.9</td>
<td>34.27</td>
<td>8.03</td>
<td>4.65</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>control</td>
<td>20.7</td>
<td>33.84</td>
<td>8.01</td>
<td>6.65</td>
<td>0.02</td>
<td>-</td>
</tr>
</tbody>
</table>
요 약

돌돔 차어 종묘 생산장에서 부화 후 약 20일 전후 대량 폐사 현상이 있는 주요 조사를 위해 사육 수질의 영양질 및 일반 세균수와 사육 허수의 영양질 농도별 차이의 폐사율을 조사항 결과는 다음과 같다.

돌돔 부화 경과 일수별 사육수의 pH는 1일 8.21, 7일 7.56으로 일령이 증가함수록 pH는 감소하였으며 암모니아는 1일 0.49 ppm, 10일 0.85 ppm으로 증가하였다.

박이생물이 사육수에 미치는 영향을 조사한 결과 클로렐라 청가전 로터리 청가 후 COD는 3.3배 증가, 사육 허수에 로터리 청가 후 COD는 약 1.2배 증가하였으며 인산염과 암모니아는 클로렐라 청가 후 약 1.7배, 2.3배 증가하여 해역 II등급 기준인 0.015 ppm, 0.1 ppm 을 합친 조화는 없었다.

돌돔 사육수 수질은 저수 사육시 COD는 3.85 mg/l였으며 유수량 증가시 다소 양호해지는 경향이 있었고 저수 사육에 비해 유수 사육시 인산염 암모니아 모두 양호한 경향이 있으나 수질 해역 II등급을 합친 조화는 없었다.

사육 수질의 경화를 위해 사용하는 PSB(영합 생명군)의 1시간 처리 전 및 후의 사육수 수질 변화는 사용 전에 비해 사용 후 COD 1.7배 증가, 인산염 2.7배 증가, 암모니아 1.4배의 증가를 보여 수질 개선효과는 없었다.

사육수의 세균 조사 결과 클로렐라 청가 전 사육수의 총균수는 8.7 × 10^2 cfu/ml, 비브리오균 수 2.7 × 10^2 cfu/ml 클로렐라 청가후 총균수 1.4 배, 비브리오균 수 1.6배 증가하였으며 부화경과 일수에 따라 사육수의 세균 수는 증가하였다.

사육 청수의 암모니아 농도별 돌돔차어(5일 측정)의 폐사율은 100 ppm에서 18시간, 50 ppm에서 20시간, 10 ppm에서 28시간에 100%의 폐사율을 나타내었으며 2 ppm에서 28시간에 40%, 1 ppm에서 28시간에 10%의 폐사를 가져왔다.

감사의 글


참고 문헌


국립수산과학원: 한국연근해 유용어류도감, p
황정규·강용진·이중화·양상근: (III) 물몸종묘생산시험. 남수연사업보고 p 406 ~ 409, 1995.