The Effect of Some Factors on the Mortality of Trochophora of Oyster, *Crassostrea gigas*

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굴, *Crassostrea gigas*, 擔輪子의 致死率에 미치는 몇 가지 環境要因의 影響

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摘 要

仁川產 굴, *Crassostrea gigas*, 擔輪子의 致死率에 미치는 塩度, 溫度, 그리고 混濁度의 影響에 關하여 研究하였다.

1. 正常海水로부터 低塩度 혹은 高塩度인 海水로 옮겨진 굴의 擔輪子는 차차 生命力을 잃었다. 擔輪子의 致死率은 各各 低塩度인 15 ppt에서 46%이었고 高塩度인 35ppt에서는 47%이었다.
2. 高溫度인 40℃ 以上은 正常海水中의 擔輪子에 對하여 致死要因이 있고, 特히 45℃에서는 30分以內에 모두 死亡하였다. 그러나 低溫은 高溫에 比하여 그렇게 致死的인 要因이 아니었다. 各 溫度의 30分과 1時間 處理에서 나타난 두 致死曲線間의 差異는 統計學的으로 有意하지 않았다 ($P>0.05$).
3. 濃混濁度 (1%)는 擔輪子의 致死率에 對하여 處理後 短時間內에는 別로 影響을 주지 않았다.

1. Introduction

It was well known that salinities, temperatures, and turbidities affect the existence and growth of marine young bivalves. A number of studies on the effect of various environmental factors on the mortalities in both young clam and oyster have been reported by many investigators. However, there are few papers on the tolerance of trochophora of oyster to certain salinities, temperatures of both extremities, and turbidities except a study on effect of lowered salinities in larvae of *Ostrea edulis* by Davis and Ansell in 1962. Choi (1965) stated an appearance frequency of veliger stage larvae of the short-necked clam, *Tapes philippinarum*, was highest at a salinity of 30 ppt in July and August, but none of veliger appeared at a low salinity below 12.6 ppt which occurred in a heavy rainy season in Inchon Bay.

In this study, the tolerance of trochophora oyster, *Crassostrea gigas*, to various salinities, temperatures, and turbidities was investigated. In the process of the study, each one of factors was varied without change of other ones at the laboratory.

2. Material and Methods

In order to get the trochophora larvae the mature oysters, *Crassostrea gigas,* were collected from the surface of rocks on the intertidal zone of Jakyak Island near Inchon, Korea. These animals were placed in a round aquarium containing sea water filtered through asbestos. Normal salinity of sea water was approximately 26 parts per thousand (ppt) in Inchon Bay. All the tests were run at room temperature of 28℃ to 30℃.

The sperm suspension was prepared by cutting the gonads of male oysters with sharp scissors in a Petri dish containing normal sea water. The ovaries of female oysters were cut in the sperm suspension and the ripe ova were introduced to sperms. Most ova were fertilized by active sperms immediately. The fertility of ova was identified under microscope. It was observed by naked eye that most eggs were developed into normal trochophora, swimming, at the room temperature the next day. The swimming healthy trochophora free from debris in sea water were transferred to fingerbowls filled with fresh sea water by droppers. Before trochophora ware used as experimental material no food was introduced.

In the first experiment trochophora were put into the sea water of the following salinities: 0, 5, 10, 15, 20, 26(control), 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, and 80 ppt. Salinities of sea water below 26 ppt was made by diluting normal sea water with distilled water, and for salinities above 26 ppt saturated sea water with salt was diluted to the required level of salinities with distilled water. Fifty larvae were used at each level of salinity tests. After 1.5-hour treatment of certain salinity, the number of alive and dead larvae were counted under microscope and the mortality was calculated in percentage. The treatments were repeated eight times at each salinity for the average mortality. Dead larvae did not come to life again.

In the second experiment following temperatures were used to check the mortality: 0, 5, 10, 28 and 30 (control), 35, 40, and 45℃. Each temperature of sea water in a beaker was regulated in water bath and maintained within ±0.5℃ of the desired level. Fifty trochophora were used for each temperature treatment.

Third tests for the different turbidities were conducted at the grades of 0.1, 0.2, 0.4, 0.6, 0.8, and 1.0 per cent of silt. Each turbidity was obtained by adding dry silt into normal sea water. Eighty four larvae were treated for each test of various turbidities.

3. Results and Discussion

Effect of Salinities

The effect of various salinities on mortality of trochophora is shown in Figure 1. All of trochophora survived at control (26ppt) during the experiments. Figure 1 shows mortalities 23% of and 46% at 20 and 15 ppt of lower salinities, and that of 29% and 47% at 30 and 35 ppt of higher salinities respectively after 1.5-hour treatments. It seems that the range of optimum salinity for trochophora life is narrow, and mortalities rapidly increase with either going low or high of salinity. It was found that there was no difference of mortalities between 1-and 2-hour treatments. Davis and Calabrese (1964) reported that optimum salinity for the growth of clam larvae was 27.0 ppt (the highest salinity tested) or possibly higher.

The mortality of trochophora was 63% at 10 ppt of salinity and increased upto 100% at 5 ppt of salinity extremely. It is assumed that trochophora could not survive at low salinity. This result was in agreement with Choi's report (1965) that none of veliger larvae of *Tapes* appeared at a salinity of 12.6 ppt during heavy rainfall in Inchon Bay. Davis and Ansell (1962) reported that larvae of oyster in the 12.5 ppt showed no growth and by ten days after swarming they had suffered 90% or higher mortality, and at 10 ppt all larvae died in less than four days.

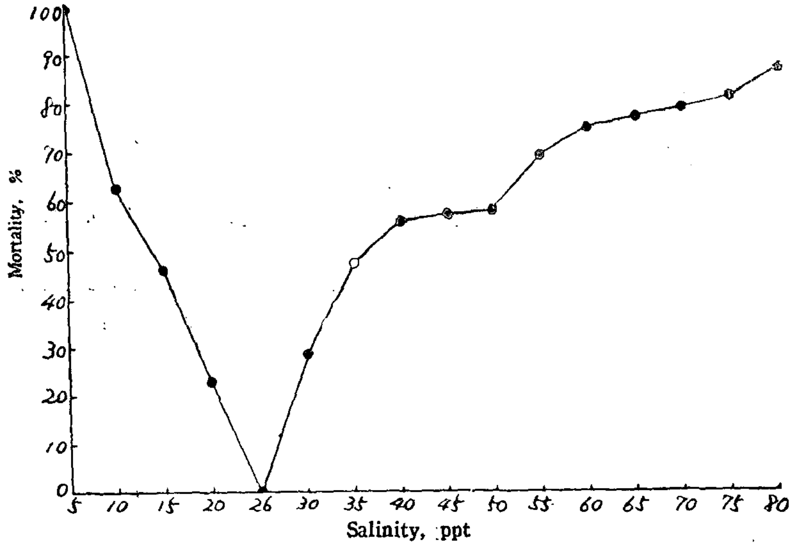

Fig. 1. Mortality curve of trochophora in different salinities at room temperature of 28. 5℃

Mortality showed a gradual increase in the higher salinities from 50 ppt to 80 ppt, and 98% of larvae died at 80 ppt (Figure 1). This means that the higher salinity is not lethal to trochophora in comparison with the lower salinity.

Effect of Temperatures

The mortalities of larvae were not increased over 10% at low temperatures except the 0℃ at which it showed 13% of mortality, in both 0.5-and 1-hour treatments (Figure 2). On the other hand, mortalities were extremely increased in straightforward lines at higher temperatures. All of larvae died at at a temperature of 45℃ within 30 minutes. The differences of the two curves of 0.5- and 1 hour treatments at each level of temperatures were not statistically significant as a result of the t-test ($P > 0.05$, Figure 2). It was found, from Figure 2, that the mortality increased along with the increasing temperature. In this series of experiments it can reasonably be assumed that the difference in mortality is due to the difference of metabolic rates at various temperatures. Present result is similar with

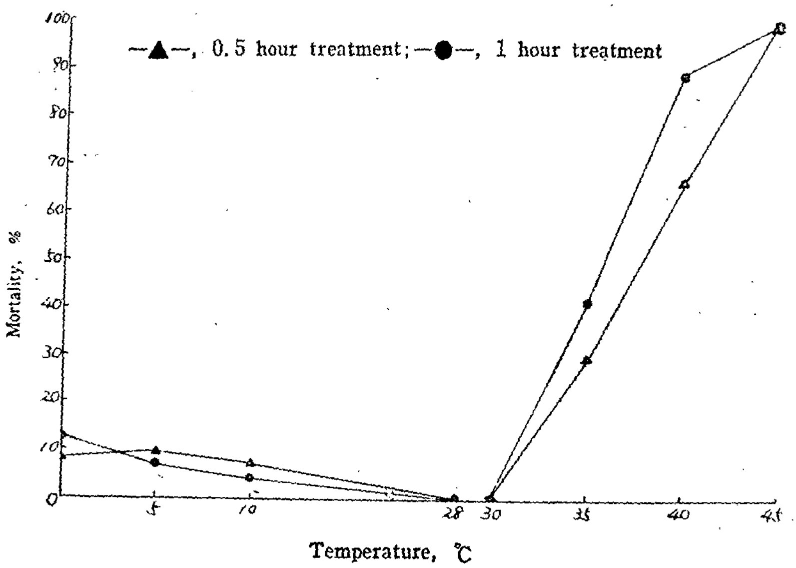

Fig. 2. Mortality curves of trochophora at diterent temperatures (P>0.05).

that of Dav is and Calabrese (1964) which described the optimum temperature for the growth of oyster larvae was between 30 and 32.5℃ at all salinities except 7.5 ppt.

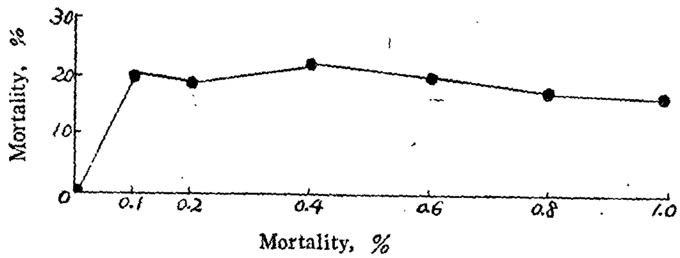

Fig. 3. Mortality curve of trochophora at different turbidities.

Effect of Turbidities

As can be seen from Figure 3, it is hard to recognize any tendency in mortality at various turbidities in 1.5-hour treatments. Mortality varied somewhat erratically at different turbidities. Highest mortality (22%) was found at a turbidity of 0.4 per cent. Especially it was surprising to find that only 13% of trochophora died at a heavy turbidity of 1.0 per cent after 1.5-hour treatment. This fact is different from the reports on the activity of gills of adult oyster and clam. Loosanoff and Tommers (1948) noticed that the pumping action of gills of oyster extremely decreased at the low turbidity (0.3g/l) of silt. Choi and Lee (1961) reported that ciliary activities of young and adult short-necked clams decreased to zero and 2% at a turbidity of 0.8 per cent respectively.

It possibly might be assumed that the silt in water could not affect the physiological activity such as respiration of trochophora in a short period, because silt particles neither adhere on the surface of small larvae nor enter their bodies. It seems, therefore, that mortality of trochophora may not be affected by the suspended silt in a short period in the sea.

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4. Summary

The effect of salinities, temperaturet, and turbidities on the mortality of trochophora of oyster, *Crassostrea gigas,* was investigated at the laboratory.

1. The trochophora of oyster, transferred from normal sea water to sea water of lower or higher salinity, lost their vital activity sooner or later. The mortalities of trochophora were 46% at lower salinity of 15 ppt and 47% at higher salinity of 35 ppt respectively.

2. The high temperature above 40℃ was lethal to trochophora in normal salinity of sea water. Especially all of them died at 45℃ within 30 minutes. However, low temperatures were not lethal to trochophora than higher ones. The differences between two mortality curves at 0.5-and 1-hour treatments at each level of temperatures were not statistically significant as a result of the t-test ($P>0.05$).

3. It was found that the heavy turbidity (1.0 per cent) did not affect the mortality of the trochophora of oyster in a short period.

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