REDUCED pH IMPACT ON EARLY LARVAL DEVELOPMENT OF PACIFIC ABALONE *Haliotis discus hannai*

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ABSTRACT

Abalone is an economic and ecologically valuable calcifying organism, providing food for humans and other organisms, balancing the ecosystem, and offering a microhabitat for other benthic organisms. A reduction in ocean pH caused by increasing atmospheric carbon dioxide (CO_2) absorption by the ocean poses a significant threat to abalone, particularly during the development of early life stages, which are more vulnerable to pH stress. Therefore, this study aims to examine the effect of reducing pH on the early life stages of Pacific abalone (*Haliotis discus hannai*). We exposed abalone eggs and larvae to five pH levels (8.2, 7.9, 7.6, 7.3, and 7.0) and examined the hatching rate, larval development, malformation rate, larval length, and oxygen consumption rate. The hatching rate was observed 24 hours post fertilization (hpf), and the larvae were collected at 24 hpf and 30 hpf to observe larval development, larval length, and oxygen consumption rate. In addition, the malformation rate was observed in 30 hpf larvae. The hatching rate showed no significant difference among the pH treatments. Veliger larvae could still form a normal shell at all pH treatments. Larvae lengths of 24 hpf at pH 7.0, 7.3, and 7.6 were significantly shorter than those of the control. However, only at pH 7.0, the larval length of 30 hpf was significantly shorter than that of the control. Furthermore, the percentage of malformation rate in 30 hpf larvae under pH 7.0 and 7.3 conditions significantly exceeded that in the controls. The oxygen consumption rate of 24 hpf larvae significantly decreased at pH 7.0 and 7.3, while the oxygen consumption rate of 30 hpf larvae significantly decreased at pH 7.0, 7.3, and 7.6. Overall, decreasing the pH to 1.2 units did not impact the hatching rate. However, the early larval development of *H. discus hannai* was highly sensitive to a pH reduction of 0.6–1.2 units from the ambient pH. This may have negative consequences for the persistence of abalone populations in natural and aquaculture environments in the near future.

METHODS

1. Design Experiment

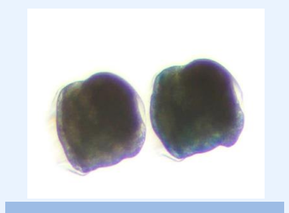
Fertilized Egg

1 L Seawater with various pH (8.2, 7.9, 7.6, 7.3, 7.0)

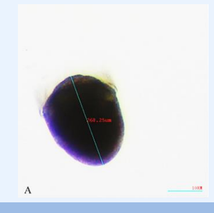
pH adjustment using HCL and NaOH

At 21℃ and 32 psu until 24 and 30 hpf

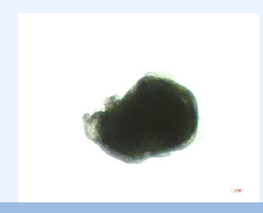
2. Parameters



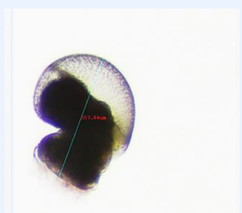
Hatching Rate



Larval length



Malformation rate

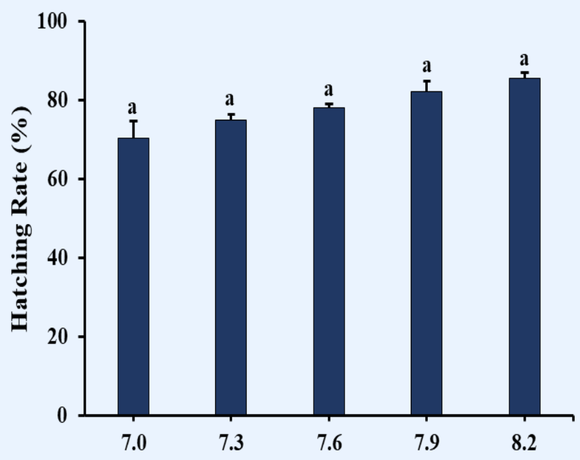


Larval development

Oxygen Consumption Rate

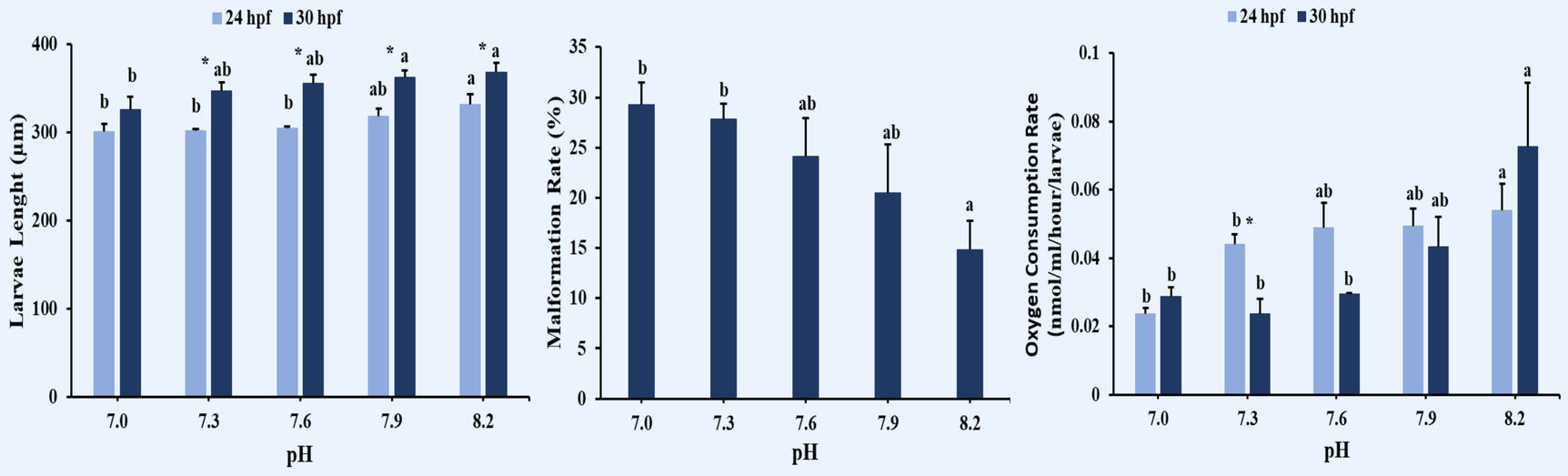
RESULTS AND DISCUSSIONS

Effect Reduced pH on Hatching Rate



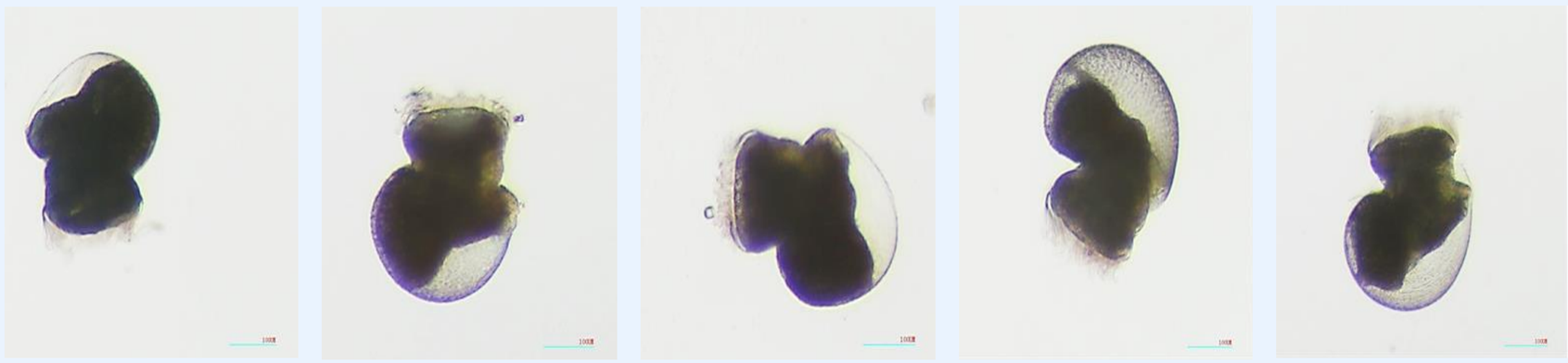
The results showed that a reduced pH of 0.3–1.2 units did not affect the hatching rate. However, acidic pH reduces the larval length and oxygen consumption rate, increasing the malformation rates of Pacific abalone larvae. It may be that alkaline environments are preferable to acidic seawater for calcification. Low pH conditions delay mineralization, result in shorter larval length, and inhibit shell formation. A decrease in metabolic rate in larvae is assumed to be a short-term energy storage mechanism for surviving stressful situations.

Effect Reduced pH on Larval Length, Malformation Rate, and Oxygen Consumption Rate



*Different lowercase letters indicate significant differences between pH levels ($P < 0.05$) for each stage. An asterisk indicate significant differences between larval stages.

Effect Reduced pH on Larval Development



pH 7.0 | pH 7.3 | pH 7.6 | pH 7.9 | pH 8.2

The 30 hpf Larval Development in Various pH Treatments

CONCLUSION

1. Reduced pH until 1.2 units than control did not affect the hacthing rate of Pacific abalone (*Haliotis discus hannai*).
2. Reduced pH from 0.9-1.2 increased significantly the 30 hpf larval malformation rate.
3. a pH reduction of 0.6–1.2 units from the ambient pH can inhibit larval development and oxygen consumption rate.

Acknowledgment

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References

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