

EFFECT OF NA/MG RATIO IN ARTIFICIAL AND NATURAL SEAWATER ON THE HATCHABILITY OF ARTEMIA CYSTS

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Abstract: The experiment was conducted to evaluate the effect of $\text{Na}^+/\text{Mg}^{2+}$ ratio in hatching medium on the hatchability of Artemia cysts, by using artificial seawater formulated at different concentration of Na^+ , Mg^{2+} and different Na/Mg ratio and natural seawater adjusted at different Na/Mg ratio. The results showed Na^+ and Mg^{2+} was the limited factor for Artemia cysts hatching, and the optimum Na/Mg ratio ranged from 6 to 8. It was concluded that the content of Na^+ , Mg^{2+} and the ratio of Na/Mg in the brine are the key factors to affect hatching and growth of Artemia also indicated the ions and trace element in natural seawater could reduce the effect of Artemia cysts.

Keywords: Artemia cysts, Hatching percentage, Sodium ion, Magnesium ion, $\text{Na}^+/\text{Mg}^{2+}$ ratio

INTRODUCTION

The brine concentration is generally considered as an important factor for Artemia cysts hatching. In our previous studies, the remarkable difference on hatching percentage and survival was observed when the Artemia cysts from Karabogazgol (Turkmenistan) were hatched in different brine source with equal salt concentration. The ground-brine (1.5-2 ‰) from Beichen District, Tianjin, China resulted in lower hatching percentage and shorter nauplii survival period (48h) than that in seawater from Bohai Bay at the same condition. The chemical analysis on the ground-brine further indicated that the Na^+ content in ground brine is relatively low, and the $\text{Na}^+/\text{Mg}^{2+}$ ratio is around 2. Moreover, the results from another experiment showed that $\text{Na}^+/\text{Mg}^{2+}$ of 8

significantly improve the hatching percentage of the same batch cysts. Therefore we assume that the content of Na^+ , Mg^{2+} and balance of both ions in the hatching medium could be the limited factors for the hatching of Artemia cysts. The current experiment was design to investigate the optimum $\text{Na}^+/\text{Mg}^{2+}$ in the brine, aiming to improve the hatching percentage of Artemia cysts.

MATERIALS AND METHODS

Preparation of artificial seawater

Artificial seawater was prepared according to the formula given in Table 1. 1.5‰, 3‰, 5‰ seawater with different $\text{Na}^+/\text{Mg}^{2+}$ ratio was obtained according to Table 2.

Table 1 Formulation of the artificial seawater

Composition	Concentration (mg/l)
NaCl	23.610
MgCl ₂	4.913
Na ₂ SO ₄	2.837
MgSO ₄	1.250
CaCl ₂	1.108
NaHCO ₃	1.212
KCl	0.665
KBr	0.096
Total	35.691

Table 2 Composition of artificial seawater with different Na⁺/Mg²⁺ ratio

Na ⁺ /Mg ²⁺	NaCl (g/l)	MgCl ₂ (g/l)	Na ₂ SO ₄ (g/l)	MgSO ₄ (g/l)	NaHCO ₃ (g/l)
0	0	28.523	0	1.250	0
0.5	4.842	23.681	2.837	1.250	1.212
1	9.695	18.828	2.837	1.250	1.212
1.5	12.952	15.571	2.837	1.250	1.212
2	15.289	13.234	2.837	1.250	1.212
4	20.419	8.104	2.837	1.250	1.212
6	22.828	5.695	2.837	1.250	1.212
8	24.227	4.296	2.837	1.250	1.212
10	25.142	3.381	2.837	1.250	1.212
12	25.786	2.737	2.837	1.250	1.212
15	26.460	2.063	2.837	1.250	1.212

Preparation of natural seawater with different Na⁺/Mg²⁺ ratio

The chemical composition of natural seawater obtained from the Bohai Bay was given in Table 3, which was modified with different Na⁺/Mg²⁺ ratio according to Table 4

Table 3 Chemical composition of the natural seawater from Bohai Bay

Salinity °Be'	Ion concentration (g/l)					
	Ca ²⁺	Mg ²⁺	Cl ⁻	SO ₄ ²⁻	Na ⁺	K ⁺
3	0.315	0.985	15.01	2.281	8.332	0.328

Table 4 Modification of natural seawater with Na⁺/Mg²⁺ ratio

Compounds	MgCl ₂ (g/l)							NaCl (g/l)		
Amount	61.336	17.873	4.301	2.661	1.575	0.799	0.216	1.356	8.866	16.378
Na/Mg	0.5	1.5	4	5	6	7	8	9	12	15

Hatching of Artemia cysts

Artemia cysts from Karabogazgol, Turkmenistan was used in this study. The hatching of Artemia cysts was performed in an incubator

with a temperature ranging from 28 to 30°C and constant illumination of 2000lux. 25 cysts were incubated in a 1000ml beaker containing 500ml of artificial seawater and natural seawater with different Na⁺/Mg²⁺ ratio. Four replicates were set

up for each treatment. The number of newly hatched *Artemia* nauplii and survival nauplii were counted on 24h, 48h and 72h, respectively.

RESULTS AND DISCUSSION

The hatching percentage of *Artemia* cysts in different treatments was shown in Fig.1-4. The hatching percentage in different kinds of artificial seawater showed that the content of Na^+ , Mg^{2+} and $\text{Na}^+/\text{Mg}^{2+}$ ratio had great effect on hatching of *Artemia* cysts. The cysts couldn't hatch out without Na^+ ; and low hatching percentage was found in the medium containing only Na^+ without Mg^{2+} . And nauplii could only survive for 72h. In the condition of both Na^+ and Mg^{2+} existing, $\text{Na}^+/\text{Mg}^{2+}$ ratio remarkably affected the hatching of the cysts, which reached to the maximum at $\text{Na}^+/\text{Mg}^{2+}$ of 6-8. However, $\text{Na}^+/\text{Mg}^{2+}$ of more than 15 affected not

only the hatching percentage but also the survival of the nauplii.

Compare with artificial seawater, except for the higher hatching percentage, changing $\text{Na}^+/\text{Mg}^{2+}$ ratio in natural seawater did not significantly influence the hatching of *Artemia* cysts. And the hatching percentage was relatively high at $\text{Na}^+/\text{Mg}^{2+}$ ratio ranging from 4 to 9. This may be because that there are many ions and trace elements in the natural seawater, which could reduce the effect of $\text{Na}^+/\text{Mg}^{2+}$ during *Artemia* hatching and developing.

In conclusion, the content of Na^+ , Mg^{2+} in the brine are the limited factors to affect *Artemia* growing, Na^+ , Mg^{2+} and $\text{Na}^+/\text{Mg}^{2+}$ ratio have great effect on hatching of *Artemia* cysts.

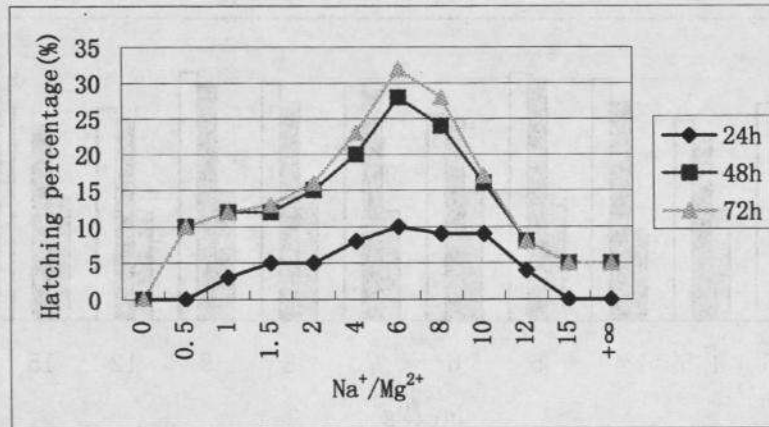


Fig. 1 Hatching percentage of *Artemia* cysts in artificial seawater (1.5°Be') with different $\text{Na}^+/\text{Mg}^{2+}$ ratio

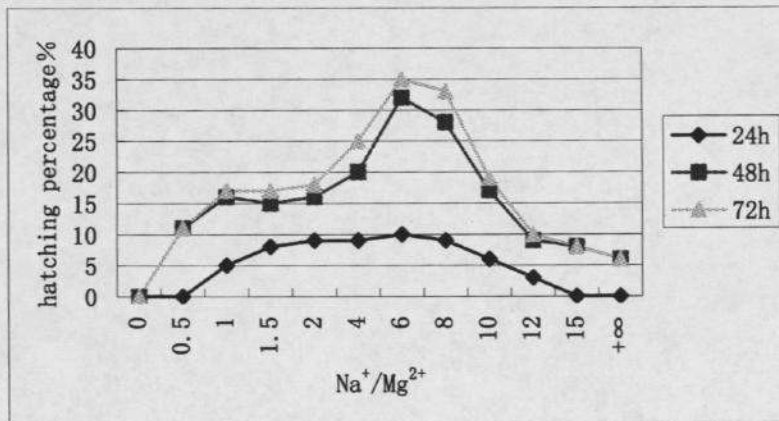


Fig. 2 Hatching percentage of *Artemia* cysts in artificial seawater (3°Be') with different $\text{Na}^+/\text{Mg}^{2+}$ ratio

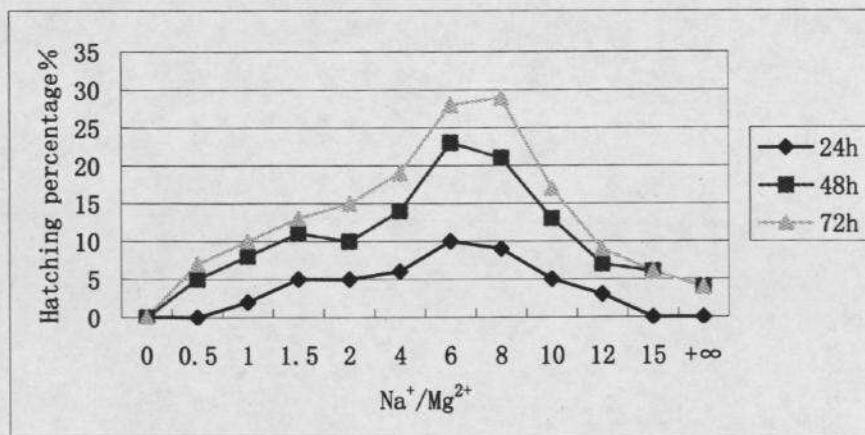


Fig. 3 Hatching percentage of *Artemia* cysts in artificial seawater (5°Be') with different $\text{Na}^+/\text{Mg}^{2+}$ ratio

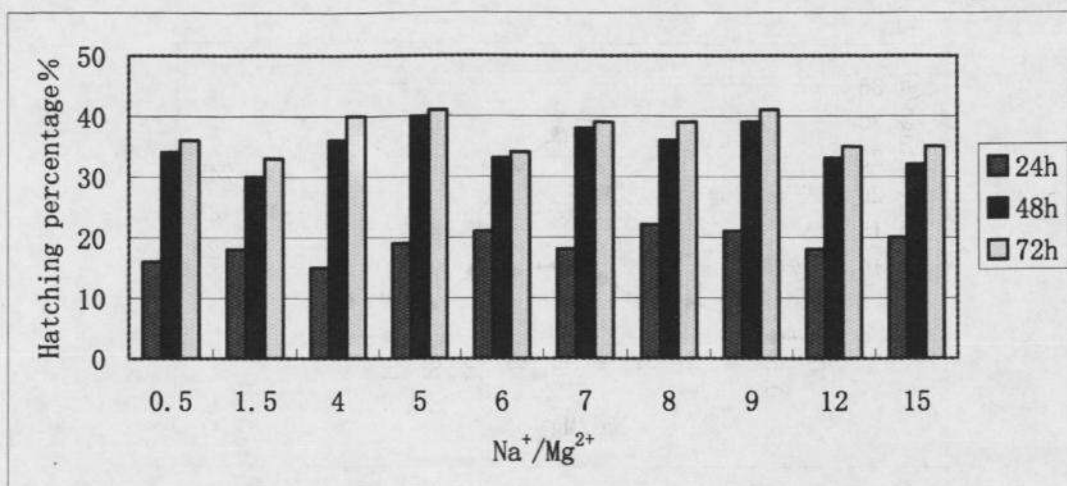


Fig. 4 Hatching percentage of Artemia cysts in natural seawater from Bohai Bay (3°Be') with different Na⁺/Mg²⁺ ratio