European Aquaculture Society EAS Special Publication No. 10 (1989)

FEEDING OF THE BRINE SHRIMP ARTEMIA ON YEAST: EFFECT OF MECHANICAL DISTURBANCE, ANIMAL DENSITY, WATER QUALITY AND LIGHT INTENSITY.

P. Coutteau and P. Sorgeloos

Artemia Reference Center, State University of Ghent, Rozier 44, B-9000 Ghent, Belgium

Introduction

In previous work we have shown that baker's yeast, if chemically treated for improving its digestibility, offers interesting possibilities as a feed for high density culturing of the brine shrimp Artemia (Coutteau et al., 1989). However, the successful production of Artemia on a yeast diet depends on a better knowledge of its feeding biology. Although several authors have studied the feeding behavior of this filter-feeder, little is known about it under tank culture conditions. Therefore, a number of these conditions were simulated in a small scale system and the effects on the feeding rate were investigated.

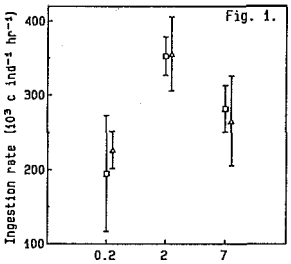
Materials and methods

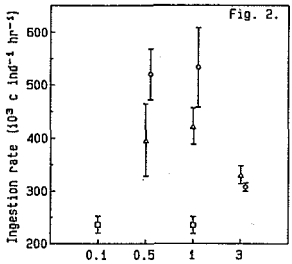
Adult Artemia (GSL or SFB strain) were allowed to graze in the experimental containers for periods ranging from 1 to 5 hours. A chemically treated Saccharomyces cerevisiae (Coutteau et al., 1989) was used as feed. The effect of mechanical disturbance was simulated in 800 ml conical tubes by applying different aeration intensities: flow rates of 0.2, 2 and 7 l/min, respectively, resulted in a weak, moderate or strong agitation of the animals. The effects of the other parameters were evaluated in 170 ml test tubes, rotating at 5 rpm. Different animal densities of 0.1, 0.5, 1 and 3 adults/ml were tested; the first being the standard used in the other experiments. The influence of water quality was studied by exposing the Artemia to ionized ammonia, nitrite or nitrate at concentrations ranging from 1 to 1,000 ppm. All experiments were run in the dark except in those where the light intensity was examined by comparing the grazing in illuminated (fluorescent daylight $\pm$ 3,000 lux) and obscured vessels. Feeding rates were estimated using the "cell-count" method. Counting was done with a Coulter Counter model ZF and ingestion rates were calculated according to the formula of Poulet (1973). The stability of the yeast cell concentration was checked in control vessels without animals. All experiments were run in three replicates and repeated in time with animals originating from a different Artemia culture.

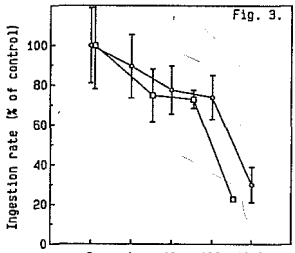
Results and discussion

Fig. 1 shows the results of two independent experiments testing the effect of mechanical disturbance on the feeding rate. The moderate aeration led to a significant (t-test, $P < 0.05$) higher ingestion rate in comparison with the weak (Exp. 1a+1b) and the strong (Exp. 1a) aeration. This reveals that an extreme strong agitation of the culture medium reduces feeding, possibly as a consequence of the loss of food particles from the filtration apparatus. On the other hand, agitation should exceed a minimum value for obtaining a favorable distribution of the grazers over the water volume. The results of the crowding experiments are shown in Fig. 2. There was no significant difference in feeding behavior between 0.1 Artemia/ml and 1 Artemia/ml (Exp. 2a). However, adult brine shrimp were found to consume significantly less at 3 versus 0.5 or 1 Artemia/ml (Exp. 2b+2c). This study cannot reveal to what extent this can be attributed to crowding since high densities implicated low oxygen levels at the end of the grazing test (98, 88, 70 and 31 % saturation for respectively 0.1, 1, 0.5 and 3 Artemia/ml). The results of the experiments testing the influence of water quality were expressed proportionally with regard to the feeding rate measured when no nitrogen compounds were added (Figs. 3 and 4). Fig. 3 demonstrates that the presence of ionized ammonia resulted in lower ingestion rates. During the relatively short exposure periods of the grazing test feeding was only significantly affected by NH_4^+ levels of 1,000 (Exp. 3a) or 340 ppm (Exp. 3b). At the conditions of our experiment (25 °C, seawater 35 ppt, pH 8.2) 4.75 % of the ammonia is present under the form of free ammonia.

Artemia was also ingesting yeast cells at a significantly lower rate in seawater containing nitrite at concentrations of 100 to 1,000 ppm (Exp. 4a+4b). This agrees with the findings of Le Roy (1988) who showed that Artemia is more sensitive to nitrite than to ammonium in chronic toxicity tests. Furthermore, it is possible that a synergistic action of ammonia and nitrite, as observed by Chen et al. (1988) in acute toxicity tests, also occurs with regard to their effect on feeding. For nitrate no significant differences in feeding rate could be detected within the range examined. The rate of food consumption was not found to be significantly different at a light intensity of 3,000 lux versus complete darkness.







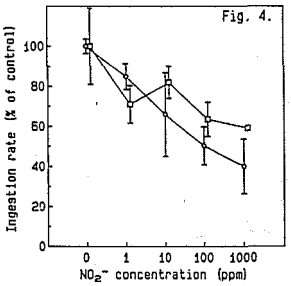


Fig. 1. Effect of mechanical disturbance.
□ : experiment 1a; △ : experiment 1b. (GSL strain).
Fig. 2. Effect of crowding.
□ : experiment 2a; o : experiment 2b; △ : experiment 2c. (GSL strain).
Fig. 3. Effect of ionized ammonia.
o : experiment 3a (SFB strain); □ : experiment 3b (GSL strain).
Fig. 4. Effect of nitrite.
o : experiment 4a (SFB strain); □ : experiment 4b (GSL strain).

Conclusion

In single variate experiments we have demonstrated that mechanical disturbance, animal density and water quality affect the feeding rate in Artemia, although the influence of these culture conditions becomes only important when they measure extreme values. Nevertheless, it should be pointed out that during the intensive production of Artemia, a combination of sub-optimal culture conditions (e.g. high densities, strong agitation, increased levels of ammonia and nitrite) may result in a rate of food consumption that is limiting the growth of the brine shrimp.

Acknowledgements

This study has been made possible thanks to the support of the Belgian National Science Foundation and the Belgian Ministry of Science Policy.

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