Potentials of converting microalgae into brine shrimp Artemia

By P. SORGELOOS

With 1 table in the text

Abstract

High densities of brine shrimp Artemia can be cultured in flow-through systems using the effluent of microalgae cultures as a combined source of culture medium and food. It has been proven at the "St. Croix Artificial Upwelling Mariculture Project" that in comparison with the fast growing clam Tapes japonica, brine shrimp assure a much more efficient conversion of plant into animal biomass. It appears from the given examples that microalgae conversion into brine shrimp Artemia offers efficient and economic applications.

Results

In a joint collaboration with the University of Texas, St.-Croix Marine Station and the Artemia Reference Centre, a flow-through technique was developed for high density culturing of brine shrimp Artemia on live algae (Tobias et al. 1979).

A filter system that is self-cleaning through the effect of an aeration collar retains the animals within the tank whereas faeces, exuvia, and other wastes are drained off with the culture tank’s effluent. As the animals grow, the filter system is removed to change the filter screen for a larger mesh size. Improvements with regard to the filter’s configuration and construction have been published recently (Brisset et al. 1982).

In the St.-Croix experiments two algal ponds (50 m², average depth of 1 m) with Chaetoceros curvisetus culture were maintained in a flow-through state on deep ocean water. Without enrichment and at a turnover rate of one pond per day (= 50 m³/pond/day) cell densities averaged 4 x 10⁵ cells/ml. The algal suspension was pumped into a head box and drained by gravity via a distribution cylinder into the Artemia tanks, where flow-through rates were adjusted to assure 90 % removal of algal cells by the Artemia. As a result of the relatively low cell concentrations in the algae cultures, brine shrimp densities had to be limited to 18 000 animals per litre; i.e. at the end of the culture period retention times had to be limited to a few minutes only so as to prevent food shortages.

Production results extrapolated to a 1 m³ tank averaged 20 kg of adult Artemia biomass (live weight) after 2 weeks of culture, starting with nauplii hatched out of 100 grams of cysts (Roels et al. 1979a).

For many years the St.-Croix Marine Station studied the technical feasibility of converting microalgae into bivalves. This was done in 30-l containers which once a week were cleaned from accumulated faeces and every other week were culled in

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function of the growth rate of the molluscs (Roels et al. 1979b). The production results obtained with the clam *Tapes japonica* (after Laurence et al. 1979) and with the brine shrimp *Artemia* (after Roels et al. 1979c) for a one-year operation under St-Croix culture conditions are compared in Table 1. For *Artemia* only one pond is considered on line since brine shrimp, contrary to molluscs, cannot survive through a starvation period of more than 24 hours, for example during an algal culture collapse.

<table>
<thead>
<tr>
<th></th>
<th><em>Tapes</em></th>
<th><em>Artemia</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Origin of animals</td>
<td>hatchery produced brood</td>
<td>dry cysts</td>
</tr>
<tr>
<td>Number of algal ponds used at a time</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Consumption of plant protein (in kg dry weight)</td>
<td>81.1</td>
<td>36.6</td>
</tr>
<tr>
<td>Culturing system</td>
<td>25 circular tanks (30 l content)</td>
<td>2 rectangular tanks (250 l content)</td>
</tr>
<tr>
<td>Biomass production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- live weight (meat, in kg)</td>
<td>220</td>
<td>285</td>
</tr>
<tr>
<td>- dry weight (in kg)</td>
<td>24</td>
<td>28.5</td>
</tr>
<tr>
<td>- protein weight (in kg)</td>
<td>9.5</td>
<td>16.5</td>
</tr>
</tbody>
</table>

Two ponds could have been considered for *Artemia* with a backup of rice bran distribution (Sorgeloos et al. 1980) during periods of algal food shortage (start up of new culture). With 50% less provision of food more biomass is produced with a higher protein content when valorizing the micro-algae for *Artemia* instead of *Tapes* production. Furthermore, operation and management inputs are much more reduced with brine shrimp than with molluscs, i.e. brood stock has to be maintained and a separate hatchery production with different algae has to be provided for the culturing of molluscs. With *Artemia* one can start with nauplii that are readily available after 24 h incubation of commercially available cysts (Sorgeloos 1980).

**Conclusion**

In conclusion it is clear that *Artemia* biomass production in flow-through culture systems is a very effective and economically attractive technique for the conversion of unicellular algae into animal protein. *Artemia* biomass is in high demand as a source of high quality food in fish and crustacean farming (Persoone & Sorgeloos 1982). Also it could be used as a valuable source of high-quality protein for animal feeding (Gallagher & Brown 1975).

Potential applications of this principle could be conceived in artificial upwelling mariculture (European Oceanic Association, 1979) or with the effluents of tertiary ponds in waste treatment plants (Goldman & Ryther 1976; Milligan et al. 1980) or of fertilized fish/shrimp ponds (Hughes-Games 1977).
Acknowledgement

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References


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