

3rd Meeting of the I.C.E.S. Working Group on Mariculture, Brest, France, May 10-13, 1977.
Actes de Colloques du C.N.E.X.O., 4 : 21-25.

THE USE OF THE BRINE SHRIMP (*ARTEMIA SALINA*) IN AQUACULTURE.

by

P. SORGELOOS[†], M. BAEZA-MESA, F. BENIJTS, E. BOSSUYT, E. BRUGGEMAN,

G. CLAUS, G. PERSOONE, G. VAN DE PUTTE and D. VERSICHELE

State University of Ghent, Laboratory for Biological Research in Environmental Pollution,

B 9000 Ghent, Belgium.

RESUME.

Pour couvrir les besoins en recherche sur l'utilisation pratique du Branchiopode Artemia salina pour l'aquaculture, une équipe scientifique de l'Université d'Etat de Gand (Belgique) étudie les points suivants :

- 1- *Culture de masse automatisée des larves.*
- 2- *Production contrôlée d'oeufs de durée.*
- 3- *Etude comparative des différentes variétés géographiques.*
- 4- *Etude du métabolisme des oeufs de durée.*

ABSTRACT.

In view of the need for research on the practical use of the brine shrimp Artemia salina in aquaculture, our research team at the State University of Ghent (Belgium) is studying the following aspects :

- 1- *The automatized mass-culturing of larvae.*
- 2- *The controlled production of cysts.*
- 3- *The comparative study of geographical strains.*
- 4- *The study of the metabolism of the cysts.*

.../...

[†] "aspirant" at the Belgian National Foundation for Scientific Research (N.F.W.O.).

Since both aquaculture and fish keeping as a hobby expand almost exponentially, it is expected that the provision of *Artemia* cysts, which presently can already not meet the demands any more, will become more and more a bottle-neck in the future.

In view of the crucial importance of the brine shrimp *Artemia salina* for the future developments of fish and crustacean aquaculture throughout the world, our team at the State University of Ghent, Belgium, is focusing on various aspects of the use of *Artemia* in aquaculture. The following research programs are in progress :

THE AUTOMATIZED MASS-CULTURING OF ARTEMIA LARVAE AT HIGH DENSITIES IN PILOT SCALE 2m³ RACEWAYS
(M. BAEZA-MESA, E. BOSSUYT, E. BRUGGEMAN).

In order to produce larvae which are larger than the freshly hatched nauplii and thus have a higher nutritional value, or to produce adults for controlled reproduction (oviparous or ovoviviparous) an air-water-lift operated raceway technique was developed (figures 1 et 2) (MOCK *et al.*, 1975 ; SORGELOOS *et al.*, 1977 a).

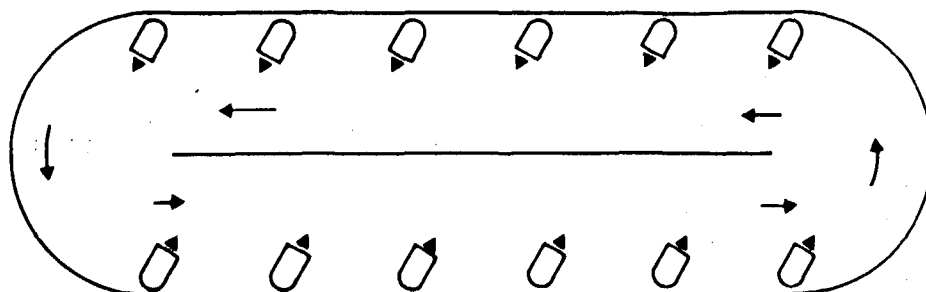


FIGURE 1 : Top view of air-lift-pump operated raceway.

As compared to other methods described in literature for the culturing of *Artemia*, this technique has several advantages : high densities of larvae (up to 3,000 per liter) can be cultured to the adult stage without any dilution nor renewal of the medium ; the oxygen level of the medium can be kept close to saturation and the culturing technique can be automatized.

A 2 m³ pilot-scale model has been built in which a number of determinants (maximal input-output rates of larvae, food conversion efficiencies, cheaper food sources, etc...) are presently analyzed in detail. In view of a possible application to the maintenance of adults over longer periods of time and to the mass production of cysts, water treatment techniques for recycling of the medium are also in progress. (Technical details on the 2 m³ raceway technique can be found in SORGELOOS *et al.*, 1977 a, b).

.../...

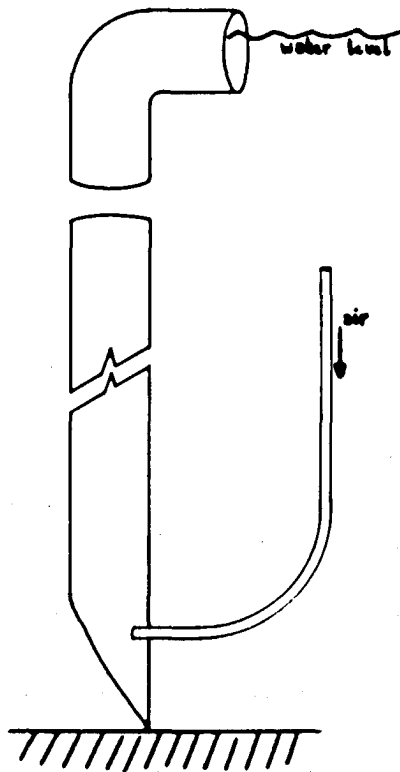


FIGURE 2 : *Disassembled air-lift-pump.*

THE CONTROLLED PRODUCTION OF CYSTS (D. VERSICHELE).

Although it is probable that the production costs of *Artemia* cysts artificially produced will be higher than the price paid for cysts harvested from nature, the study of the oviparous reproduction biology of the brine shrimp is important not only for a better understanding of the cyst production in nature but also and especially for the variety of fundamental research brine shrimp are utilized as a test-organism. Indeed, contrary to cysts harvested in nature, artificially produced cysts have a well-known prehistory, i.e. the abiotic and biotic conditions to which the mother *Artemia* was subjected when producing these cysts, and constitute as such a much more reliable study-material.

At the lab scale we are already able to control the mode of reproduction in *Artemia* populations : the application of cyclic oxygen stresses or the addition to the medium of ferric EDTA, induces the production of haemoglobin and seems to shift reproduction from ovoviviparity to oviparity. Techniques are now worked out to produce cysts in *Artemia* cultures of several hundred liters.

Preliminary data seem to indicate that the F_1 produced cysts can differ considerably from the cysts originating from natural populations (P_1) : e.g. cyst's size, chorion thickness, fatty acid composition, etc...

.../...

The abiotic and biotic parameters which determine these characteristics are now under investigation.

It is well-known that the dormancy of the cysts is discontinued by their transfer in a medium with suitable hatching conditions. The induction to hatch is, however, totally dependent of a previous dehydration of the cysts after their deposition by the female *Artemia*. The critical dehydration levels are now traced in order to work out practical techniques for harvesting and processing of cysts produced indoor.

COMPARATIVE STUDY OF GEOGRAPHICAL STRAINS OF ARTEMIA SALINA (C. CLAUS, F. BENIJTS).

Although brine shrimp populations are found all over the world, cysts are only harvested for commercial exploitation at a few places (especially in North America). The present shortage of cysts, as a consequence, is only temporary since many other sources could be exploited commercially.

At the European level f.ex., many aquaculture farms are complaining of difficulties to obtain good quality cysts, whereas in several European countries there are numerous salterns where *Artemia* cysts can be found (France, Italy, Spain, Portugal, Sardinia, Bulgaria, etc...). It is clear that prior to start commercial exploitation of stocks that are available locally, the quality as well as the quantity of the cysts have to be evaluated. Indeed, from the comparative study which is presently carried out in our laboratory on 50 different strains collected from all over the world, it appears that there are important differences from one strain to another : e.g. cyst's size, chorion thickness, hatching rate, tolerance ranges for survival and growth of the larvae in function of the temperature and salinity of the medium, mode of reproduction (zygogenesis versus parthenogenesis), etc... Other characteristics which are under study are the biochemical composition of the freshly hatched nauplii, their nutritional value as a food source for fish and crustacean larvae and the optimum growth and reproduction rates. Preliminary data on this comparative study have already been reported in SORGELOOS *et al.* (1976) and CLAUS *et al.* (1977).

STUDY OF THE METABOLISM OF ARTEMIA CYSTS (F. BENIJTS, G. VAN DE PUTTE).

Aquaculture farmers often complain about the considerable differences in hatchability from one batch of cysts to another. In our opinion this can be explained by the uncontrolled harvesting techniques which are utilized for collecting the cysts in nature ; indeed the time lapse between the washing ashore of the cysts and their harvest is not constant and often extends over several weeks. Fundamental research on the cyst's metabolism (SORGELOOS *et al.*, 1976 ; BENIJTS *et al.*, 1977) revealed that during this period, the cysts can be subjected to repeated metabolic activities due to the local climatic conditions. As a consequence the energetic contents of the cysts might decrease and result in a prolonged incubation time from immersion until hatching, a significant decrease of the size of the hatched nauplii and even a decrease of the hatchability.

.../...

We are convinced that by harvesting the cysts as soon as possible after their washing ashore and of course applying appropriate techniques for processing (drying) and packing (either vacuum sealed or under nitrogen atmosphere) the quality of the cysts, i.e. in the first place the hatching rate and efficiency, can be optimized.

BIBLIOGRAPHY.

- BENIJTS, F., G. VAN DE PUTTE and P. SORGELOOS, 1977. Energetic aspects of the metabolism of hydrated *Artemia* cysts. In Fundamental and applied research on the brine shrimp *Artemia salina* (L.) in Belgium. Special Publication n° 2, European Mariculture Society, Ed. Jaspers, E., Institute for Marine Scientific Research, Bredene (Belgium), 79-87.
- CLAUS, C., F. BENIJTS and P. SORGELOOS, 1977. Comparative study of different geographical strains of the brine shrimp, *Artemia salina*. In Fundamental and applied research on the brine shrimp *Artemia salina* (L.) in Belgium. Special Publication n° 2, European Mariculture Society, Ed. Jaspers, E., Institute for Marine Scientific Research, Bredene (Belgium), 91-105.
- MOCK, C.R., L.R. ROSS and B.R. SALSER, 1975. Design and evaluation of waste removal systems for shrimp culture in closed raceways. 6th Annual Meeting of the World Mariculture Society, Seattle (Washington, U.S.A.), January 27-31, 1975. Prepublication draft. 41 pp.
- SORGELOOS, P., M. BAEZA-MESA, F. BENIJTS and G. PERSOONE, 1976. Current research on the culturing of the brine shrimp *Artemia salina* L. at the State University of Ghent, Belgium. In Proc. 10th European Symposium on Marine Biology, Ostend (Belgium), September 17-23. Ed. PERSOONE, G., JASPERS, E., Vol. 1 : Research in Mariculture at Laboratory and Pilot Scale. Universa Press, Wetteren, Belgium, 473-495.
- SORGELOOS, P., M. BAEZA-MESA, E. BOSSUYT, E. BRUGGEMAN, G. PERSOONE, G. UYTTERSROT and D. VERSICHELE, 1977 a. Automatized high density culturing of the brine shrimp, *Artemia salina* L. 8th Annual Meeting of the World Mariculture Society, January 9-13, 1977, San Jose, Costa Rica.
- SORGELOOS, P., M. BAEZA-MESA, C. CLAUS, G. VAN DE PUTTE, F. BENIJTS, E. BOSSUYT, E. BRUGGEMAN, G. PERSOONE and D. VERSICHELE, 1977 b. *Artemia salina* as life food in aquaculture. In Fundamental and applied research on the brine shrimp, *Artemia salina* (L.) in Belgium. Special Publication n° 2. European Mariculture Society, Ed. Jaspers, E., Institute for Marine Scientific Research, Bredene (Belgium), 37-46.

POISSONS MARINS PLATS

MARINE FLATFISH