

## BIOMASS PRODUCTION OF ARTEMIA IN AIR-WATER-LIFT RACEWAY SYSTEM

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### ABSTRACT

Biomass production in a bisexual strain (Great Salt Lake (GSL), USA) and parthenogenetic strains (India and Sri Lanka) of *Artemia* was studied in an air-water-lift (AWL) raceway system. *Spirulina* sp. was given as food. After two weeks of culturing, the biomass production amounted to 6.3 kg/m<sup>3</sup> in the GSL strain; 3.78 and 4.35 kg/m<sup>3</sup> in the Indian and Sri Lankan strains respectively. The advantages of biomass production of *Artemia* through AWL are discussed.

*Key-words* : *Artemia*, Biomass, AWL Raceway System.

*Artemia* biomass is in great demand as a source of high quality food in fish and crustacean farming (Persoone and Sorgeloos, 1982). Recent studies have proved that adult *Artemia* have higher nutritive value, contain 60% protein and rich in all essential amino and fatty acids required for growth of shrimps (Sorgeloos, 1980). Adult *Artemia* could also be used as a valuable source of high quality protein for animal feeding. Moreover, maturation in various penaeid species is much more effective by using adult *Artemia* than with eye-stalk ablation (Sorgeloos, personal communication).

Extensive production of *Artemia* is still confined to tropical climates with prolonged dry seasons. This restricts its integration into aquaculture systems of only those sites.

Recently a breakthrough in the technology of *Artemia* batch culture in air-water-lift raceway system (AWL) was developed by Sorgeloos, Baeza-Mesa, Benijts, Bossuyt, Bruggeman, Claus, Persoone, Vandeputte and Versichele (1977) which is a modified system developed by Mock, Neal and Saiser (1973) for the production of shrimp. The main advantage of controlled production of *Artemia* through this system is that it can be performed with very high densities i.e., several thousands of animals per litre. Construction and maintenance of such a raceway system is fairly simple. Advantages of culturing *Artemia* in raceways are many; different stages of *Artemia* such as nauplii, pre-adults and adults produced can be used for hatcheries and pet fishery market either in live form/frozen or freeze-dried form. Continuous production of nauplii can be used directly as live feed, thus can minimise the quantity of cyst requirement. Different agricultural waste products such as rice bran, wheat bran, soya bean meal, and whey powder have been found to be good food sources for *Artemia* and this can

be converted to nutritive animal protein. It was found that the shrimp *Metapenaeus monoceros* was able to convert maximum of the food into body tissue when fed adult *Artemia* in pelleted form (Sumitra-Vijayaraghavan, Wafar and Royan, 1978). Good growth rates were observed in *Penaeus indicus*, *P. monoceros* and *M. monodon* when fed with live adult *Artemia* (Royan, Sumitra-Vijayaraghavan and Krishna Kumari, 1987). Thus adult *Artemia* biomass can be used as an ingredient of protein source of feeds for cultivable organisms. The present paper summarises the results of the biomass production of three different geographical strains (one bisexual Great Salt Lake strain and two parthenogenetic strains - India and Sri Lanka) in an air-water-lift raceway system.

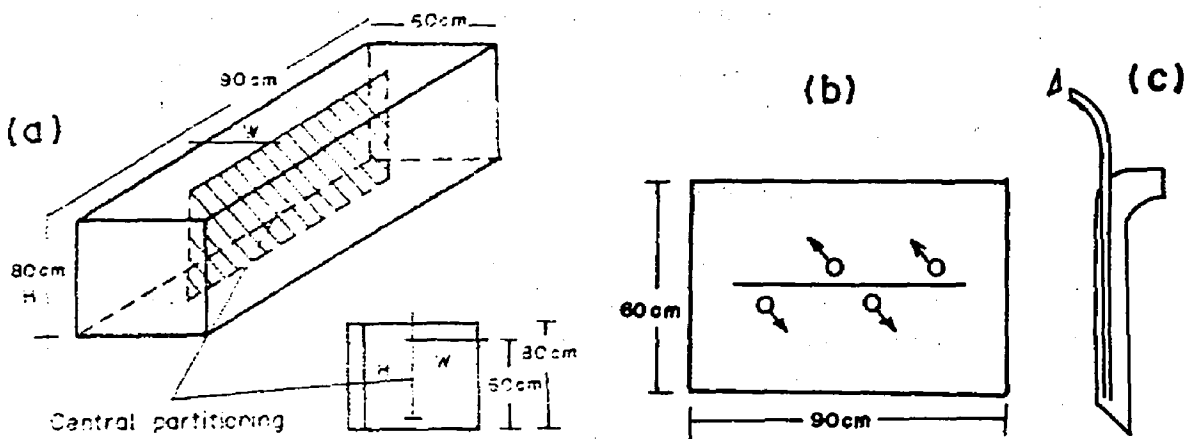


Fig.1. AWL - raceway system: (a) side view showing the positioning of central partition, (b) top view of 300 l tank, water depth 60 cm with position of AWL's and (c) position of aeration tube in AWL-raceway system.

The design and construction of AWL were according to Bossuyt and Sorgeloos (1980) for 300 l capacity tank. Fiber glass tank of 30 x 60 x 80 cm dimension was used (Fig. 1). An Elgi air compressor (Model 105 M) with an oil trap and water displacement capacity of 144 l/minute was used for aeration. The culture medium consisted of natural sea water whose salinity was raised to 50‰ by adding sea salt. This helped in suppressing the growth of filamentous bacteria and Peritrichous ciliates which otherwise cause mortality (Brisset, Bossuyt, De Ruyck and Sorgeloos, 1982). The water level in the tank was maintained at 60 cm. pH of the culture medium was maintained between 7 and 8 by adding sodium bicarbonate. Dissolved oxygen was  $4.43 \pm 0.75$  mg/l during the study period. Water temperature was maintained at 30°C by using thermostatically controlled Rena Aquarium water heater.

50 g of *Artemia* cysts from the GSL (USA), Indian strain (Balamba, Saurashtra) and the Sri Lankan strain (Hambantota) were hatched following the standard proce-

dures given by Sorgeloos, Bossuyt, Lavens, Léger, Vanhaecke and Versichele (1983). Immediately after hatching, the first instar nauplii were collected, washed and introduced into the tank at a density of 2000 nauplii/l. The experiments were conducted in triplicate for each strain. The duration of each experiment was for a period of 16 days. Animals were fed daily with *Spirulina* suspension made with sea water (25 g/l)/ *Spirulina* dry power was obtained from the Central Food Technological Research Institute, Mysore and the biochemical composition of the feed is given in Table I.

Table I – Biochemical Composition of *Spirulina* produced at CFTRI, Mysore  
(All values in percent dry matter - from Venkataraman, 1983).

Crude Protein (N x 6.25)	55-65
Lipid	2-6
Carbohydrate	10-15
Crude Fiber	1-4
Ash	6-15
Moisture	5-10

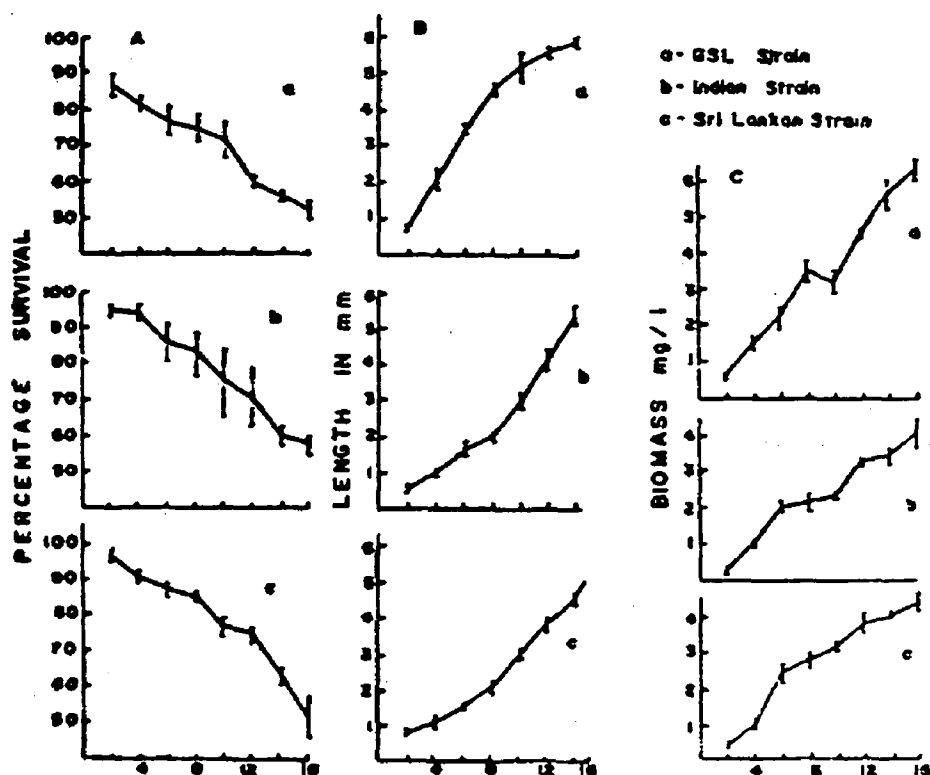


Fig.2. Survival rate of the three strains of *Artemia*

Transparency of the culture medium was taken as a parameter for determining the food level present in the medium. Transparency level was measured using Secchi disc and maintained between 15 and 20 cm during the first week and 20 - 25 cm thereafter by adding *Spirulina* suspension. Once in four days, faecal matter was removed by stopping the aeration for 1 hr and siphoning out the settled faecal matter. Data on survival, length increment and wet weight gain were recorded at two days intervals. The results represent the mean of three values.

Survival of the three strains of *Artemia* are shown in Fig. 2A. The parthenogenetic strains had a higher survival rate than the GSL strain upto 12th day, thereafter all the three strains have almost similar survival. This is comparable with the results reported for the Tientsin (Chinese) and the GSL strains fed with *Dunaliella* sp. and agricultural by-products respectively (Vanhaecke and Sorgeloos, 1980; Royan - unpublished). Fig. 2B shows growth of the three strains. Here, the GSL strain recorded good growth as compared to the parthenogenetic strains. Among the parthenogenetic strains, upto 10th day, there was not much difference in growth but towards the end, the Indian strain grew faster than the Sri Lankan strain. Tobias, Sorgeloos, Roels and Sharfstein (1980) have summarized the survival percentage and length measurements of 17 geographical strains on the 15th day of culture. The length recorded in the present study compared well with them. The survival of GSL strain after 15 days in the present study is 50% less than that reported for GSL and San Francisco Bay (SFB) strains. The parthenogenetic strains recorded better survival than the Australian and Tuticorin (Indian strain) but less than that reported for Chinese and Italian strains.

Biomass increase between the strains was found to be more or less same upto 6th day. However, towards the end, when extrapolated to  $1\text{ m}^3$  culture volume, the GSL strain yielded 6.3 kg whereas, the Indian and the Sri Lankan strains yielded only 3.78 kg and 4.35 kg respectively (Fig. 2C). Lavens, De Meulemeester and Sorgeloos (1987) obtained 11.6, 11.3, 14.5 and 14.7  $\text{kg}/\text{m}^3$  biomass from the GSL strain fed with a combination of corn byproduct and rice bran/soya bean waste/wheat bran/cheese by-product respectively. Royan (Personal communication) using soya bean waste and corn by-product obtained a biomass upto 12  $\text{kg}/\text{m}^3$  for the GSL strain and 7  $\text{kg}/\text{m}^3$  in the Tientsin strain. Compared with these values, the biomass recorded in the present study is rather low. Bossuyt and Sorgeloos (1980) have reported yield of 5 - 7  $\text{kg}/\text{m}^3$  in 2 weeks culturing with various sizes (300 to 5000 l capacity) of AWL raceway systems in a bisexual strain and found that the biomass production figures did not vary much due to the feed or geographical strains. On the contrary, in the present study, biomass yield of the parthenogenetic strains was less than the bisexual strain. This may probably be attributed to culture period and conversion efficiency which are strain as well as feed dependent.

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