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Short Communication

Studies on the Utilization of *Oscillatoria thiebautii* as Food Source for *Artemia* sp Culture

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Abstract. Growth and population of a native parthenogenetic *Artemia* sp in relation to *Oscillatoria thiebautii* was studied. *O. thiebautii* was inoculated to confirm its utilization in the *Artemia* sp culture. The study was carried out between October-July when the temperature ranged between 16-30 °C. The culture salinity and pH was maintained at 50 ppt and 8±1, respectively. The *Artemia,* at these culture conditions, showed good growth and survival in the presence of *O. thiebautii* as its food source. The study indicates *O. thiebautii* as a cost-effective feed for *Artemia* sp culture, which is both inexpensive and available in abundance.

Keywords: *Oscillatoria thiebautii*, *Artemia* sp, algal bloom, *Artemia* food, *Artemia* culture, aquaculture

Aquaculture is expected to grow at a fast pace. This is necessary to match with the additional demand for high quality protein in order to keep pace with the anticipated population growth. The importance of phytoplanktons as the source of fish and shrimp feed is well known. They provide the basis of low-technology in the intensive pond culture systems. It has been observed that *Oscillatoria thiebautii* and other cyanobacteria growing in ponds are consumed by *Artemia* sp and many other zooplanktons. *O. thiebautii,* a eurythermal cyanobacterium occurring mainly in tropical seas, performs many important functions. It has the ability to fix elemental nitrogen and uptake combined nitrogen nutrients (Carpenter and McCarthy, 1975; Sournia, 1968; Desikachary, 1959). It has been observed during earlier studies that large quantities of cyanobacteria, especially *O. thiebautii,* are consumed by tilapia and channel catfish (Han and Dickman, 1995; Perschbacher, 1995).

Artemia is a non-selective filter feeder, feeding on particulate matter of biological origin (organic detritus from mangrove waters), as well as on living organisms of the appropriate size and range including microscopic algae and bacteria (Reeve, 1963). Nutritionally, *Artemia* has high digestibility and appears to meet most of the macro- and micronutrient requirements of freshwater and marine fishes, and crustacean larvae. Phytoplanktons are the basic unit of the food web in aquaculture systems. Maintenance of the phytoplankton bloom is the most important aspect in *Artemia* culture and for successful production of its biomass and cyst. Being important in the food chain and as a nitrogen fixer, *O. thiebautii* was cultured and studies were undertaken in the laboratory to assess the feasibility of its utilization as feed by *Artemia*.

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The phytoplankton and *Artemia* culture. *O. thiebautii* was cultured in four aquaria measuring 45 x 35 x 26 cm and three aquaria measuring 29 x 29 x 21 cm. The aquaria were filled with reconstituted seawater from saltworks where the native *Artemia* sp was found to be present. The salinity of the seawater was maintained around 50 ppt and the temperature ranged between 16-30 °C during the period of study. The pH of water was maintained at 8±1. Dissolved oxygen during the study ranged between 5-8 mg/l. *O. thiebautii* inoculum population was collected from the intermediate 50 ppt salinity ponds of solar saltworks at Korangi Creek, Karachi, Pakistan, with the help of phytoplankton nets with 5 µm mesh and inoculated in the study aquaria. After one week of inoculation, the population of *O. thiebautii* multiplied and the algal bloom started. At this stage, the nauplii of *Artemia,* which were hatched separately, were introduced at the rate of 25 nauplii in 10 litre and 50 nauplii in 50 litre of water, respectively, in small and large aquaria. Total *O. thiebautii* colonies during the mentioned period were reported as cells (1.2×10^4/ml).

Nutrient supplementation. The salt nutrients, such as KNO_3, $Na_2HPO_4.2H_2O$ and urea at the rate of 15 g/1 were supplemented weekly to enhance the growth and population of *O. thiebautii*, as the *Artemia* population was feeding on the phytoplankton.

Population determination. Samples of *Artemia* and *O. thiebautii* were collected weekly from the aquaria for wet weighing and the recording of population data. For the determination of *O. thiebautii* biomass, 5% formaldehyde was added to one litre of culture medium from the aquaria. The biomass of the phytoplankton was allowed to settle for 48 h, the supernatant was decanted and the sedimented material was analysed for weight and cell count.

***Artemia* health status.** The *Artemia* health status was determined by their swimming activity, which they exhibited well in a small glass beaker placed near a light source. The *Artemia* were noted to concentrate at one spot, showing the crowding effect. Microscopic inspection revealed that the digestive tracts were always full with food. However, when the thoracopod and mouth region was clean, it meant that the animals were starving. Growth of *Artemia* was followed by determining the wet weight of the *Artemia* present in 15 samples/l of the culture medium. These data were extrapolated for the calculation of *Artemia* biomass in the total culture medium volume of the aquaria.

Observations on the growth of *O. thiebautii* and *Artemia*. The phytoplankton material was studied under the microscope for the identification of *O. thiebautii*. The microalgal cell count was low in the hotter months May-July (27-30 °C) and high in cooler months December-April (16-23 °C). These low and high values of *O. thiebautii* cell colony count corresponded with low and high population of *Artemia* during these months (Table 1; Fig. 1). The average size of *Artemia* reached about 8 mm in two weeks. The *Artemia* biomass harvested from small aquaria was 25 g/10 litre culture medium, and from large aquaria was 1 kg/50 litre of culture medium during one month of culture. It was observed that as the *Artemia* population increased, the *O. thiebautii* population decreased. It has been reported that the growth of *Artemia* was directly proportional to the population of *O. thiebautii* (Neelakanta and Papanasam, 1987; Wongart, 1986). It has been also observed that as the temperature increased above 30 °C the growth of *O. thiebautii* declined (Sorgeloos *et al.,* 1986). Our observations, therefore, are in agreement with those reported in the literature.

Table 1. The effect of seasonal variation on the growth of *Oscillatoria thiebautii* and *Artemia* in aquaculture*

Month	pH	Average temperature (°C)	Average count of *O. thiebautii* per ml **	Number of *Artemia* per litre
October	8.1	24	5000	9000
November	8.0	24	8000	10200
December	8.0	23	10800	12500
January	7.9	20	12000	17500
February	7.9	16	18000	19500
March	7.9	16	20500	20400
April	8.0	25	19500	18500
May	8.0	27	6000	8000
June	8.0	28	5900	7600
July	8.0	30	5400	7100

*salinity was maintained at 50 ppt; **total *O. thiebautii* colonies during the respective mentioned period.

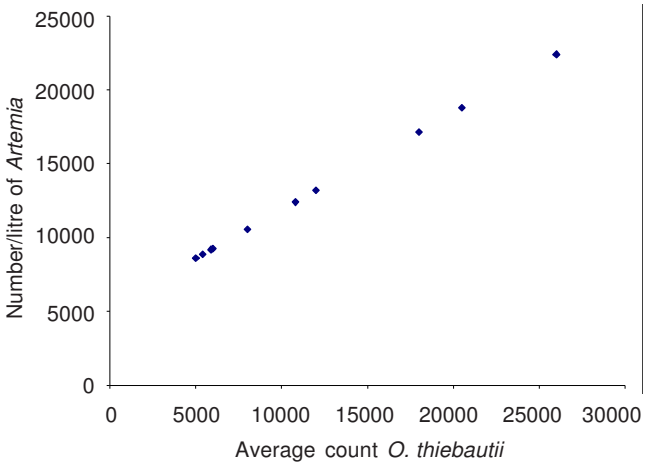

Fig. 1. Regression graph showing *Oscillatoria thiebautii* density *vs* number of *Artemia* from October to July.

The maximum harvest of *Artemia* averaged 25 kg wet biomass for the total culture in 230 litres of culture medium in 5 months. The *Artemia* population ranged between 3000-15000 individuals/litre. Sorgeloos *et al*. (1986) indicated that efficient conversion of the algal food by *Artemia* in a flow-through culture system was attained when the algal cell concentration in the effluent approximated the critical minimum cell concentration of about 5000 cells/ml. This could be achieved by adjusting the retention time of algal culture in the *Artemia* aquaria (Roels *et al.,* 1979). The survival rate of *Artemia* in the present studies was observed to be 100%, which was estimated by measuring the wet weight of the *Artemia* present in several samples of one litre culture medium and extrapolating the average to the total aquarium volume in accordance with Vanhaecke and Sorgeloos (1989). *Artemia* reached maximum size of 10 mm in 3-week old cultures and started breeding.

The nutritional quality, ingestibility and food value of *O. thiebautii* were verified in preliminary growth and survival tests, by placing freshly hatched nauplii in 25 ml algal cell suspension in 10 cm petri plates at different cell concentrates for the culture period of 14 days. The nutritional quantity of the *Artemia* fed on *O. thiebautii* revealed very healthy population, with continuous reproduction and good growth condition. The proximate analysis of *Artemia* showed 35.2% protein, 9.8% fat, 13.1% carbohydrates and 17.4% ash.

The present studies have shown that *O. thiebautii* is a good food source for *Artemia*. Both these organisms have shown a positive relationship.

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