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Influence of Micro-algae Food on Growth of Larvae and Spat-set in Pearl Oyster Pinctada fucata (Gould)

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Abstract
Optimum concentration of Isochrysis galbana as food was 4000-5000 cells per day per larva of Pinctada fucata (Gould). Acceptability of Pavlova lutheri, Chromulina freiburgensis, Dicrateria sp. and Dunalieilla sp. was tested. The effect of algal food on growth and spatset determined. Increase in growth was recorded in Pavlova fed larvae than in I. galbana. Larvae fed with Dunalieilla sp. did not survive beyond 13 days. Isochrysis and Chromulina at 1:1 ratio showed better growth. Larvae fed with Dicrateria showed poor growth and higher spatset when fed singly or in combination with Isochrysis. In 1:1:1 combination of Isochrysis : Pavlova : Chromulina the larval growth was better than that in Isochrysis : Pavlova : Dicrateria combination.

Introduction
Isochrysis galbana was an ideal food for larvae and juveniles of bivalves (Loosanoff and Davis, 1963; Walne (1970). Wada (1973) reared the larvae of P. fucata at 10 cells of Isochrysis per µl for 12 days and at 20 cells /µl afterwards. Minaur (1969) fed the larvae of Pinctada maxima with different algal species at a density of 100 cells/µl. I. galbana was supplied to the straight hinge stage of P. fucata at 80-120 cells/µl (Alagarsswami et al., 1983). Alagarsswami et al., (1989) fed the larvae of Pinctada margaritifera with Isochrysis at 5 cells /µl from day 2 and 10 cells /µl from day 5 onwards. The present work was undertaken to standardise optimum requirement of I. galbana to the larvae of P. fucata and to assess the relative value of other algae on growth and spatset.

Materials and Methods
Veligers of P. fucata were stocked at a density of 2 larvae/ml and fed with I. galbana at different concentrations viz. 1000, 2000, 4000, 5000, 6000 and 8000 cells/larva/day (2, 4, 8, 10, 12, and 16 cells /µl). The ration was doubled from umbo stage onwards. The growth of larvae at the above concentrations was monitored every 5 days. The spatset at each concentration was recorded.

Pavlova lutheri, Chromulina freiburgensis, Dicrateria sp. and Dunalieilla sp. fed to the larvae of P. fucata individually. The growth of larvae and spatset in each alga were recorded. The combination of these alga with I. galbana and the combination of Chromulina and Dicrateria with Pavlova at 1:1 ratio were studied.

Three species combination of Isochrysis: Chromulina: Dicrateria and Pavlova: Chromulina: Dicrateria was tested at equal proportion.

Results and Discussion
Among the different algal concentrations 4000-5000 cells/larva/day (8-10 cells / l) gave better growth and high spatset. On day 23 the larvae attained 172.9 m in dorso-ventral measurement (DVM) when fed at 4000 cells/larva/day and 150.4 m when fed at 5000 cells/larva/day. The percentage spatset was 5.9 and 3.0 in the respective feeding rates (Table 1).

Pavlova fed larvae showed slightly higher growth than I. galbana fed ones and the percentage spatset was equal. Larvae fed with Chromulina and Dicrateria indicated lower growth than in I. galbana and Pavlova fed ones. The percentage spatset in Dicrateria feeding was high (9.5%). Dunalieilla fed larvae survived only for 13 days. It was found unsuitable to the larvae of P. fucata.

When the larvae fed with Isochrysis and Chromulina at 1:1 combination better growth was obtained than in Isochrysis: Pavlova and Isochrysis: Dicrateria combination. 11.8% spatset was obtained in Isochrysis: Pavlova fed larvae. The growth in two species combination was higher than in single food (Table 2).

In three species combination viz., Isochrysis: Pavlova: Chromulina and Isochrysis : Pavlova : Dicrateria the growth and spatset were good in the former. The growth in three species feeding was lower than in single food (Table 2).

Determination of optimum requirement of food for a larva at its different stages of development was a prerequisite in larval rearing systems. The level of feeding varies at different stages. Minaur (1969) fed the larvae of P. maxima at 100 cells /µl. I. galbana was supplied to the larvae of P. fucata at a concentration of 80-120 cells/µl (Alagarsswami et al., 1983). In the present study I. galbana at 10 cells /µl up to umbo stage; at 20 cells / µl up to eyed stage and 30 cells /µl till spatset was found to be the optimum requirement for the larvae. Loosanoff and Davis (1963) stated that the higher algal concentration on bivalve larvae affects the regulatory capacity and also produces more external metabolites resulting in lower growth and spatset. A similar effect was observed in the present study where the growth and spatset were poor at higher algal concentration.
The larvae of *P. margaritifera* showed higher growth in Isochrysis feeding than in Pavlova (Alagarwami et al., 1989). Wada (1973) demonstrated that *Monochrysis lutheri (= Pavlova lutheri)* promoted better growth in the larvae of *P. fucata*. Walne (1963) reported that *P. lutheri* gave slightly better growth than *I. galbana* in the larvae of *Ostrea edulis*. A similar result was obtained in the present study. The food value of Dicrateria inornata on the growth of larvae of *O. edulis* was poor than in *I. galbana* and *Chromulina pleiades* (Walne, 1956). Though a similar result was obtained in the present study, the percentage spatset was high when fed with Dicrateria singly or in combination. Saddar and Taub (1972) opined that the presence of relative amounts of essential nutrients in algal food may promote good growth and high spatset. Walne (1956) reported that the growth in the larvae of *O. edulis* was comparable with *I. galbana* and *Chromulina pleiades* feeding. In the larvae of *P. fucata* the growth was poor when fed with *Chromulina*.

*Dunaliella eichhorlia* and *Dunaliella* sp. found to induce better growth in the oyster larvae after 6 days of development (Loosanoff and Davis, 1963). *Dunaliella* sp. gave good growth in the larvae of *O. edulis* (Bruce et al., 1939). The larvae of *P. fucata* neither metamorphosed nor survived beyond 13 days when fed with *Dunaliella* sp.

Loosanoff and Davis (1963) classified the algae as per their food value as *Monochrysis lutheri, I. galbana*, and *Dicrateria sp.* in *Mercenaria mercenaria; M. lutheri, I. galbana, Chromulina* and *Dicrateria* in *Crassostrea virginica*. In our study the order was *P. lutheri, I. galbana, Dicrateria* sp. and *Chromulina* freiburgensis.
Ukeles (1969) reported better growth in combination of food (Chlorococcum, I. galbana and M. lutheri) than in single food. A mixture of I. galbana, M. lutheri, Platymonas sp. and Dunaliella euctorea induced rapid growth both in clam and oyster larvae than in single food (Davis and Quillard, 1958). Similarly in the present investigation I. galbana at 1:1 combination with P. lutheri, Chromulina freiburgensis, Dicrateria resulted in better growth than in single food.

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