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EFFECTS OF FOOD ON THE GROWTH OF *CRASSOSTREA MADRASENSIS* (PRESTON) LARVAE

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ABSTRACT

The effect of different concentrations of algal foods on the growth of the larvae of edible oyster *Crassostrea madrasensis* was studied in the laboratory. Of the different algal concentrations (5, 10, 20, 40, 80 cells/µl) of *Isochrysis galbana* fed, the maximum growth was obtained at the concentration of 40 cells/µl. The mixed diet (*I. galbana* and *Chaetoceros calcitrans* 20 cells each) was also found to be best food for these larvae.

Key - words : Growth, algal food, *Crassostrea* sp.

Study on the growth of bivalve larvae provides some of the basic information necessary for the efficient operation of commercial bivalve hatchery. Work on the influence of food on survival and growth of the larvae of commercially important bivalves from other regions of the world was studied and reviewed by Loosanoff and Davis (1963); Walne and Spencer (1968) and Bayne (1983). Work on the food requirements of bivalve larvae from Indian waters is scanty (Kalyanasundaram and Ramamoorthi, 1988). Hence, a preliminary study was undertaken to determine some of the basic relationships between algal food density and the effects of various diets on the growth of the larvae of the oyster *C. madrasensis* in the laboratory.

The edible oysters were collected from the natural population of Porto Novo and were thoroughly cleaned. Induced spawning and larval rearing procedures were similar to those of Kalyanasundaram and Ramamoorthi (1987). Filtered and sterilized estuarine water (S=30‰) was used for larval rearing. The sterilization of the water was effected by heating to 70-80°C for 30 minutes. Fingerbowls (500 ml), pipettes and 11 beakers used for the experiments were cleaned thoroughly and sterilized. The straight-hinge larvae were screened through bolting silk of fine mesh (40 µ), washed in sterilized water and resuspended in another beaker containing sterilized water. 1 ml of sample was pipetted into Sedgewick rafter counting cell and the larval number was counted. The average number was calculated after 4-5 counts.

Three series of experiments were carried out. In the first series, the effect of different concentrations of the algal food *Isochrysis galbana* (5, 10, 20, 40, 80 cells/µl)

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on the growth of the bivalve larvae, was determined. The system was not aerated. In the second series, the effect of aeration (by bubbling) on the growth of larvae fed with *I. galbana* at a concentration 40 cells/µl was studied. In the third series, the effect of different algal diets viz. *Chaetoceros calcitrans*, *Tetraselmis* sp., *I. galbana* and mixed diet of *I. galbana* and *C. calcitrans* (20+20 cells each) was determined.

The density of the larvae was adjusted to 5 larvae/ml . The pure cultures of the algal diets were enumerated using a haemocytometer. The medium was changed daily and the required volume of algal cultures were added to this medium in the rearing containers. The growth of the larvae was monitored on the 4th and 8th day of the experiment and the shell length of 30 larvae was measured by means of an ocular micrometer for comparing the same with measurements taken on a sample of larvae, at the start of the experiment. The growth co-efficient (K) value was calculated using the formula of Helm (1977).

$K = \log_e l_4 - \log_e l_o$

where l_4 and l_o are the lengths of the larvae after four days of the experiment and start of the experiment respectively.

Effect of different densities of Isochrysis galbana on growth of the larvae

Table I shows the growth increment and growth co-efficicant (K) for the larvae of *C. madrasensis* recorded after feeding with different concentrations (5, 10, 20, 40, 80 cells/µl) of *I. galbana*. Growth increased with increasing algal density upto 40 cells/ µl but declined at the algal density of 80 cells/µl. Maximum growth was achieved at a concentration of 40 cells/ µl.

Table I. The growth increment (mean length of larvae (µ), 95% confidence interval and mean K_4) of *C. madrasensis* larvae fed with different concentration of *I. galbana* in duplicate cultures.

Concentration (cells/µl)		0-4 days	4-8 days	Mean K_4
5	Mean	90.3 ± 4.2	111.7 ± 1.7	0.224
	Range	70.0 - 100.0	110.0 - 130.0	
10	Mean	93.7 ± 3.5	120.0 ± 2.2	0.307
	Range	70.0 - 110.0	110.0 - 130.0	
20	Mean	100.7 ± 2.9	140.7 ± 4.3	0.387
	Range	90.0 - 110.0	110.0 - 160.0	
40	Mean	107.0 ± 3.5	156.0 ± 4.7	0.438
	Range	80.0 - 120.0	120.0 - 170.0	
80	Mean	76.0 ± 2.0	86.3 ± 2.5	0.142
	Range	65.0 - 80.0	80.0 - 100.0	

Effect of aeration on larval growth

Table II shows the growth increment and 90% confidence intervals for *C. madrasensis* larvae fed with 40 cells/µl of *I. galbana*, with and without aeration. The larval growth was depressed in the cultures that received aeration.

Table II. The growth increment in µ (together with 95% confidence interval) of *C. madrasensis* larvae fed with *I. galbana* of 40 cells/µl with and without aeration.

		0-4 days	4-8 days
With aeration	Mean	100 ± 3.25	112.7 ± 3.09
	Range	80 - 120	100 - 130
Without aeration	Mean	110.3 ± 3.17	160.3 ± 3.72
	Range	80 - 120	120 - 170

Table III. The growth of larvae (expressed as the co-efficient K_4, between 0-4 and 4-8 days when fed with four diets.

Days	*I. galbana*	*C. calcitrans*	*Tetraselmis* sp.	Mixed diet of *I. galbana* + *C. calcitrans* (20+20 cells)
0-4	0.529	0.438	0.208	0.594
4-8	0.374	0.399	0.223	0.319
Mean	0.452	0.419	0.216	0.457

Effect of different diets on larval growth

Table III shows the larval growth in response to various diets (*I. galbana, C. calcitrans, Tetraselmis* sp. and mixed diet of *I. galbana* + *C. calcitrans*) expressed as 'K_4' co-efficients. Growth with a monospecific culture of *I. galbana* was better when compared with growth produced by the algae *C. calcitrans* and *Tetraselmis* sp. Less growth was recorded when the larvae were fed on *Tetraselmis* sp. Examination of the mixed cultures revealed that best growth was achieved when the larvae were fed with equal concentrations of *I. galbaaa* and *C. calcitrans*.

Maximum growth increment in the bivalve larvae was recorded at an algal density of 40 cells/ µl and it decreased at a density of 80 cells/µl. The algal concentration of 40 cells/µl is adequate to produce maximum growth for the larvae of *C. madrasensis*. Reduction in the growth of the larvae at the higher algal density of 80 cells/µl may be due to mechanical disturbances of food cells on the larval swimming and also by producing external metabolites which are toxic to the larvae. Similar conclusions have

been drawn by Loosanoff and Davis (1963). Walne (1966) reported similar results in his experiments with batch feeding of *I. galbana* to the larvae of the European oyster sp. He concluded that there was no advantage in batch feeding at a concentration of 1,20,000 cells/ml compared to 30,000 cells/ml under the conditions of his experiments. Malouf and Breese (1977) observed that the important cause for reduced growth at high algal densities might be excessive formation of pseudofeaces. Guillard (1958) found that *Isochrysis* is known to produce substances toxic to bivalve larvae under certain conditions. Kalyanasundaram and Ramamoorthi (1988) observed that larvae of *Saccostrea cucullata* attained maximum growth at the algal density of 40 cells/ml of *Isochrysis galbana.*

The decrease in growth of the larvae observed in the present study confirmed the conclusion of Helm and Spencer (1972) and Nascimento (1980) that aeration was detrimental to the growth of the small straight-hinge larvae during the first few days of their free swimming existence.

Of the three species of algae tested, feeding with *I. galbana* resulted in a faster growth rate. *C. calcitrans* also formed a very good diet. *Tetraselmis* sp. produced poor growth. Loosanoff, Miller and Smith (1951) and Davis (1953) observed that the larvae of *Mercenaria mercenaria* were capable of selecting food quantitatively from the mixture of food organism provided to them. Davis and Guillard (1958) stated that a single type of organism such as *Monochrysis lutheri* and *I. galbana* served as the best food for sustaining good growth of larvae of *M. mercenaria.* Bayne (1965) also observed that the larvae of *Mytilus edulis* grew well when fed either on *Monochrysis* or *Isochrysis.*

Davis and Guillard (1958) showed that the larvae of *C. virginica* and *M. mercenaria* grew more rapidly in the laboratory when fed with a mixture of four species of flagellate algae than with the best of the constituent species fed alone. The results of the present study showed that the larvae grew more rapidly when fed with an algae mixture consisting of *I. galbana* and *C. calcitrans,* thus confirming the observations made by Davis and Guillard (1958), Bayne (1965), Walne and Spencer (1968), Calabrese and Davis (1970), Walne (1970) and Helm (1977).

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