Majalah Ilmu Kelautan, (2002), 25 (VII) : 51 - 58 — *ISSN 0853 - 7291*

Effects of Different Microalgae on the Survivorship of Giant Clams Larvae (*Tridacna squamosa*)

Ambariyanto*

Marine Science Department, Faculty of Fisheries and Marine Science, Diponegoro University, Semarang, Indonesia. Email: ambariyanto@telkom.net

Abstrak

Salah satu kendala yang dihadapi dalam usaha memproduksi Kima (giant clams, Bivalvia: Tridacnidae) adalah tingkat kelangsunganhidup larva yang rendah. Terdapat dua sumber energi utama bagi kima yang mempengaruhi kelangsunganhidup dan pertumbuhannya, yakni translokasi hasil fotosintesa dari zooxanthellae dan melalui proses filter feeding. Dalam penelitian ini larva kima diproduksi melalui teknik induce spawning dengan mengkombinasikan metoda kenaikan suhu dan penyuntikan serotonin pada gonad induk. Selanjutnya larva kima yang berumur 2 hari dan 9 hari diberi pakan beberapa jenis mikroalgae. Pengamatan terhadap jumlah larva dilakukan selama masing-masing 5 hari. Hasil penelitian menunjukkan tidak terdapat perbedaan yang nyata dari mikroalgae yang berbeda terhadap kelangsunganhidup larva kima. Namun terdapat kecenderungan bahwa larva yang diberi pakan mikroalgae dari genus Chaetoceros mempunyai laju kelangsunganhidup yang lebih tinggi dibandingkan dengan larva yang diberi pakan mikrolagae jenis lain maupun kontrol. Disamping itu, tidak seperti yang dilaporkan oleh peneliti lain, ternyata larva kima mampu mencapai metamorfosis walaupun tanpa pemberian pakan alami. Diduga hal ini disebabkan larva tersebut mampu memanfaatkan sumber energi lain dari lingkungan air laut disekitarnya .

Kata kunci: *kima, pakan alami, mikroalgae, kelangsunganhidup*

Abstract

One of the major problems in giant clams (Bivalvia: Tridacnidae) production is low level of survival rate, especially within larvae development. There are two diiferent important sources of energy required, which influence the survivorship of the clams, i.e. through zooxanthellae translocation and filter feeding processes. The best microalgae that can be fed to clams larvae, however, has not known yet. The present study aimed to investigate the influence of various microalgae on the survival rate of giant clams larvae. The larvae produced by inducing adult giant clams using the combination of temperature increment and serotonin injection. Two different stages of larvae were used in this study i.e. 2 and 9 days old larvae. The number of larvae were monitored daily for 5 days. Statistical analysis showed that there was no significant effects of different microalgae on the survivorship of the larvae. However, larvae which were fed by Chaetoceros had higher survival rate than other treatments and control. Furthermore, unlike other reports, this study shows that larvae which were not fed by microalgae have reached metamorphoses. It is believed that these larvae are capable of utilizing other energy sources from their sorrounding environment.

Key words : *giant clams larvae, natural feed, microalgae, survival rate*

Introduction

Giant clams (Family Tridacnidae) are marine bivalves which live in coral reef ecosystem around Indo-Pacifik. There are 8 (eight) different species of giant clams known and 7 (seven) of them can be found in Indonesian waters. (Lucas, 1988; 1994). Tradisionally, people around coastal area have been using giant clams, either for food source, building materials or household equipments. Recently giant clams have become a very interesting aquarium animals and also becoming important export commodities of several South Pacific countries (Tisdell, 1989; Tisdell *dkk.* 1994).

Since giant clams demand has increased in the last two decades, natural populations of these animals decreased sharply due to overexploitaton

* Corresponding Author

Diterima / Received : 03-02-2002
Disetujui / Accepted : 22-02-2002

(e.g. Pearson, 1977; Villanoy *et al.*, 1988; Pasaribu, 1988). Two larger species i.e. *Tridacna gigas* and *T. derasa* were put on the list of endagered species in 1983 during the fourth meeting of CITES (*Convention of International Trade in Endangered Species*), and in 1985 all the rest of giant clams species were also put on the list.

At the moment, one of the problems faced by giant clams aquaculture industry is high mortality rate of the larvae which can reach 90-95 % (Fitt dan Trench, 1981). Antibiotics have been used as hatchery pratices to increase the survivorship of the larvae (Norton *dkk.*, 1993 a,b,c; Norton *dkk.*, 1994). Since the use of antibiotics has become an important issue as that is this practice is environmentally and medically questionable. Other efforts, therefore, are needed to minimise the mortality rate of clams larvae.

The main sources of giant clams nutrition are from photosynthate translocation by zooxanthellae and filter feeding habit (Fitt, 1993; Ambariyanto, 1997). In addition, microalgae are important natural food of giant clams which is ingested through filter feeding activity (Klumpp *dkk.*, 1992; Klumpp dan Griffiths, 1994; Klumpp dan Lucas, 1994). However, microalgae which gives best influence to giant clams larvae is not yet known. Therefore, the present study was set to investigate the effects of different microalgae on the survivorship of giant clams larvae.

Material and Methods

Larvae production

Larvae production was carried out twice i.e. August and October 2000 using twentyfive (25) and eleven (11) adult clams (*T. squamosa*; 25 - 30 cm in shell length), respectively. Before serotonin injection, the outer shell of the clams were cleaned from dirt and debris using plastic brush and followed by washing the outer shell with 2 % chlorin to minimized bacteria contamination. All the clams then were put under the sun for approximately one hour before putting them into clean concrete tank filled with filtered sea water.

These clams then were injected with 1.5 ml 2μM serotonin into its gonad to induce spawning. The first clam expeled its sperm occured 5 minutes after the injection. These sperm then were collected in a plastic backet. When one clam started to expel its eggs, this clam then was put into separate tank. These clams were taken back to the sea after finish spawning.

Fertilization was carried out by adding sperm into a tank filled with clams eggs. Aerations were give rigorously to ensure the mix of clams sperm and eggs. Hatching rate was calculated by counting the number of trocophore divided by the number of eggs multiply by 100 %.

Microalgae addition

The microalgae used in the present study were (1). *Tetraselmis chui;* (2). *Tetraselmis iso;* (3). *Nannochloropsis* sp.; (4). *Chaetoceros simplex;* (5). *Chaetoceros* sp.; (6). *Chaetoceros gracilis;* (7). *Chaetoceros calcitrans.*

These microalgae were given to two (2) days old larvae (first experiment) and nine (9) days old larvae (second experiment) and these experiments were carried out twice i.e. on August and October 2000.

First experiment:

Two days old clams larvae were put into 24 small glass aquariums (1 L) with density of 5 larvae ml-1. Different microalgae than were put into different aquarium with density of 3000 cell ml-1 as treatments, and without addition of microalgae as control. Three replications were carried out in the present study. Adjusted number of microalgae were done everyday, and the number of the larvae were also monitored daily for five days using larvae counter.

Second experiment:

The second experiment was done similar with the first experiment, but using nine (9) days old larvae. During the experiment aeration was continously given to the larvae.

Results and Discussion

Hatching rate

Table 1 shows the hatching rate of the larvae from both fertilization carried out in August and October. As can be seen on the table, the value of hatching rate are between 71 – 75 %. This result is similar to those reported by Ambariyanto (2000b).

Tabel 1. The number of eggs, trochopore and hatching rate of the larvae produced during two fertilization attempts.

Fertilization	Number of eggs	Number of trochopore	Hatching rate (%)
August	20.625.000	15.000.000	72.72
October	4.800.000	3.600.000	75.00

Giant clams are potandric hermaphrodites bivalves (Lucas, 1988), where the sperm are expelled earlier than eggs (Jameson, 1976; Braley, 1988). In the present study not all adult clams expelled their sperm and eggs. In the August experiment, only 10 out of 25 clams produced sperm and only 2 out of those 10 clams produced eggs. While in the October experiment, only 7 out of 13 clams produced sperm and only 1 clams produced eggs. Based on field experience, after spawning adult clams need approximately 6 months to be able to spawn again.

First experiment:

Figure 1. shows daily survivorship of the larvae during the experiment. As can be seen in the figure, on the last day of the experiment (7 days old larvae) the number of the larvae decreased to reach between 50 - 80 %. The result of ANOVA test shows that there was no significant different on the survivorship of the larvae on the last day of the experiment both August and October experiment with P= 0.704 and P= 0.807, respectively. See Figure 2

Second experiment:

Similar trend was found on the survivorship of 9 days old clams larvae during 5 days monitoring. Figure 3. ANOVA test also shows that there was no significant different on the survivorship of the larvae on the last day of the experiment both August and October experiment with P= 0.785 and P= 0.588, respectively. See Figure 4

A part from photosynthates translocation by zooxanthellae to giant clams, the nutrition of these bivalves come from filter feeding activity (Klumpp *dkk.* 1992; Klumpp dan Griffiths, 1994). The most interesting results of the present study is that statistically there is no significant effects of different microalgae fed to giant clams larvae on the survivorship of the larvae on both larvae stages (2 and 9 days old). However, there was a trend that the genus *Chaetoceros* gave a better survivorship than other microalgae. It suggests that, probably, giant clams larvae do not require any external food through filter feeding before metamorphoses which started to occur on day 10. See Figure 1 - 4.

In their reports Gwyther and Munro (1981); Southgate (1988) stated that giant clams larvae which are not given external food will never reach metamorphoses. This present study, however, found that unfed larvae (control) reached metamorphoses similar to those which were given microalgae as external food as in agreement with other scientists (Fitt *dkk.* 1984; Heslinga *dkk.* 1990). This can be explained by the fact that giant clams larvae are also capable of utilizing dissolved organic matter within the seawater surounding them as a source of energy. Ambariyanto and Hoegh-Guldberg (1999) found that dissolved organic matter uptake can become a source of energy for giant clams. Furthermore, Ambariyanto (2000b) reported that giant clams larvae absorbed dissolved free amino acids, although there was no preference on specific class of these amino acids. This author suggested that dissolved organic matter absorbsion is an important biological procces in giant clams larvae (before metamorphoses) as a source of energy. Another possibility is that the filter feeding activity has not effectively done since the filter feeding related organs, such as gills, digestive system, etc. have not completely developed.

The results of the present study showed that all larvae fed by different microalgae and unfed larvae (control) reached metamorphoses. This suggests that until the larvae reach metamorphoses, external feeding with microalgae becomes optional clams hatchery practice. Therefore, in order to minimise the production cost in the hatchery, giant clams larvae are not recommended to be fed by microalgae.

Conclusion

One important aspect which worth to be noted is that, although feeding of different microalgae statistically not significantly influenced the survivorship of clams larvae, feeding with *Chaetoceros* gave a better survival rate compared with other species and control. Secondly, in contrary with other research which stated that unfed clams larvae will not reach metamorphoses, the present study found that the clams larvae reached metamorphoses. Further study needs to be done especially to investigate the effects microalgae on the survival and growth rates of giant clams juvenil.

Acknowledgement

The present study is funded by Riset Unggulan Terpadu VII No. 44/SP/RUT/1999, 30 April 1999. The author would like to thank Ikhsan Ramli for his help and this study was conducted at Marine Lab. UNHAS Barrang Lompo Island, Makassar.

References

Ambariyanto. 2000a. Introduksi zooxanthellae sebelum metamorfosis dan pemberian kombinasi antibiotik pada larva kima (Tridacnidae). *Ilmu Kelautan*, 20: 234-240.

Ambariyanto. 2000b. Kemampuan absorbsi asam amino oleh larva kima (*Tridacna squamosa*) sebagai sumber energi untuk pertumbuhan. *Ilmu Kelautan*. 20(V): 273-279.

Ambariyanto. 1997. The role of zooxanthellae on the nutrition of giant clams. *J. Coastal Development*. 1(1): 43-48

Ambariyanto and Hoegh-Guldberg, O. 1999. The uptake of dissolved free amino acids by the giant clam, *Tridacna maxima*: alternative sources of energy and nitrogen? *Coral Reefs* 18(1) :91-96

Braley, R.D. 1988. Reproductive condition and season of giant clams *Tridacna gigas* and *T. derasa* utilizing a gonad biopsy technique. *In*: Copland, J.W., Lucas, J.S. (eds). Giant Clams in Asia and The Pacific. ACIAR Monograph No. 9. Canberra. p: 98-103.

Fitt, W.K. 1993. Nutrition of giant clams. *In* W.K. Fitt (ed.). Biology and Mariculture of Giant Clams. ACIAR Proceedings No. 47. p:31-40

Fitt, W.K., Fisher, C.R. Trench, R.K. 1984. Larval biology of tridacnid clams. *Aquaculture*. 39: 181-195.

Fitt, W.K., Trench, R.K. 1981. Spawning, development and acquisition of zooxanthellae by *Tridacna squamosa* (Mollusca, Bivalvia). *Biol. Bull.* 161: 213-235.

Gwyther, J. Munro, J.L. 1981. Spawning induction and rearing of larvae of tridacnid clams (Bivalvia : Tridacnidae). *Aquaculture*. 24: 197-217.

Heslinga, G.A., Perron, F.E. Orak, O. 1984. Mass culture of giant clams (F. Tridacnidae) in Palau. *Aquaculture* 39: 197-215.

Jameson, S.C. 1976. Early life history of the giant clams *Tridacna crocea* Lamarck, *Tridacna maxima* (Roding) and *Hippopus hippopus* (Linnaeus). *Pac. Sci.* 30(3): 219-233.

Klumpp, D.W., Bayne, B.L., Hawkins, A.J.S. 1992. Nutrition of the giant clam *Tridacna gigas* (L.). I. Contribution of filter feeding and photosynthates to respiration and growth. *J. Exp. Mar. Biol. Ecol.* 155: 105-122.

Klumpp, D.W., Lucas, J.S. 1994. Nutritional ecology of the giant clams *Tridacna tevoroa* and *T. derasa* from Tonga: influence of light on filter-feeding and photosynthesis. *Mar. Ecol. Prog. Ser.* 107: 147-156.

Klumpp, DW. and Griffiths, C.L. 1994. Contributions of phototrophic and heterotrophic nutrition to the metabolic and growth requirements of four species of giant clam (Tridacnidae). *Mar. Ecol. Prog. Ser.* 115: 103-115.

Lucas, J.S. 1988. Giant Clams: Description, Distribution and Life History. *In*: Copland, J.W., Lucas, J.S. (eds). Giant Clams in Asia and the Pacific. ACIAR. Canberra. p: 21-32.

Lucas, J.S. 1994. The biology, exploitation, and mariculture of giant clams (Tridacnidae). *Reviews in Fisheries Science*. 2(3): 181-223

Norton, J.H., Perkins, F.P., Ledua, E. 1993b. Morteilia-like infection in a giant clam, Tridacna maxima, in Fiji. *J. Invert. Pathology*. 61: 328-330.

Norton, J.H., Sheperd, M.A., Abdon-Naguit, M.R., Lindsay, S. 1993c. Mortalities in the giant clam Hippopus hippopus associated with rickettsiales-like organisms. *J. Invert. Pathology*. 62: 207-209

Norton, J.h., Sheperd, M.A., Prior, H.C. 1993a. Intracellular bacteria associated with winter mortality in juvenile giant clams, *Tridacna gigas* *J. Invert. Phatology*. 62: 204-206

Norton, J.H., Thomas, A.D., Barker, J.R. 1994. Fungal infection in the cultured juvenile boring clam *Tridacna crocea*. *J. Invert. Pathology*. 64: 273-275.

Pasaribu, B.P. 1988. Status of giant clams in Indonesia. *In*. Copland, J.W., Lucas, J.S. (eds). Giant Clams in Asia and the Pacific. ACIAR Monograph No.9 p: 44-46.

Pearson, R.G. 1977. Impact of foreign vessels poaching giant clams. *Australian Fisheries*, 36: 8-13.

Southgate, P.C. 1988. Biochemical developments and energetics of *Hippopus hippopus* larvae. *In*: Copland, J.W., Lucas, J.S. (eds). Giant Clams in Asia and the Pacific. ACIAR Monograph No. 9. p: 140-144.

Tisdell, C. 1989. Pacific giant clams and their products: an overview of demand and supply. *In*: Campbell, H., Menz, K. Waugh, G. (eds). Economics of fishery management in the Pacific region. ACIAR Proceeding No. 26. p: 100-104.

Tisdell, C. , Shang, Y.C., Leung, P. 1994. Economics of Commercial Giant Clam Mariculture. ACIAR Monograph 25. 306 p.

Villanoy, C.L., Juinio, A.R., Menez, L.A. 1988. Fishing mortality rates of giant clams (Family Tridacnidae) from the Sulu Archipelago and Southern Palawan, Philippines. *Coral Reefs*. 7: 1-5.

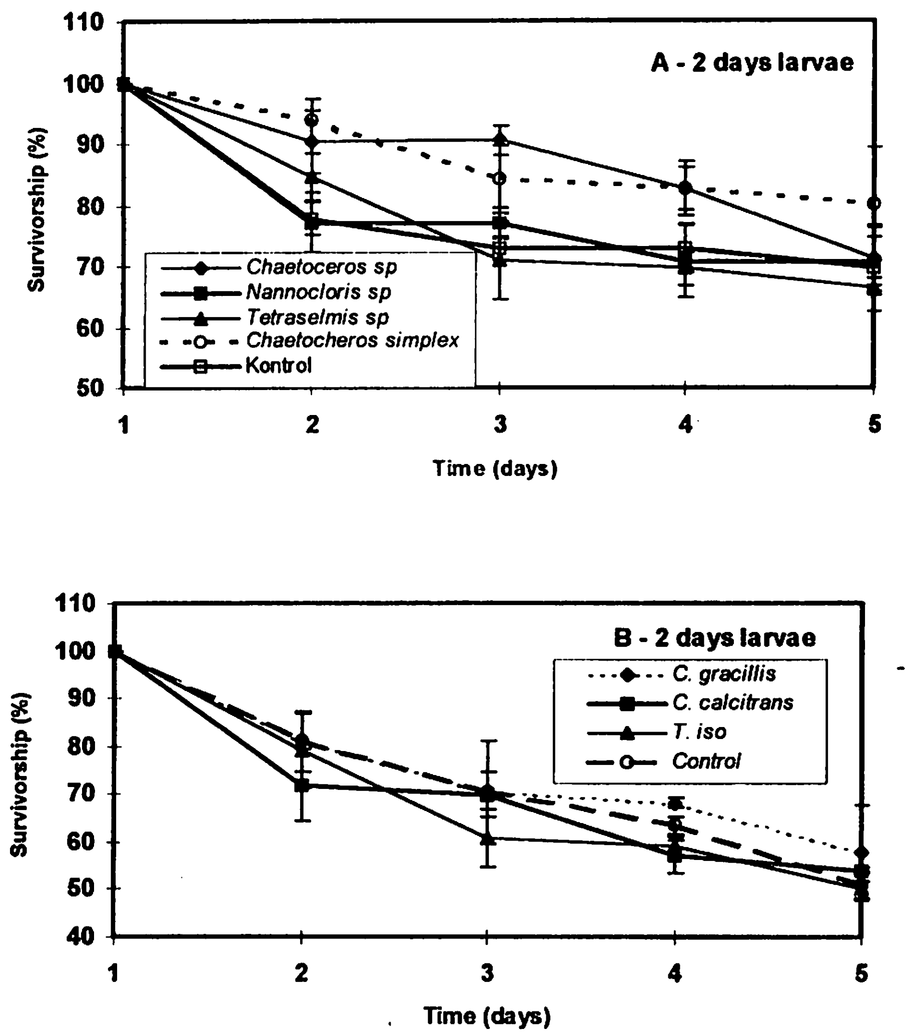


Figure 1. Mean (±SD) daily survivorship of 2 days old giant clams larvae fed by different microalgae. A. August; B. October 2000

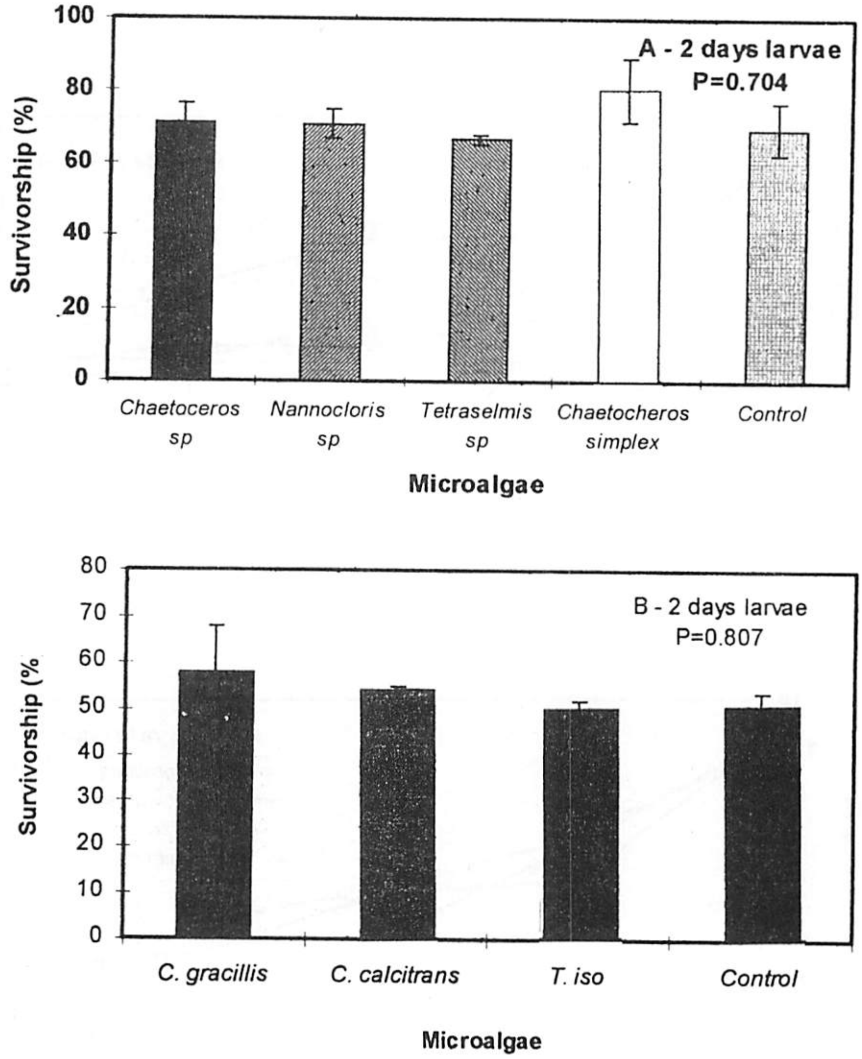


Figure 2. Mean (±SD) survivorship 2 days old giant clams larvae fed by different microalgae at the end of the experiment. A August; B. October 2000.

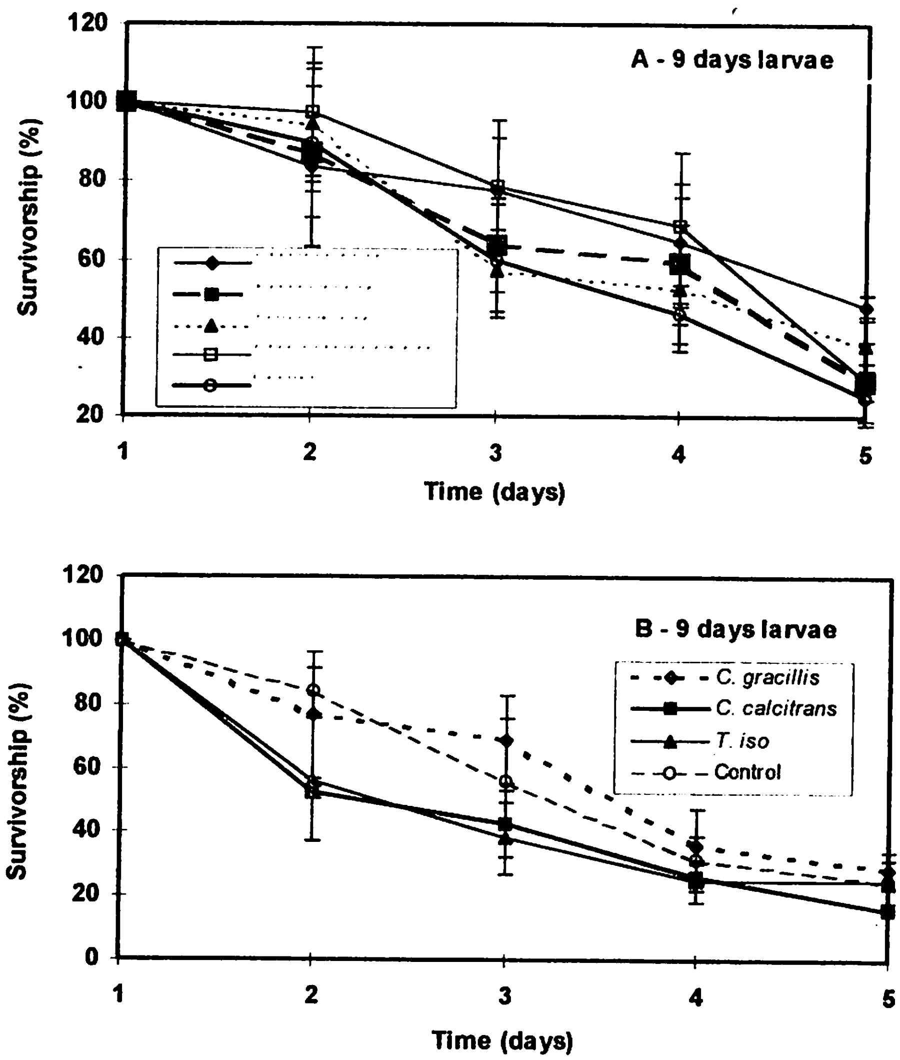
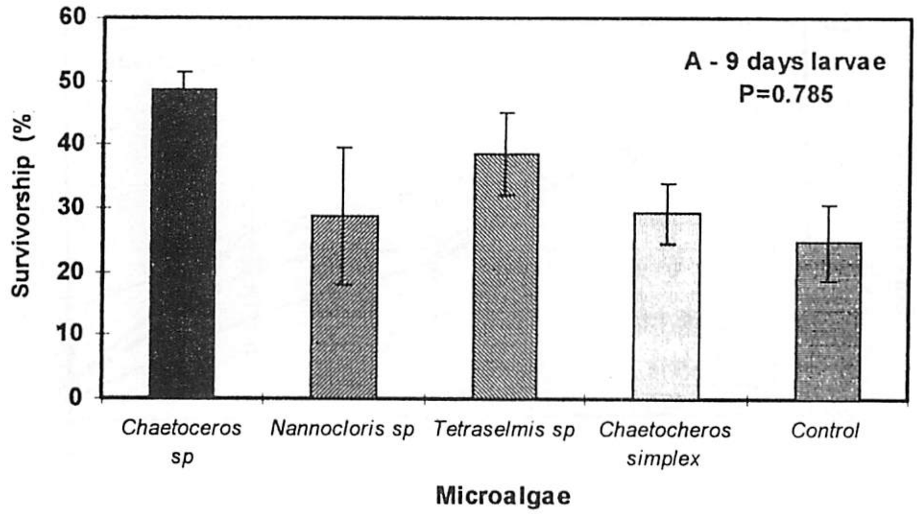


Figure 3. Mean (±SD) daily survivorship of 9 days old giant clams larvae fed by different microalgae. A. August; B. October 2000



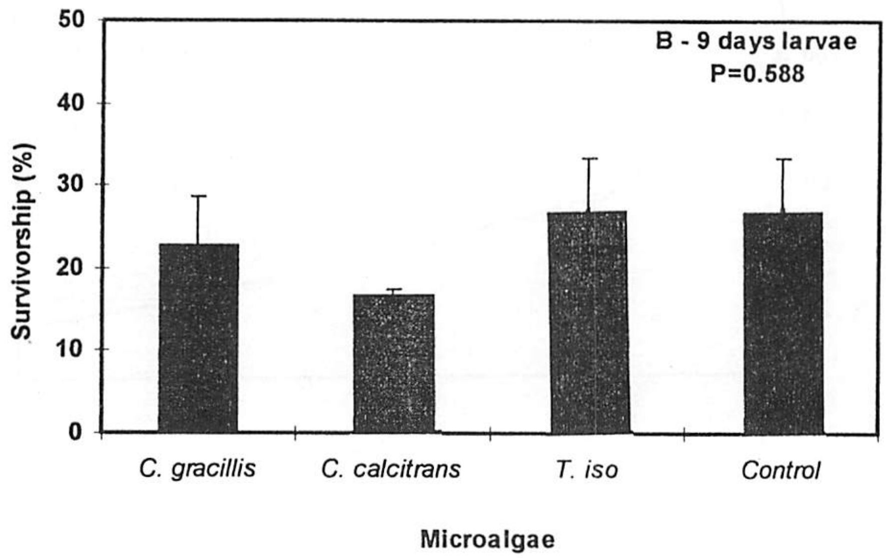


Figure 4. Mean (±SD) survivorship 9 days old giant clams larvae fed by different microalgae at the end of the experiment. A August; B. October 2000.