Proc. Indian Acad. Sci. (Anim. Sci.), Vol. 99, No. 6, November 1990, pp. 519–523.

Production of rotifer, *Brachionus plicatilis* Muller fed with different cell densities of microalgae, *Chlorogibba trochisciaeformis* Geiter

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MS received 20 July 1990

Abstract. The production dynamics such as growth rate (K), doubling time (Dt) and production ($ml^{-1}\ d^{-1}$) on rotifer, *Brachionus plicatilis* was studied in different cell densities of microalgae, *Chlorogibba trochisciaeformis*. A significant increase in rotifer production was achieved at a density of 50×10^6 *Chlorogibba trochisciaeformis* cells ml^{-1}.

Keywords. *Brachionus plicatilis*; *Chlorogibba trochisciaeformis*; growth rate; doubling time.

1. Introduction

Several attempts have been made in recent years towards improving the culture conditions and nutritional quality of rotifers for aquaculture in view of their importance as the prime food in the initial stages of many crustacean and fish larvae. In addition to inert food (Hirata and Mori 1967), several species of algae have also been tried to determine their impact on growth of rotifers (James *et al* 1983; Lubzens 1987; Rezeq-Abu and James 1987). It was suggested that the monotypic algal feed had little effect on the reproductive rates of rotifers (Theilacker and McMaster 1971; Scot and Baynes 1978). On the other hand a substantial difference has been observed in reproductive rates of rotifers with different algal species (Snell *et al* 1983; Yufera *et al* 1983; Okauchi and Fukusho 1984).

In the present investigation, production dynamics of a rotifer, *Brachionus plicatilis* using different cell densities of a microalgae, *Chlorogibba trochisciaeformis* are dealt.

2. Materials and methods

The feeding experiments on rotifers was conducted using a local strain of marine microalgae a xanthophycean *C. trochisciaeformis* maintained in the laboratory at a temperature of 26°C, salinity 28 ‰ and pH 8·05. The algae were harvested in the exponential growth phase when the cell number was 70×10^6 and then diluted to obtain 10, 20, 30, 40, 50 and 60×10^6 cells ml^{-1} by adding seawater having a salinity of 28 ‰. The algal cells were counted with the help of a haemocytometer. The experiment was run in 4 replicates for each treatment using 5 litre beaker. Throughout the experimental period, the water temperature was maintained at $26{\cdot}23 \pm 1{\cdot}05$°C, while providing continuous aeration.

The amictic rotifers numbering 1000 $litre^{-1}$ were inoculated into the beakers and their population counts, pH and dissolved oxygen of the culture medium were monitored every 24 h. Each day 10% of the culture medium was filtered and the

corresponding volume was replaced with fresh seawater having desired cell densities of algae. The experiment was terminated after 7 days.

Doubling times were calculated by dividing $\log e^2$ by the instantaneous growth rate (K) from the expression

$$K = \frac{\text{In } Nt - \text{In } No}{t},$$

where No = initial number of rotifer, Nt = final number of rotifer and t = duration.

2.1 *Statistical analysis*

The production ($ml^{-1}\ d^{-1}$), doubling time (Dt) and instantaneous growth rate (K) were subjected to test of significance by adopting the second degree polynomial regression formula (Snedecor and Cochran 1967).

3. Results

The results show that the production of rotifers per ml per day increased with increasing cell density of the feed (algae), but at higher cell concentration of the latter, the number of rotifers were found to decrease. At 50×10^6 concentration of algal cells ml^{-1} in the culture medium, maximum production of rotifers ($69{\cdot}91 \pm 4{\cdot}7\ ml^{-1}\ d^{-1}$) was discerned (table 1). The production of rotifers showed a linear relationship with the cell density of the algal feed (figure 1A). The increase in rotifer production between different treatments was significant ($P < 0{\cdot}05$), but at higher algal cell concentration (50 and 60×10^6 cells ml^{-1}) the production of rotifers was insignificant ($P < 0{\cdot}05$). The doubling time of rotifers decreased from $0{\cdot}98 \pm 0{\cdot}02$ to $0{\cdot}81 \pm 0{\cdot}01$ with increasing cell densities of the algal feed (figure 1B), which showed a significant difference among the treatments ($P < 0{\cdot}05$).

The instantaneous growth rate (K) of rotifers showed a curvilinear relationship with the algal feed (figure 1B) where the values for the former increased from $0{\cdot}71 \pm 0{\cdot}01$ to $0{\cdot}87 \pm 0{\cdot}01$ with corresponding increase in cell densities of the latter (table 1), but whereas at a concentration of 60×10^6 algal cells ml^{-1} the growth rate ($0{\cdot}86 \pm 0{\cdot}01$ K) of rotifers was found to be less pronounced. However, a significant ($P < 0{\cdot}05$) difference of growth rate (K) of rotifers was noticed between 10 and 60×10^6 cells ml^{-1}, reaching an asymptote stage beyond an algal densities of 40×10^6 cells ml^{-1}. The number of rotifers increased rapidly with increasing cell densities of algal feed. The mean rotifer densities recorded were 430·5, 490·5, 352, 281, 164 and 156 rotifers ml^{-1} at algal cell densities of 60, 50, 40, 30, 20 and 10×10^6 cells ml^{-1} respectively. The maximum density of rotifer increased between 5 and 6 days, whereas on other days the increase in population was not prominent.

4. Discussion

The increase in population density of rotifers with the corresponding increase of cell number of algae (*C. trochisciaeformis*) was apparent in the present study. Beyond an algal concentration of 50×10^6 cells ml^{-1}, there was a reduced growth rate of rotifers. The present results are in accordance with the findings of Rezeq-Abu and

Table 1. Production of rotifer, *B. plicatilis* in different cell densities of algal feed *C. trochisciaeformis*.

C. trochisciaeformis cell densities ($\times 10^6$ cells ml^{-1})	Replicates	Initial No. of rotifer ($\times 10^3$ ml^{-1}) (a)	Final No. of rotifer ($\times 10^5$ ml^{-1}) (b)	Duration (days)	Number of rotifer produced ($\times 10^5$ ml^{-1}) (b–a)	Rotifer production (ml^{-1} d^{-1})	Doubling time (Dt)		Instantaneous growth (K)	
10	1	5·2	7·7	7	7·65	21·851		0·98		0·71
10	2	5·3	8·5	7	8·45	24·134	22·24	0·95	0·98	0·73	0·71
10	3	5·5	6·9	7	6·85	19·557	±	1·00	±	0·69	±
10	4	5·6	8·25	7	8·20	23·411	1·75	0·98	0·02	0·71	0·01
20	1	5·7	8·7	7	8·64	24·694		0·96		0·72	
20	2	5·6	6·5	7	6·44	18·411	23·27	1·02	0·97	0·68	0·72
20	3	5·1	9·3	7	9·25	26·425	±	0·94	±	0·74	±
20	4	5·4	8·3	7	8·25	23·56	2·99	0·96	0·03	0·72	0·02
30	1	5·3	13·95	7	13·90	39·705		0·87		0·80	
30	2	5·5	11·60	7	11·55	32·987	40·03	0·90	0·87	0·77	0·8
30	3	5·2	14·70	7	14·65	41·851	±	0·86	±	0·81	±
30	4	5·2	16·00	7	15·95	45·567	4·57	0·85	0·021	0·82	0·02
40	1	5·3	18·00	7	17·95	51·279		0·84		0·83	
40	2	5·5	15·00	7	14·95	42·701	50·13	0·87	0·85	0·80	0·82
40	3	5·9	19·00	7	18·94	54·119	±	0·84	±	0·83	±
40	4	5·9	18·40	7	18·34	52·403	4·40	0·85	0·01	0·82	0·01
50	1	5·6	25·50	7	25·44	72·697		0·80		0·87	
50	2	5·7	22·30	7	22·24	63·551	69·91	0·82	0·81	0·85	0·87
50	3	5·9	26·60	7	26·54	75·833	±	0·80	±	0·87	±
50	4	5·4	23·70	7	23·65	67·559	4·70	0·80	0·01	0·87	0·01
60	1	5·5	22·50	7	22·45	64·128		0·81		0·86	
60	2	5·6	23·60	7	23·54	67·270	62·20	0·81	0·81	0·86	0·86
60	3	5·7	21·20	7	21·14	60·41	±	0·81	±	0·85	±
60	4	5·3	20·00	7	19·95	56·991	3·87	0·81	0·01	0·85	0·01

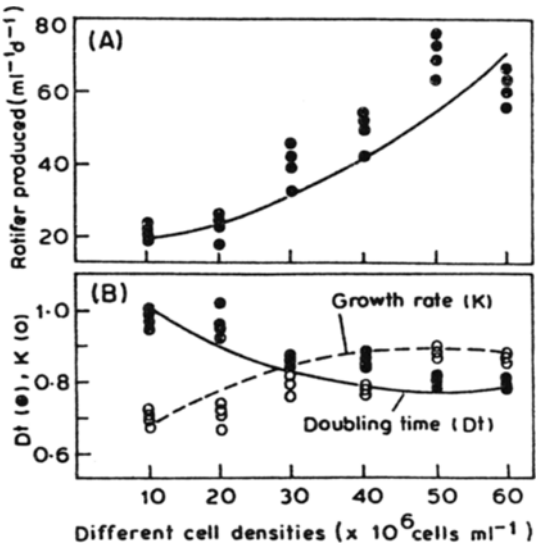

Figure 1. (A) Production of rotifers in different cell densities of *C. trochisciaeformis*. Each point represents the individual value of each replicate (rotifer production $ml^{-1}\,d^{-1}$ $Y = 1{\cdot}12 + 1{\cdot}229\,X + 0{\cdot}00033\,X^2$; $r^2 = 0{\cdot}85$, n = 24); (B) Instantaneous growth rate (*K*) and doubling time (*Dt*) of rotifers in different cell densities of *C. trochisciaeformis* (*K*, $Y = 0{\cdot}7873 + 0{\cdot}000195\,X + 0{\cdot}00000004\,X^2$; $r^2 = 0{\cdot}85$, n = 24. *Dt*, $Y = 0{\cdot}8747 + 0{\cdot}000163\,X + 0{\cdot}00000003\,X^2$; $r^2 = 0{\cdot}85$, n = 24).

James (1987), who concluded that, beyond a concentration of ($37{\cdot}5 \times 10^6$ cells ml^{-1}) of *Chlorella* sp, the rotifer population may reach a steady state without further increase in production. James and Rezeq-Abu (1988) have observed that the rotifer fed with an algae, *Chlorella capsulata* showed an increase in population density, production and growth rate only up to 10×10^6 cells ml^{-1} beyond which the population tended to decline.

Earlier investigation (Hirayama *et al* 1973) on the contrary with the present findings, has suggested that the most suitable cell density of *Chlorella* for optimum population growth and net reproduction rate of *Brachionus rubens* were $1{\cdot}5 \times 10^6$ cells ml^{-1}. Similarly Pilarska (1977) has also noticed the highest daily growth rate of *B. rubens* at cell densities of *C. vulgaris* ranging from $0{\cdot}4 \times 10^6$ to $1{\cdot}0 \times 10^6$ cells ml^{-1}.

Yufera *et al* (1983) while using high cell densities (up to 100×10^6 cells ml^{-1}) of marine algae, *Nannochloris* sp. and *Nannochloropsis* sp. for feeding two strains of *B. plicatilis*, observed an increase in density of rotifer at an optimum algal concentration of 50 and 70×10^6 cells ml^{-1}. Earlier observations have suggested that rotifer could thrive on more than $2{\cdot}6 \times 10^6$ *Chlorella* cells ml^{-1}, whereas, Rezeq-Abu and James (1987) have found more than $37{\cdot}5 \times 10^6$ *Chlorella* cells ml^{-1}. In the present study a xanthophycean group of alga, *C. trochisciaeformis* was tested at different cell densities for the rotifer production. The results were similar to that of *Chlorella* sp. but there was a reduction in rotifer production beyond a concentration of 50×10^6 cells ml^{-1} of algae, *C. trochisciaeformis*.

Acknowledgement

One of the authors (ASR) is indebted to the University Grants Commission, New Delhi for the award of a fellowship.

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