P-V3

Chemical composition of the Rotifer (*Brachionus plicatilis*, Muller) fed on *Brachiomonas* sp. and *Eunotia* sp.

M. CARIC, B. SKARAMUCA and J. SANKO-NIJRE

Biological Institute, P.O. Box 39, Dubrovnik (Yugoslavia)

As a live food, rotifer (Brachionus plicatilis Muller) is well-suited to the purpose of rearing the larvae of most marine fish, due to its appropriate size, rapid production rate and capability to be fed on a variety of live unicellular algae or baker's yeast. Nutritional quality of the rotifer is very important in the survival of fish larvae (Howell, 1977). This study aims at investigating the nutritional effects of phytoplankton monocultures Brachiomonas sp. and Eunotia sp., which were isolated in Biological Institute in Dubrovnik, on the chemical composition of the rotifer. The rotifer's samples were taken at exponential, stationary and death phases in order to determine water, ash, total lipids, proteins and carbohydrates contents.

Algae were cultured in the pasteurized natural sea-water enriched with nutrient and in their late exponential phase of growth, the rotifer was added. The rotifers were separated on 53 µm aperture naylon mesh. In the samples the moisture were determined by drying at 60° C and ash content by ashing at 800° C (Lovergrove,1966). Lipids were extracted with a chloroform-methanol mixture and estimated by the sulphophospho-vanillin method (Barnes and Blackstock,1973). To the lipid free pellets TCA was added. In supernatant total carbohydrates determinations were done using a phenol sulfuric acid method reported by Kochert (1978). In precipitate protein was assayed as described by Bradford (1976). Three experimental series were performed.

Table I shows the values of water, ash, lipids, carbohydrates and proteins content in rotifers fed on the green algae Brachiomonas sp. and the diatoms Eunotia sp. at exponential, stationary and death phases. In the both samples water content reached its lowest value at the stationary phase of growth. Ash levels were highest at the death phase, probably due to a decline in organic matter. Its highest value was found in Eunotia sp.-fed rotifer and probably was consistent with siliceous nature of cell walls of diatoms. Lipids and carbohydrates were observed to decline from the exponential to the death phases. Protein levels increased at the stationary phase and reached the highest value in Eunotia sp.-fed rotifers. At the last growth phase a marked and fast decline in lipids, carbohydrates and proteins was observed along with an increase in ash and water contents. The above results indicate that the rotifer should be maintained at the late exponential phase when it was observed to be most suitable to the feeding purposes.

In our further research rotifers at the late exponential phase of growth fed on Brachiomonas sp. and Eunotia sp. should be used as a diet for fish larvae. The chemical composition and the survival rate of fish larvae would be observed.

TABLE I: Moisture (%wet weight), ash, lipid, carbohydrat, protein (%dry weight).
Growthcycle: I-exponential, II-stationary and III-death phases.
Means at the same phase of growth followed by different superscripts are significantly different (P<0,05, Student's t-test)
Inoculum on Day 0 contained 89,7% moisture, 6,9% ash, 12,4% lipid, 2,1% carbohydrat and 38,4% protein.

		ROTIFERS FED ON				
	PHASES OF GROWTH	BRACHIOMONAS sp.	EUNOTIA sp.	BRACHIOMONAS sp.	EUNOTIA sp.	PHASES OF GROWTH
LIPID	I	13,9[a]	14,5[a]	87,5[a]	89,7[b]	I
	II	11,5[a]	13,3[a]	86,9[a]	88,3[a]	II MOISTURE
	III	10,3[a]	12,2[a]	90,0[a]	91,7[a]	III
CARBO-HYDRAT	I	3,5[a]	4,1[a]	6,1[a]	10,2[b]	I
	II	2,9[a]	3,8[a]	7,9[a]	12,7[b]	II ASH
	III	2,2[a]	2,8[a]	13,2[a]	17,0[b]	III
PROTEIN	I	28,7[a]	42,3[b]			
	II	45,1[a]	54,6[b]			
	III	34,2[a]	38,5[b]			

REFERENCES.

BARNES, H. and BLACKSTOCK, J., 1973. Estimation of lipids in marine animals and tissues: detailed investigation of the sulphophospho-vanillin method for total lipids. J. Exp. mar. Biol. Ecol., 12: 103-118.

BRADFORD, M. M., 1976. A rapid and sensitive method for the quantitation of micrgram quantities of protein utilizing the principle of protein-dye binding. Anal. Biochem., 72. 248-254.

HOWELL, B. R., 1977. Aspects of the development of cultivation techniques for flatfish, Ph. D. Thesis, M.A.F.F., Fisheries Laboratory, Lowestoft U.K., 53: 833-838.

KOCHERT, G., 1978. Carbohydrate determination by the phenol-sulfuric acid method. In: Handbook of phycological methods: physiological and biochemical methods. Ed. by J. A. Hellebust and J.S. Craigie. London: Cambrige University Press: 95-97.

LOVERGROVE, T., 1966. The determination of the dry weight of plankton and the effect of various factors on the values obtained. In: Some contemporary studies in marine science. Ed. by H. Barnes, London: 429-467.

P-V4

Heterotrophic Plankton dynamics in the stratified water column in the Gulf of Trieste (Northern Adriatic)

Valentina TURK, Lovrenc LIPEJ and Alenka MALEJ

Marine Biological Station, Institute of Biology, JLA 65, 66330 Piran (Yugoslavia)

The classical view of planktonic food chain changed with the realization that bacterioplankton is a major pathway in the flux of organic material and energy in pelagic marine ecosystems. Nanoflagellates are important bacterivores, and appear to be regulated through predation by larger protozoa (Wikner & Hagström, 1988). Rapid remineralization of organic matter channeled through bacterioplankton and the prozoan predator-prey chain can cause the release of nutrients.

The field population dynamics based on abundances of bacterioplankton and those organisms presumed to be their predators was followed in the coastal waters of the Gulf of Trieste during summer in 1988 and 1989. Standard methods were used for collection of the samples. Epifluorescence microscopy was used to count bacteria and nanoflagellates in formalin preserved and stained samples, and live cyanobacteria in green excitation light. Bacterial production was measured by the incorporation of ^{3}H-thymidine (Fuhrman & Azam,1982). Microzooplankton (< 200 µm) was enumerated in formalin preserved samples, using a Wild inverted microscope. The quantitative counts of net zooplankton (10 Standard net, 200 µm mesh size) were made on aliquots of the formalin sample.

A seasonal study showed the dominance of autotrophic cyanobacteria, and an increase of heterotrophic bacterial biomass and production during the period of stratification (Fig.1-A,B). The biomasses of heterotrophic bacteria and cyanobacteria were high in July and August, with abundances of 9.1-14.0*10^8 cells $l^{-1}$and 2.6-5.6*10^7 cells l^{-1}, respectively. A peak of bacterial production up to 5.4*10^4 cells l^{-1} h^{-1} was observed in August.

A bloom of nanoplankton and picoplankton developed in late July-August presumably due to low abundance of main predators, and direct microbial utilization of the fraction ungrazed by higher levels. The seasonal dynamics of protozoa and metazoa (Fig.1-C,D) support this presumption. After a peak of 1.4 *10^6 cells l^{-1}, flagellate number decreased through the summer, while abundance of ciliates increased at the end of August, which coincided with bacterioplankton sharp decrease. Total microzooplankton abundance varied from 56 to 669 ind./l, with the dominance of oligotrichous ciliates such as Aloricates (*Strombidium* and *Tontonia*) and the tintinnid *Helicostomela subulata*. Other tintinnids (*Eutintinnus* spp., *Tintinnopsis* spp., *Dictyocysta* sp., *Favella ehrenbergi*, *Stenosemella* spp., and *Steenstrupiella*) were encountered rarely with low abundance.

Copepods with dominant neritic species (*Acartia clausi*, *Clausocalanus* spp., *Ctenocalanus vanus*, *Paracalanus* sp., *Temora longicornis*, *Centropages typicus*, *Oithona* spp., *Oncaea* spp.) were not important in the stratified pelagic system and showed clear peaks of abundance in May and October. On the contrary, cladocerans (dominant species *Penilia avirostris*) showed a large pulse of abundance in August, and similar seasonal pattern has been observed also for Appendicularia (dominant species *Oikopleura dioica* and *O. longicauda*).

Bacteria and cyanobacteria are actively consumed and metabolized by a variety of micrograzers depending on individual feeding capability and efficiency. Similar trophic interaction and the role of predators in regeneration of nutrients in the pelagic food web have been observed also in other environments (Rassoulzadegan & Sheldon, 1986; Wikner & Hagström, 1988).

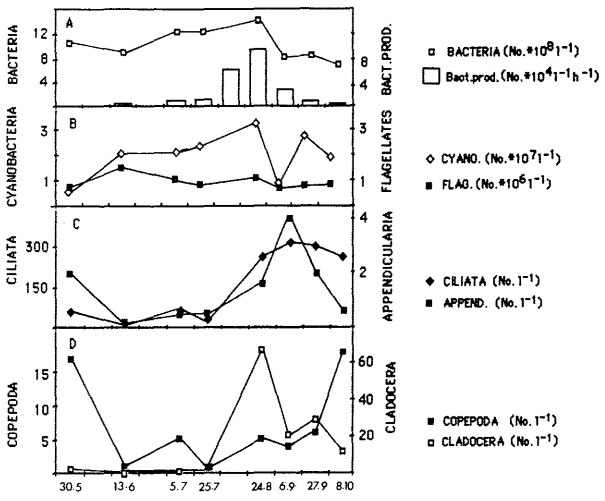

Fig. 1. Seasonal dynamics of bacterioplankton (A,B), microzooplankton and net zooplankton (C,D)in the Gulf of Trieste in the stratified water column during summer 1989.

Fuhrman, J.A. and F. Azam. 1982. Thymidine incorporation as a measure of heterotrophic bacterioplankton production in marine surface waters: evaluation and field results. Mar. Biol. 66: 109-120.

Wikner, J. and Hagström Å. 1988. Evidence for a tightly coupled nanoplanktonic predator-prey link regulating the bacterivores in the marine environment. Mar. Ecol. Prog. Ser. 50:137-145.

Rassoulzadegan, F. and R.W. Sheldon. 1986. Predator-prey interactions of nano-zooplankton and bacteria in an oligotrophic marine environment. Limnol. Oceanogr. 31(5): 1010-1021.