Residue from Bacterial Decomposition of Green Algal Cells as Food for Daphnia

STUDIES of the ecological significance of particulate organic matter as food for zooplankton in seawater and lake have established the nutrient significance of such detritus for different species of Cladocera.

Rodina[1] showed that daphnids develop when fed on newly collected lake detritus. And *Cladocera* can feed on suspensions of artificial detritus, made by pounding up vegetable and animal tissues. Little attention, however, has been paid to the age of detritus. Jørgensen[2] pointed out that it is reasonable to assume that the food value of detritus will vary considerably, especially with its age: the nutritional value of recently dead organisms decreases with time because of bacterial decomposition. Knowledge of the food value of dead algal cells decomposed by bacteria is essential for assessments of the role of old detritus in deep seawater. We have tested the food value of the residue of dead green algae, *Scenedesmus* sp., after bacterial decomposition.

Scenedesmus sp., killed by freeze-drying, was decomposed by microflora extracted from lake mud in aerobic conditions at 20° C for 220 days[3]. The residue was then centrifuged and dried in a vacuum desiccator with phosphorus pentoxide. The residue consists of fragments of green algal cells containing chlorophyll derivatives. Young *Daphnia carinata*, produced from five parthenogenetic females within 12 h of arriving in the laboratory, were put into water which had been filtered through a 'Millipore' filter (HA-type mean pore size 0·45 microns). After 24 h their initial body length was measured. Ten daphnids were then introduced into each of three bottles with 500 ml. of filtered water and the temperature was kept at 25° C for 17 days.

The first group was fed once daily with a 2 ml. suspension containing about 1 mg dry weight of fresh *Scenedesmus* sp. killed by freeze-drying. The second group was fed daily with a 2 ml. suspension containing about 1 mg dry weight of decomposed residue of *Scenedesmus*. The composition of the dead algae was 51·88 per cent C, 7·48 per cent H and 9·22 per cent N, and of the residue 61·30 per cent C, 5·50 per cent H and 8·25 per cent N on an ash-free basis. A third group was starved.

The offspring produced during this experiment were counted every 1 to 2 days and removed from the culture vessel. The guts of daphnids fed with the residue were always filled with the green residue.

Fig. 1 shows the change of mean body length of each daphnid group. The daphnids fed with the residue, the second group, showed a significant increase in body length, although the growth rate of this group was less than that of the first group fed with fresh *Scenedesmus*. The growth of daphnids fed with fresh *Scenedesmus* was almost the same as that reported by Suginome and Baba[4]. On the other hand, the starved daphnids died within a few days without growing.

Fig. 2 shows the total number of young produced. In the group fed with fresh *Scenedesmus*, the first young

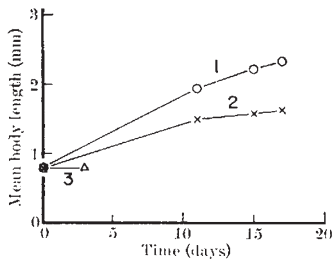

Fig. 1. Growth of mean body length of each daphnid group. (1) Fed with fresh *Scenedesmus* killed by freezing-dry; (2) fed with the decomposition residue of *Scenedesmus*; (3) starved.

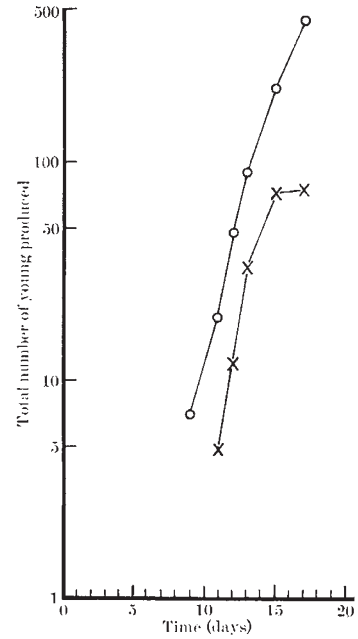

Fig. 2. The total number of young produced by ten mother animals. ○, Fed with fresh *Scenedesmus*; ×, fed with the decomposition residue.

appeared on the ninth day, whereas the second group fed the residue produced their first offspring on the eleventh day. The mother daphnids of the first group continued to produce young, but those of the second group ceased to produce young on the fifteenth day. This suggests, as expected, that the nutritional value of the residue is less than that of fresh *Scenedesmus*. The residue we used contains bacterial organic matter, but not enough to account for the growth of the daphnids. The residue contains only about 0·02 per cent bacterial carbon. The growth and reproduction of the daphnids can therefore be attributed to the nutritional value of the residue.

Our results and similar experiments[6] indicate that the residue of algal cells decomposed by bacteria can maintain the growth and reproduction of planktonic *Crustacea* to a certain extent. The residue we used is equivalent to aged detritus of algal cells in natural waters, and estimates of the settling velocity of algal cells[5] in the sea indicate that the detritus would settle below 600 m from surface during 200 days.

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Received February 24; revised April 9, 1969.

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