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Nutrition and Aging in *Tokophrya infusionum**

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Tokophrya infusionum, a fresh water protozoan from the class Suctorina, is exceptionally favorable for experiments on the influence of food on life span and reproduction.

Since the organism feeds only on living ciliates which become attached to its tentacles, the amount of food and time of feeding can be regulated. Both *Tokophrya* and the prey are cultured in bacteria-free conditions. It is easy to create a state of overfeeding because there is no limit as to the amount of food ingested. The endogenous budding method permits the reproducing adult to continue reproducing while surviving for a period of weeks, which makes it possible to perform experiments on the same reproducing individual for a considerable length of time. Because adult *Tokophrya* are sessile, individual records are possible on many organisms in the same culture vessel throughout their life span.

It was found that the amount of food influences the rate of reproduction. If a *Tokophrya* feeds constantly for over 48 hours, it changes to a giant individual. Such a giant organism stops reproduction and disintegrates after a few hours, which leads to the conclusion that the amount of food influences not only the reproduction rate but also the life span.

A series of experiments were performed in the summer of 1951 to determine the effect of heavy feeding, contrasted with meagre diet and intermittent starvation, on the life span of *Tokophrya*.

The first experiments were performed in hanging drops. This method, although efficient for the problem of reproduction, was found unsatisfactory for prolonged experiments dealing with life span. The frequent lifting of the cover-slip, fastened by vaseline to the moist chamber, entailed both the danger of breaking the cover-slip and of contamination. Moreover, because of the small size of the drop, the growing population became confusingly dense. This method was therefore replaced by the use of tubes with screw caps. To each tube filled with autoclaved spring water, a few embryos, together with a small amount of food, were introduced. On the outside of the

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tube, a square mark was drawn close to the top of the medium. The organisms which appeared on the glass within the marked square were checked periodically. Every young Tokophrya, found attached to the glass within the mark, was recorded on a graph paper by a number. A squared micrometer, placed in the eyepiece of the microscope, made it possible to determine the location of each Tokophrya. In this way, a map was formed which showed the location of each Tokophrya. A record of every Tokophrya was kept as to the age and amount of food consumed. When food was introduced, notes were made as to the amount of ciliates attached and taken in by each of the studied Tokophrya, only a limited number of Tokophrya, about 30, were kept under observation in one tube, which was not an excessive number for simultaneous, exact observation. The value of the tube method lay in the large amount of culture medium, in the easy way of feeding, and in the fact that all experimental individuals were subject to the same conditions as to air, temperature, exposure to light, and food distribution.

Three series of experiments were performed:

- A. Abundant food introduced daily (each Tokophrya consumed 8-15 Tetrahymena daily).
- B. Abundant food, with intermittent starvation lasting one day (each Tokophrya consumed 8-15 Tetrahymena every second day).
- C. Little food, with intermittent starvation lasting 1-2 days (each Tokophrya consumed 1-3 Tetrahymena every second to third day).

In Series A, over one third lived 2-5 days, and almost a half of the experimental individuals lived 6-9 days. In Series B, where food was abundantly furnished every second day, a significant prolongation in life was found. In this series also, 23 individuals (over 38%) survived 10-13 days, while in Series A, only 11 (18.3%) lived 10-13 days. In Series B, besides this, 15% of individuals lived 14-17 days, a life span not attained by any one of the animals in Series A. The results in Series C differ significantly from both Group A and B; 17% of individuals lived 18-25 days, a length of time not reached by those in the other two groups.

Of interest is the average life span in these three series of experiments. In Series A, the average life span is 6.87 days; in B, 9.5 days; in C, 13.2 days.

These experiments point to the conclusion that individuals kept on a meagre diet, with intermittent starvation, live on the average almost twice as long as those kept on a heavy diet. These experiments show clearly that abundant food shortens life drastically in Tokophrya infusionum, while both a meagre diet and intermittent starvation favor longevity.