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**Wykorzystanie zielenicy *Dictyosphaerium pulchellum*
jako pokarmu przez niektóre skorupiaki planktonu
słodkowodnego**

**The utilization of the green alga *Dictyosphaerium
pulchellum* as food for certain crustaceans of fresh water
plankton**

Wpłynęło 12 listopada 1974 r.

Abstract — An investigation was carried out on the suitability of the green alga *Dictyosphaerium pulchellum* as food for seven species of aquatic crustaceans: *Daphnia longispina*, *D. magna*, *Simocephalus vetulus*, *Scapholeberis mucronata* (Cladocera, Phyllopora), *Notodroma monacha* (Ostracoda), *Macrocyclus fuscus* (Cyclopoida, Copepoda), *Diaptomus* sp. (Calanoida, Copepoda). It was found that the largest daily food ration of *D. magna* was almost 16 per cent of its body weight. The nutritive value of this green alga evaluated on the basis of the assimilation index (C_a/w) is very low, this index having values lower than 1 per cent.

A knowledge of the degree of utilization of food by various zooplankton organisms allows their role in the circulation of organic matter and energy in a water body to be evaluated. Among different methods that may be used in determining food rations, assimilation, etc., the ^{14}C method was selected, which, being constantly developed, permits rapid quantitative determination of these parameters (Marshall, Orr 1955 a, b, Sorokin 1966, 1968, Schindler 1968, Monakov 1972).

In the present work the nutritive value of the green alga *Dictyosphaerium pulchellum* for seven plankton crustaceans was studied. This green alga (fig. 1) develops very well in waters containing great amounts of nitrogen compounds. In the Laboratory of Water Biology of

the Polish Academy of Sciences in Kraków its culture was conducted on diluted sewage from the fertilizer department of the Tarnów Nitrogen Works. The sewage contained on the average about 120 mg/l of total nitrogen. Of this about 100 mg was N-NH₄, about 15 mg N-NO₃ and about 2 mg N-NO₂ (collective work, 1973). Parallely, the culture of this species was carried out on Chu-10 medium. Because of the strong development of *D. pulchellum* in the sewage, an attempt was made to find such crustacean species for which this green alga could serve as food.

Method

Labelling of food was conducted in a slightly differences from that recommended by Sorokin (1968). To 150 ml of carbonate-free Chu-10 medium about 40 μ Ci Na₂¹⁴CO₃ was transferred, several millilitres of alga culture condensed by centrifugation then being added. The flask with the inoculated medium was placed in a culture box at 22°C under 3 600 lux. After four days the algae were centrifuged and diluted to 100 ml with lake water. This was repeated five times, after which the centrifuged algae were passed to a 50 ml measuring flask and diluted with lake water. Some of these labelled algae were used in determining the initial concentration of algae: N₁ — number of cells in 1 ml of the suspension.

From the parallely conducted unlabelled culture some of the algae were taken for determination of the average weight of a dry cell. A few millilitres of alga suspension of known concentration of cells was filtered through a membrane filter (SM 113 08 type), washed with 0.05 N HCl, dried, and weighed. The number of cells in 1 ml were determined using a Coulter Counter. In this way the dry weight of a cell was found to be 49.4×10^{-9} mg.

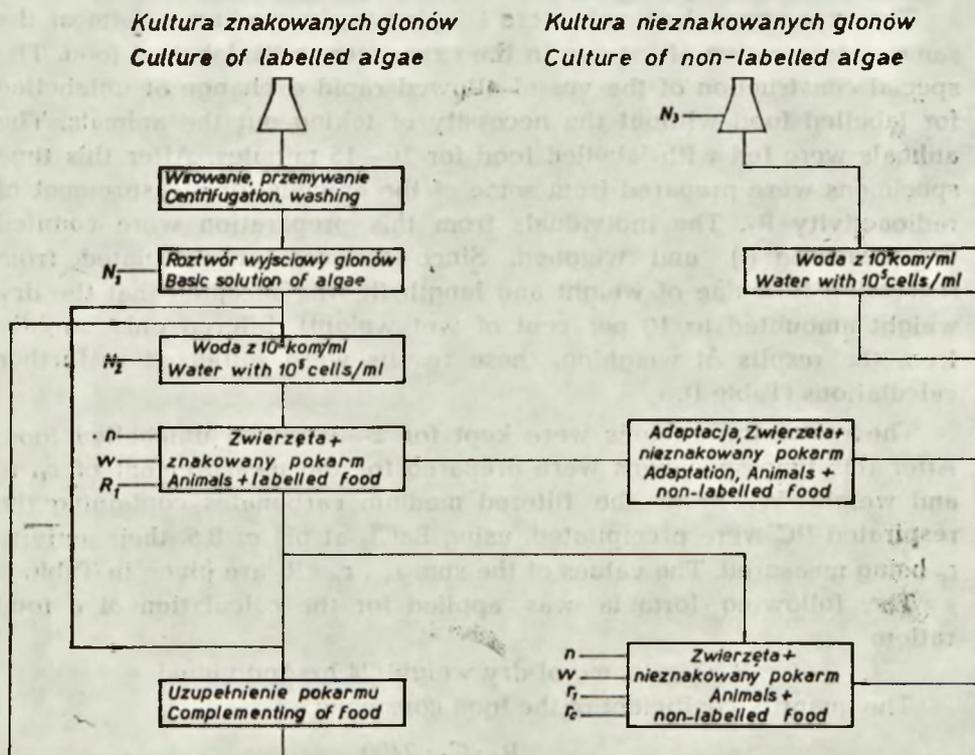
Fig. 2 shows the scheme of the experiment. In the water with the concentration of about 100 000 cells of *D. pulchellum* in 1 ml, prepared from the initial solution, the number of cells was precisely determined (N₂). From the activity measurement of three samples prepared by filtering 1 ml of alga suspension through a membrane filter the reverse of specific activity C_r was determined:

$$C_r = \frac{c}{R} \text{mg/impulse}$$

where R is the activity of the sample and c — its dry weight.



Ryc. 1. — Fig. 1. *Dictyosphaerium pulchellum* (fot. — phot. W. Huk)



Ryc. 2. Schemat doświadczenia
Fig. 2. Scheme of the experiment

Tabela I. Dane o wykorzystaniu pokarmu (*Dictyosphaerium pulchellum*) przez różne skorupiaki planktonowe. \bar{w} - średnia sucha masa osobnika w mg; \bar{N} - ilość komórek *D. pulchellum* = ml; C_r - odwrotność aktywności właściwej w 10^{-9} mg suchej masy na impuls; R_1, R_2 - aktywność zwierząt przed wydalaniem zjedzonego pokarmu i po wydaleniu w imp./godz./osobnik; C - dzienna racja pokarmowa w mg suchej masy; C/\bar{w} - współczynnik ilości zjedzonego pokarmu w %; C_a/\bar{w} - indeks przyswajania w %

Table I. Data on the utilisation of food (*Dictyosphaerium pulchellum*) by various plankton crustaceans. \bar{w} - average dry weight of a specimen in mg; \bar{N} - number of *D. pulchellum* cells in ml; C_r - the reverse of the specific activity in 10^{-9} mg of dry weight per impulse; R_1, R_2 - activity of animals before excreting the food consumed and after the excretion in imp./hour/specimen; C - daily food ration in mg of dry weight; C/\bar{w} - coefficient of quantity of the food consumed in percentage; C_a/\bar{w} - assimilation index in percentage

Gatunek Species	\bar{w}	\bar{N}	C_r	R_1	R_2	C	C/\bar{w}	C_a/\bar{w}
<i>Daphnia longispina</i>	0.0574	119 600	216	327.10	6.12	0.001695	2.95	0.055
<i>Daphnia magna</i>	0.0188	86 400	289	432.48	12.26	0.002997	15.94	0.450
<i>Simcephalus vetulus</i>	0.0994	119 600	227	74.29	26.70	0.000404	0.41	0.146
<i>Diaptomus</i> sp.	0.0960	111 300	102	79.43	4.90	0.000194	0.20	0.012
<i>Macrocyclus fuscus</i>	0.0188	66 500	259	81.92	1.12	0.000359	1.91	0.037
<i>Scapholeberis mucronata</i>	0.0380	82 900	125	418.10	11.77	0.001254	3.30	0.093
<i>Notodroma monacha</i>	0.0930	100 600	133	44.72	4.14	0.000142	0.15	0.014

The experimental animals were adapted to the medium of almost the same concentration of food as in the experiment with labelled food. The special construction of the vessel allowed rapid exchange of unlabelled for labelled food without the necessity of taking out the animals. The animals were fed with labelled food for 10—15 minutes. After this time specimens were prepared from some of the animals for measurement of radioactivity R_1 . The individuals from this preparation were counted (n), measured (l), and weighed. Since the weight calculated from regression formulae of weight and length (it was accepted that the dry weight amounted to 10 per cent of wet weight) differed only slightly from the results of weighing, these results were subjected to further calculations (Table I).

The remaining animals were kept for 2—3 hrs on unlabelled food. After this time specimens were prepared for the measurement of r_1 , n , and weight W . From the filtered medium carbonates containing the respired ^{14}C were precipitated, using BaCl_2 at pH of 8.5, their activity r_c being measured. The values of the sum $r_1 + r_c = R_2$ are given in Table I.

The following formula was applied for the calculation of a food ration:

$$C = R_1 \cdot C_r \cdot 24 \text{ mg of dry weight/24 hrs/individual}$$

The quantity coefficient of the food consumed

$$C/\bar{W} = \frac{R_1 \cdot C_r \cdot 2400}{W} \%_0$$

Index of assimilation:

$$C_a/\bar{W} = \frac{R_2 \cdot C_r \cdot 2400}{W} \%_0$$

where: R_1 — activity of animals before the excretion of food in impulse /hr/ individual,

R_2 — sum of animals' activity after the excretion of food and of the activity of respired carbon in impulse /hr/ individual,

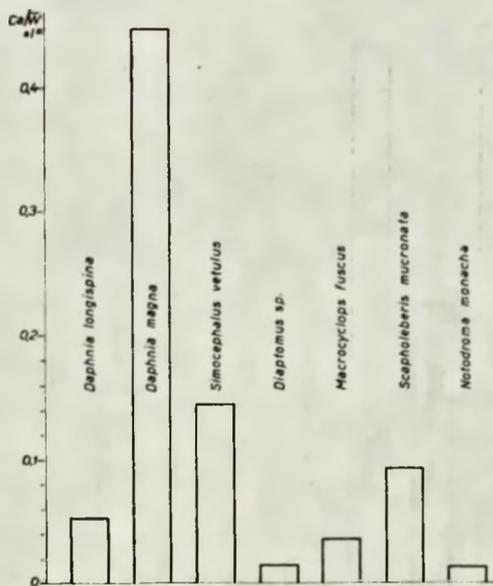
C_r — reverse of specific activity in milligrams of dry weight per impulse,

\bar{W} — mean dry weight of an animal in mg.

All measurements of preparations whose thickness exceeded 1 mg/cm^2 were corrected for self-absorption (Sorokin 1968, McGregor, Wetzel 1968) and background.

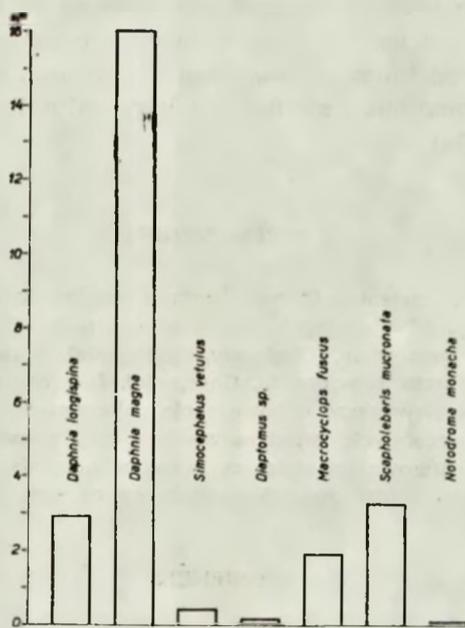
Results

The results are presented in Table I and in figs 3, 4, and 5. Out of seven species of crustaceans tested only *Daphnia magna* consumes *Dictyosphaerium pulchellum* in an amount attaining almost 16 per cent



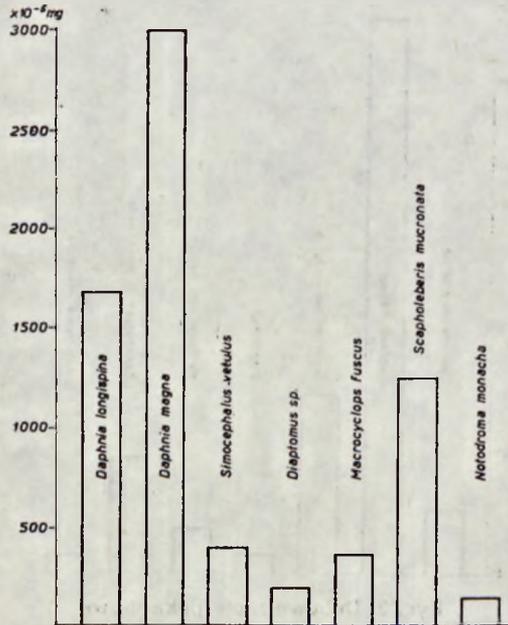
Ryc. 3. Dobowe racje pokarmowe

Fig. 3. Daily food rations



Ryc. 4. Dobowa racja pokarmowa jako procent wagi ciała

Fig. 4. Daily food ration as percentage of body weight



Ryc. 5. Indeks asymilacji dla badanych skorupiaków
 Fig. 5. Assimilation index of the investigated crustaceans

of its body weight. The other species practically did not consume this green alga. A review of assimilation indices (C_a/w) suggests poor suitability of this species for the crustaceans examined. For all species the above-mentioned index is less than 1 per cent, while, e.g., detritus from *Elodea* or *Lemna* has a similar nutritive value for *Bosmina coregoni* (Semenova 1974).

STRESZCZENIE

Badano przydatność zielenicy *Dictyosphaerium pulchellum* jako pokarmu dla siedmiu gatunków skorupiaków wodnych: *Daphnia longispina*, *D. magna*, *Simocephalus vetulus*, *Scapholeberis mucronata*, (*Cladocera*, *Phyllozoa*), *Notodroma monacha* (*Ostracoda*), *Macrocylops fuscus* (*Cyclopoida*, *Copepoda*), *Diaptomus sp.* (*Calanoida*, *Copepoda*). Stwierdzono, że największą dobową rację pokarmową ma *D. magna* — prawie 16% wagi ciała. Dla pozostałych gatunków wielkość racji pokarmowej waha się od 0,2 do 3,3%. Wartość pokarmowa tej zielenicy oceniona na podstawie wielkości indeksu przyswojenia (C_a/w) jest bardzo niska. Wskaźnik ten ma wartości mniejsze od 1%.

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