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Investigations concerning the energy turn-over of the Hyphantria cunea Drury caterpillars

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The primary consumers, i.e. organisms feeding on living vegetable material are of great importance in productive biology. As a result of their metabolism, the radiating energy fixed by the plants becomes accessible to the other members of the animal communities. The whole complicated system of the other organism of accumulative type (consumer) in the animal communities is established by their activity. They play a decisive role in directing the energy and material supplies of the animal communities to different levels. Neverthless our konwledge is very insufficient as to the details of their functioning.

These considerations led me to examine the energy turn-over of a caterpillar feeding on green leaves. I have chosen for the investigation Hyphantria cunea DRURY, recently carried from America into Europe, for this species can be easily reared, and besides, I have already made some researches concerning its all over metabolism (1.3.).

I used caterpillars of second generation, reared in the laboratory with open windows and fed the animals on leaves of Acer Negundo L. At the times of molting and when they have reached their maximum weight, a sufficient number of them were picked out, so were also a number of pupae less than 24 hours of age. Their excrement was gathered and separated for each larval instar. The energy content of these and that of the leaves was measured by burning of 0,27 to 0,94 g abs.dry material in a bombcalorimeter. The energy content measured in this way and expressed in cal. units, are represented in table 1. The data are the mean values of 2 to 4 measurements.

Food	Caterpillars		Excrement	
energy content (abs. dry material) cal/g	age (by moltings)	energy content (abs. dry material) cal/g	taken at larval instar	energy content (abs. dry material) cal/g
4380	1.	5481	1.	4024
	2.	5345	2.	4208
	3.	5370	3.	4202
	4.	5287	4.	4170
	5.	5285	5.	4202
	6.	5237	6.	4180
	at the maximal weight	5918	7. until the maximal weight	3928
	pupa	6635	after the maximal weight	3900

Table 1.

It leaps to one's eye that in the first six larval instars the specific energy content of the excrement is only, with 3,5 to 8,1 % less, while the specific energy content of the caterpillar is with 19 to 25 % more than that of the food. The situation changes in the seventh larval instar. The energy content of the excrement decreases (89,7 % of the food) while the energy content of the caterpillars considerably increases; finally a pupa with 1 g abs.dry weight at the pupation has an energy content surpassing by 51 % that of the food of equal weight.

Interpreting these data, we can say, that - though the organism of the caterpillar is composed, of course, of materials richer in energy then the leaves wich it feeds on - nevertheless the energy content of the excrement is considerably high, too. In other words: these animals can utilize the energy content of the food but in a relatively small degree; a great part of it gets into the excrement, i.e. to the excremental level. The energy store of the excrement of the caterpillars is only slightly lower then that of the green leaves. This fact directs our attention to the great importance of the course the excrement is going to take. By the same reason we emphasize the very important role played by the organism of coprophagous-recuperative type.

Heading	A caterpillar consumes, before reaching its maximal weight, 376,2 mg. of food (abs.dry material), of which		
	is accumulated	gets into the excrement	is consumed for maintenance of the organism
1.	12,2 %	77,0 %	10,8 %
2.	46,1 mg	289,5 mg	40,6 mg
Heading	A caterpillar receives with the food, before reaching its maximal weight, 1647,5 cal of energy, of which		
	is accumulated	gets into the excrement	irradiates
3.	16,6 %	70,9 %	12,5 %
4.	272,7 cal.	1168,2 cal.	206,7 cal.

Table 2.

The changes, mentioned above, taking place in the last one of the larval instars, can be explained by the fact that in this phase the animal - in order to secure the processes of the metamorphosis - stores materials of high energic content, principally fats (2.). This process is undoubtedly connected with the simultaneous decrease in the energy content of the excrement.

Calculations concerning the quantitative relations of the energy turn-over of the caterpillars can be made by comparing the data given in table 1 with the data of the all over metabolism of the animals.

The data given in the heading 1 of table 2 show the approximate percentage distribution of the dry material of the nutriment (accumulated, excreted and oxidated materials). In collecting these data, I relied up on my previous investigations (1.3.). By means of these data, the all- over metabolism of caterpillars of identical ontogenesis can be quantitatively calculated. (See table 2, heading 2.) So the outlines of the quantitative relations of the energy turn-over of these animals can be determinated. (See table 2, headings 3 and 4.) Details of calculation are omitted. It must be emphasized that the caterpillars utilize the food in a considerably varying measure during their ontogenesis. This fact was taken into consideration in the calculations.

The data of table 2 show that an average caterpillar receives with the food more than 1500 cal energy before reaching its maximum weight. 16,6 % of this energy is accumulated, 70,9 % gets into the excrement, and 12,5 % is radiated out of the system, during the processes maintaining the life-functions. All these data demonstrate the importance of the excremental phase.

The energy-contents were determined in the Institute of Physical Chemistry of the Technical University, Budapest.

LITERATURE

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