disturbance of embryonic processes that precede ovariole development[3].

A detailed report on the numbers of ovarioles and their structure is being prepared for publication. I am indebted to Mr. W. J. Brown of this Institute for identification of species and assistance with problems of synonymy.

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[1] Bonhag, P. F., "Ann. Rev. Entomol.", 3, 137, 143 (1958).
[2] Leng, C. W., "Catalogue of the Coleoptera of North America, North of Mexico" (Cosmos Press, 1920).
[3] Robertson, F. W., *J. Genet.*, 55, 410 (1957).

Nutritive Values of Carbohydrates for the Silkworm, *Bombyx mori*

Nutritional requirements for carbohydrates in insects have been widely studied[1], but not enough in the leaf-eating forms. This is mainly due to the fact that there are difficulties which must be solved before the determination of their nutritional requirements, namely, in devising a suitable test diet. In the silkworm, *Bombyx mori*, the nutritive value of the mulberry leaves has hitherto been discussed on the basis of the analytical data of leaf components as well as of the rearing experiments of larvæ. Though many efforts have been made to formulate a chemically defined diet for this insect, no suitable one has so far been made available. I have recently tried to determine the nutritive values of carbohydrates for the silkworm by means of oral administration of them.

Newly moulted, unfed fifth instar larvæ were used. All substances were supplied in the form of either a solution or a suspension and no leaf was offered to the larvæ[2]. A hypodermic needle mounted on a syringe was inserted from the mouth opening into the gut lumen and a known volume of such a solution (10 per cent, w/v) was administered once a day. The larvæ were kept at room temperature and weighed every day until death. Ten larvæ were used for one substance in each experiment. Data on survival tests have been calculated as the number of days that the larvæ remained alive, in other words, days to 100 per cent mortality. The mean was obtained by dividing the summation of days for each larva in one group by ten, as summarized in Table 1.

Any carbohydrate which increases survival beyond that of the control larvæ supplied with water alone can be assumed to be of nutritive value. Control larvæ usually survived for three days or a little longer and died somewhat sooner than those starved.

Among four pentoses tested, only xylose is utilized and arabinose and rhamnose are of little or no value. Ribose is slightly better than those two. Of the hexoses, glucose, fructose and mannose are good; galactose is of moderate value, while sorbose is exceptionally bad. The disaccharides are uniformly good. The trisaccharides raffinose and melezitose are well utilized. Both glycosides tested are scarcely utilized. Among alcohols, sorbitol and mannitol are utilized, but inositol is intermediate, and dulcitol is of no value. Dextrin is also good and much better than starch.

Table 1. Survival of Silkworm Larvæ administered with various Carbohydrates

Carbohydrate	Mean length of survival (days)		
	Experiment 1	Experiment 2	Experiment 3
Pentoses			
L-Arabinose	3·3	3·3	4·1
L-Rhamnose	3·2	2·9	4·0
D-Ribose	4·0	4·4	5·5
D-Xylose	5·9	7·8	9·8
Hexoses			
D-Fructose	6·1	5·6	7·7
D-Galactose	5·1	5·5	5·7
L-Sorbose	3·3	3·0	3·4
D-Glucose	6·8	7·1	7·9
D-Mannose	6·9	7·8	7·7
Disaccharides			
Sucrose	6·8	7·1	8·2
Maltose	5·9	6·9	6·2
Lactose	5·8	7·9	8·5
Cellobiose	7·2	8·7	8·3
Trehalose	6·9	6·3	8·2
Melibiose	6·2	7·3	8·4
Trisaccharides			
Raffinose	7·5	7·8	7·7
Melezitose	8·6	8·2	8·6
Glycosides			
α-Methylglucoside	3·5	3·2	4·3
α-Methylmannoside	2·7	2·8	3·6
Sugar alcohols			
Inositol	—	5·3	6·2
Mannitol	—	—	8·3
Dulcitol	—	2·6	3·8
Sorbitol	6·2	8·3	9·7
Polysaccharides			
Dextrin	—	6·0	9·6
Starch	—	—	5·4
Water	3·1	2·8	3·5
Starved	3·1	3·4	4·4

The results on the increase in body-weight also supported that on survival tests; carbohydrates increasing the length of life resulted in an increase in body-weight, while those not increasing survival were generally of no effect on the weight or rather often inhibitory. Thus, it is of interest that the nutritional requirements for carbohydrates by the silkworm are in good agreement with those of many other insects in many ways, even though there are great differences between insect species in the survival value of certain compounds.

Preferences for sugars have also been studied with this insect[3], and it is concluded that there is no correspondence between the nutritive value of various sugars and preference for them. Sugars which are preferred most and are of high nutritive value are sucrose, fructose and raffinose.

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[1] Trager, W., in "Insect Physiology", 350, edit. by Roeder, K. D. (John Wiley and Sons, Inc., New York, 1953). Lipke, H., and Fraenkel, G., "Ann. Rev. Entomol.", 1, 17 (1956). Friend, W. G., "Ann. Rev. Entomol.", 3, 57 (1958).
[2] Ito, T., and Tanaka, M., *Bull. Seric. Exp. Sta.*, 15, 353 (1959).
[3] Ito, T., *J. Inst. Physiol.* (in the press).

GENETICS

Autogenous Necrosis in an *Antirrhinum* Species Hybrid

Heritable plant tumours have been found in interspecific hybrids of *Nicotiana*[1,2], particularly in the hybrids of *N. glauca* × *N. langsdorffii*. Seldom, however, have they been found in any other plant material; an inbred line of clover[3] and interspecific hybrids of *Datura*[4] being possible extensions of the