dominantly circular outlines, have, all around, other fibrils of 40–60 Å closely crowded together among themselves so as to give the appearance of a surrounding wall (Figure 6).

Other observations carried out on the cells of the Walker tumour, on those of the Yoshida tumour and on those of human breast adenocarcinoma, have permitted us to establish that the nucleolini, present also in great numbers in the nucleoli, there corresponds to 'clear fibrillar zones' (Figure 7) with ultrastructural characteristics similar to those seen in the nucleoli of the oocytes.

Like the nucleolini, the clear zones are absent (Figure 2) in the smallest nucleoli and therefore they are more numerous in relation to the dimensions of the nucleoli. And this is the case as much in the oocytes as in the tumour cells. In the oocytes of *Patella coerulea* the same zones, like the nucleolini, are constantly absent in the so-called 'primary nucleolus' and present in the so-called 'amphinucleoli'. While the first always remain at a distance from the nuclear membrane, the second come alongside it an adherre closely to it. In the oocytes of *Haliotis lamellosa* the clear fibrillar zones, like the nucleolini, are only found in the peripheral part (Figure 5) of the more developed nucleoli. In fact, in the central part one finds a very large vacuole (Figure 5), which, in the electron micrographs, appears to contain material similar to that of the rest of the karyoplasm.

Moreover, in the amphinucleoli of the oocytes of *Patella coerulea*, it is possible to find rather large vacuoles (Figure 4) which have ultra-structural characteristics similar to those of *Haliotis lamellosa*.

What has been said will help to establish that it is not opportune, as some authors[8,9] have done, to identify the clear fibrillar zones with the endonucleolar vacuoles. In fact, already under the photon microscope, it was possible to single out the differences between the nucleolini and the vacuoles[3]. Now the electron microscope has enabled us to confirm these differences. These can be assigned, besides to the ultra-structural characteristics, to the dimensions, as well. These dimensions remain rather limited for the clear fibrillar zones, but for the vacuoles are always quite notable.

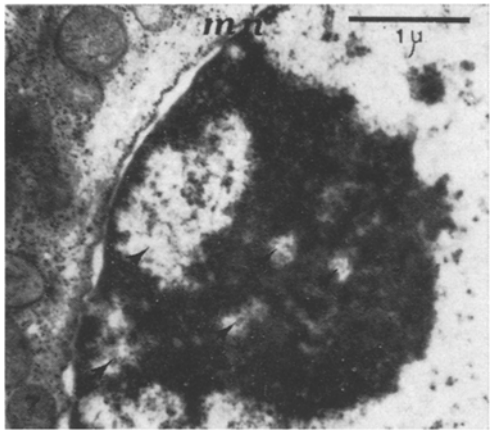

Fig. 7. Nucleolus of a cell of the Yoshida tumour adhering to the nuclear membrane (mn); various fibrillar zones are found (arrows). Technique is outlines in the text. × 16,000.

[8] H. Swift, *The Molecular Control of Cellular Activity* (McGraw-Hill Book C. Inc., New York 1962), p. 00.
[9] J. Gonzáles-Ramírez, Bol. Est. Med. Biol., Mexico *28*, 121 (1973).

The Influence of Maltose and Other Carbohydrates on the Feeding Behaviour of *Heteronychus arator* (Scarabaeidae: Coleoptera)

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Summary. Several of 17 carbohydrates stimulated ingestion by black beetle larvae (*Heteronychus arator*) and of these maltose induced an exceptionally strong response. Only maltose, glucose, fructose and sucrose stimulated feeding by adult beetles.

Investigations into chemical factors positively influencing ingestion by phytophagous insects have usually revealed a major role for sugars. Fructose, glucose, sucrose and maltose have been implicated in the feeding behaviour of a number of species. Sucrose has been particularly frequently cited as a strong phagostimulant, in comparison both with other sugars and with other plant constituents generally. In the case of those scarab larvae whose feeding behaviour has been studied[1,2], sucrose again emerged as the most effective carbohydrate; maltose, glucose and fructose were somewhat less so.

As part of a programme to identify the chemical basis for plant resistance to the black beetle, *Heteronychus arator*, we investigated the influence of 17 carbohydrates on ingestion by larvae and adults. Efforts by colleagues to rear this insect in the laboratory had been frustated by a failure of larvae and adults to feed vigorously on a standard artificial diet[3] containing sucrose and glucose (at concentrations of 3% and 0.5% respectively) as the only sugars. We hoped to resolve this problem.

Field-collected 3rd instar larvae and young adult beetles were starved for 24 h, then enclosed separately in 5.5 cm petri dishes, each with a single test disc of an artificial medium (4% agar, 4% cellulose powder) prepared with either distilled water or solutions of single sugars at concentrations of 0.1 *M*. Ingestion was estimated by counting the faecal pellets produced by each insect in 24 h[1].

Most of the carbohydrates induced some feeding by 3rd instar larvae; and sucrose, fructose, glucose and 1% starch can be considered effective feeding stimulants (Table I). But the response to 0.1 *M* maltose was exceptional. It far exceeded that to the other sugars and established that maltose is a major stimulant for feeding by these larvae.

[1] O. R. W. Sutherland, N.Z. Jl Sci. Technol. *14*, 18 (1971).
[2] R. J. Wensler and A. E. Dudzinski, Entomologia exp. appl. *15*, 155 (1972).
[3] P. Singh, New Zealand Patent applied for No. 174449. Date filed 4 June 1974.

Table I. The feeding responses of 20 3rd instar *Heteronychus arator* larvae and adults to carbohydrates tested at a concentration of 0.1 *M*

Test chemical	Total faecal pellets produced	
	Larvae	Adults
Pentoses		
Arabinose	168	47
Rhamnose	140	28
Xylose	206	32
Hexoses		
Fructose	474	464
Glucose	423	527
Galactose	287	19
Mannose	236	23
Sorbose	246	31
Disaccharides		
Maltose	894	588
Sucrose	570	362
Trehalose	302	35
Cellobiose	193	42
Melibiose	161	—
Tri- and polysaccharides		
Melezitose	253	40
Raffinose	128	68
Starch (0.1%)	217	20
Starch (1.0%)	484	127
Polyhydric alcohol		
Dulcitol	109	56
Blank	152	7

Table II. The feeding response of 20 3rd instar *Heteronychus arator* larvae to 0.1 *M* sucrose, 0.1 *M* maltose and 0.01 *M* ascorbic acid and to combinations of these

Test chemicals	Total faecal pellets produced
Sucrose	563
Sucrose + ascorbic acid	652
Maltose	901
Maltose + ascorbic acid	587
Ascorbic acid	285
Blank	142

At other concentrations maltose was less active: groups of 20 larvae offered discs containing the sugar at 0.001 *M*, 0.01 *M*, 0.1 *M* and 1.0 *M* concentrations produced 186, 492, 743 and 139 faecal pellets respectively. Adult beetles failed to respond to the majority of the test sugars. Only sucrose, fructose, glucose and maltose induced sustained feeding, but again maltose provoked the strongest response.

An earlier study[4] on the feeding behaviour of larvae of another scarab, *Costelytra zealandica*, showed that the response to the most active sugar, sucrose, was greatly enhanced by the addition of 0.01 *M* ascorbic acid, although on its own the acid had little effect on ingestion. Black beetle larvae, too, fed more vigorously on medium incorporating both these nutrients than on sucrose alone (Table II). But the addition of ascorbic acid to test discs containing maltose diminished rather than enhanced the insects' response to the sugar.

The response of *H. arator* larvae and adults to maltose is unusual. The sugar has commonly been mentioned as a phagostimulant for phytophagous insects but in only one earlier instance has it been found more effective than sucrose[5]. We have no explanation for the particularly strong response of black beetle larvae and adults to maltose. Starch can, however, be considered as being composed of a number of units of maltose and the response to it is therefore consistent with that to maltose.

We are glad to report that incorporation of maltose into the standard artificial diet rendered it much more acceptable to *H. arator* and the insects now feed more vigorously on it (PRITAM SINGH, personal communication).

[4] O. R. W. SUTHERLAND and J. R. HILLIER, N.Z. Jl Zool. *1*, 211 (1974).
[5] S. R. LOSCHIAVO, Ann. Am. ent. Soc. *58*, 576 (1965).

Anthelmintic Activity of Albendazole Against Liver Flukes, Tapeworms, Lung and Gastrointestinal Roundworms

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Summary. A new derivative, albendazole, of the benzimidazole group of anthelmintics which is active against nematode, cestode and trematode species, was found.

This article reports the discovery of a new anthelmintic with outstanding potency and spectrum of activity against liver flukes, tapeworms, and both lung and gastrointestinal roundworm infections. Albendazole is methyl [5-(propylthio)-1H-benzimidazol-2-yl]carbamate and has the chemical formula $C_{12}H_{15}N_3O_2S$ (Figure).

Albendazole is prepared from 4-*n*-propylthio-*o*-phenylenediamine and carboxymethylcyanamide. It is a stable, white, odorless powder melting at 214–215°C with decomposition. It is insoluble in water and is only slightly soluble in most organic solvents.

A single dose of 2.5–10 mg/kg administered orally to sheep and cattle naturally or artificially infected eliminated 94–100% of *Haemonchus*, *Ostertagia* and *Trichostrongylus* in the abomasum; and *Strongyloides*, *Nematodirus*, *Cooperia*, *Bunostomum*, *Trichostrongylus*, *Capillaria*, *Oesophagostomum* and *Chabertia* in the small and large intestines. *Trichuris* was reduced by 85% at 10 mg/kg.