Invertase activity in the gut of 6th instar larvae of *Spodoptera mauritia* Boisd. (Noctuidae, Lepidoptera)

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Summary. Invertase activity has been studied in the fore-, mid- and hindgut of the 6th instar larva of *Spodoptera mauritia.* The highest activity was in the midgut except during the early hours of the larval period when the foregut showed comparatively increased activity. The hindgut invertase activity may be from the voiding of enzyme along with the undigested food.

The process of enzyme-secretion is greatly affected by the developmental stage of the insect[2-4]. The nature of invertase in the salivary gland and/or gut of various insects has been studied by several investigators[4-8]. However, no information is available on the changes of invertase activity in the gut of insects during larval development. This paper describes the variations in the invertase activity in the different parts of the gut during the development of sixth instar larvae of *Spodoptera mauritia.*

Materials and methods. 6th instar larvae were separated immediately after moulting from the stock culture maintained in the laboratory under constant temperature and relative humidity. These larvae were fed on fresh grass *Eschaemum asistatum.* Invertase activity was determined throughout the 6th instar larval period at 24-h intervals.

The larvae were dissected in physiological solution to take out the alimentary canal which was then transected into fore-, mid- and hindgut. The various tissues were collected in small vials (8×4 mm), 5-10 similar tissues being pooled and homogenized in ice-cold distilled water. The homogenate was centrifuged at 3000× g for 30 min and the supernatant was used as the enzyme extract. The activity of invertase was determined by the colorimetric method of Somogyi-Nelson[7]. The activity was represented in terms of the weight of reducing sugar (glucose equivalent) produced by the enzymatic action per gm of gut tissue per definite period of time using glucose as standard.

Results and discussion. The invertase activity was localized in the fore-, mid- and hindgut of the larvae. Variations in the activity of this enzyme is represented in figures 1-3. It has been well known that the herbivorous insects generally have a fair amount of invertase activity in the gut and/or salivary gland[9-12]. The invertase activity is higher in the foregut immediately after moulting but it falls gradually up to 96 h and then registers a slight increase at 120 h. On the other hand the enzyme activity during the early period of development is low in the midgut. Later it increases up to 72 h and then falls at 96 h. At 120 h the invertase activity in the midgut rises to the highest level. The pattern of enzymatic activity changes very much with the development in *S. mauritia.* It has been reported that there is a steady increase in the amylase activity during the larval development of *Tenebrio molitor*[13], *Drosophila*[14] and *Lygus disponsi*[4]. Similar results are also obtained for protease activity during the larval development of *Bombyx mori*[15], *Galleria mellonella*[16] and *Lygus disponsi*[4].

The salivary gland shows invertase activity (unpublished observation). The secretion of this enzyme from the sali-

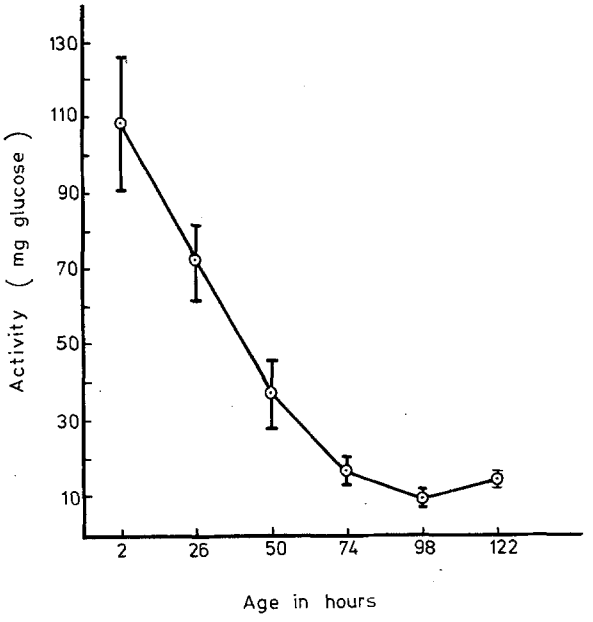

Fig. 1. Developmental variation of the foregut invertase activity of the 6th instar larvae of *S. mauritia* at pH 5.5, at 37 °C during at 30-min incubation.

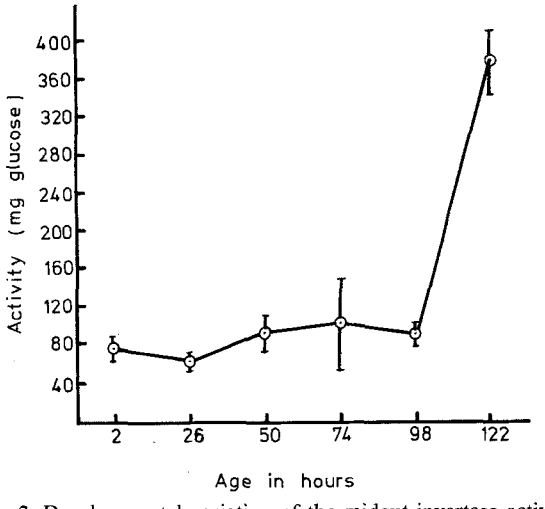

Fig. 2. Developmental variation of the midgut invertase activity of the 6th instar larvae of *S. mauritia* at pH 5.5, at 37 °C during a 30-min incubation.

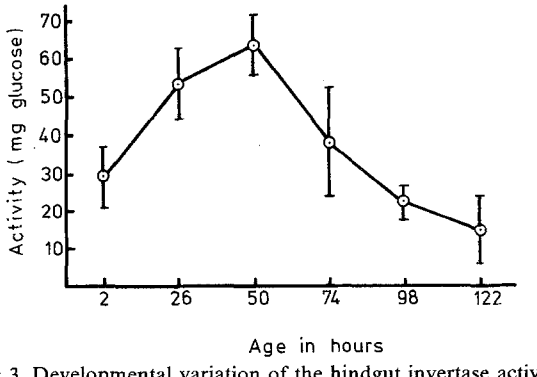

Fig. 3. Developmental variation of the hindgut invertase activity of the 6th instar larvae of *S. mauritia* at pH 5.5, at 37 °C during a 30-min incubation.

vary gland and the foregut during the initial stages of digestion may be the reason for an higher invertase activity in the foregut just after moulting. An alternative possibility is the regurgitation of enzyme from the midgut. However, there is a great decline in the activity of this enzyme in the foregut during the later period of development. The larva stops feeding at 72 h. Food materials are present only in the midgut during the final hours of development. This observation correlates well with the highest enzyme activity found in this region at 120 h. Though the invertase activity in the hindgut is low it is comparatively higher than that of foregut except at 120 h when the lumen is empty. It is quite probable that the invertase activity in the hindgut is a result of the voiding of enzymes along with the undigested food.

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Seasonal distribution of *Drosophila* species[1]

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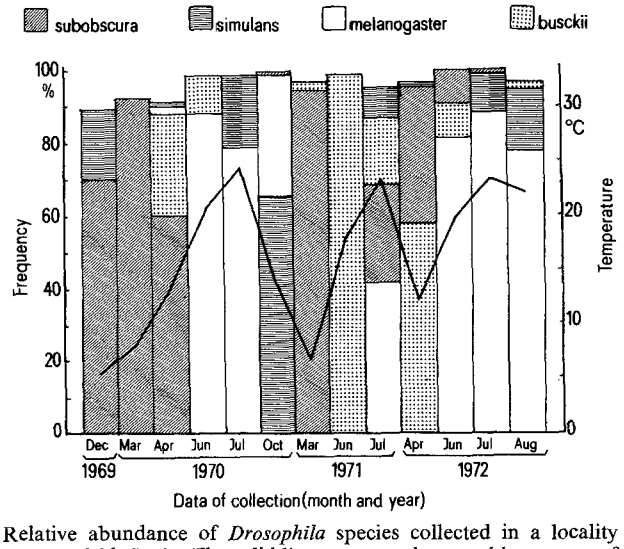
Summary. During a period of 3 years, and in different seasons, adult specimens of *Drosophila* were captured in an area in the center of the Iberian Peninsula. 11 different species were collected over the whole period. The abundance of the 4 more common species follows seasonal patterns: *D. busckii* assumes a preponderance in the spring, *D. melanogaster* in the summer, *D. simulans* in the autumn, and *D. subobscura* in the winter. It is suggested that seasonal changes may play a major role in making possible the existence of related species in the same habitat.

The coexistence of closely related species in the same habitat is a common phenomenon. What factors make possible the coexistence of species sharing in common some food and other resources remains a largely unsolved question. Competing species may coexist in a globally stable equilibrium if they utilize partially different resources, or at least of they utilize them with different efficiency[2]. One possibility little explored is that temporal variations in climate and other environmental characteristics may alter the composition of resources or the efficiency with which they can be utilized by related species.

Material and methods. This report gives the results of a series of *Drosophila* collections made in a small isolated wood from December 1969 to August 1972. The collection site is a small elm wood (387 × 13 m) in the outskirts of Madrid (11 km. from the town of Vallecas). The wood is surrounded by small bushes and grass with no other forests in the neighborhood, and the nearest isolated tree about 7 km away. The climate is continental with clearly differentiated seasons and little precipitation. Collections were made using baits of mashed banana seeded with yeast, left for 1 week at a time.

Results. 11 different species were collected over the whole period; 7 species were always rare or absent, while the other 4 were common at some time or other (table). The abundance of the 4 common species follows seasonal patterns; the figure shows the frequencies of different species in the various collections. *D. melanogaster* appears in late spring and is the predominant species in the summer months; *D. subobscura* is the most common species in late autumn and winter; *D. busckii* is found primarly in the spring, and *D. simulans* mostly in the autumn.

Discussion. The correlation between temperature and relative abundance may be used as an index of the association between specific abundance and season. The figure shows the monthly averages of the mean daily temperatures. The correlation between these monthly averages and the relative abundance of *D. melanogaster* is significantly positive ($r = +0.8347$, with 11 degrees of freedom, 95% confidence interval from $+0.45$ to $+0.93$) while the correlation with



Relative abundance of *Drosophila* species collected in a locality near Madrid, Spain. The solid line connects the monthly average of the mean daily temperatures.