

## Studies on the Physiology of Digestion in the last Instar Larva of the Rice Moth (*Corcyra cephalonica* Stainton)

### I. $p_H$ of the alimentary Canal

(*Lepidoptera: Galleriidae*)

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#### Introduction

*Corcyra cephalonica* STAINTON (*Lepidoptera: Galleriidae*), the Rice moth, is one of the common stored grain pests known in India. Its importance as a pest has been known since long, but in recent years the larva is being used as a host for rearing the parasites on large scale for the biological control of potato tuber moth (*Gnorimoschema operculella* ZELL.) and sugar cane borers, which has thus increased its importance. Considerable work on its nutritional requirements has been done by various workers, but its physiology of digestion remains untouched; it was, therefore, worked out in great detail to fill in this lacuna. The present paper deals only with the hydrogen-ion concentration of the alimentary canal of *Corcyra* larva.

WATERHOUSE (1949) has determined the  $p_H$  of the alimentary canal of 2 larvae and 40 adult lepidoptera, and has also given a review of the  $p_H$  of the gut of other lepidopterous insects.

#### Material and methods

Larvae were reared in laboratory and maintained on coarsely milled and autoclaved 'Jowar' (*Sorghum vulgare*) mixed with powdered yeast.

The most suitable method for the determination of the hydrogen-ion concentration in the alimentary canal was found to be one used by WATERHOUSE (1940), since the gut is transparent while its contents are opaque white. Fully developed last instar larvae were fed on grains of rice soaked in indicator solutions and then dissected at regular intervals. The change in the colour of food in different regions of the alimentary canal indicated the  $p_H$  range in the gut.

#### Observations

Table showing the hydrogen-ion concentration of the various regions of the alimentary canal and excreta of *Corcyra* larva

Name of the indicator	Regions of the gut			Excreta
	Fore-gut	Mid-gut	Hind-gut	
Bromo-cresol Green	>5.2	>5.2	>5.2	>5.2
Chlorophenol Red	>7.0	>7.0	{ <7.0 >4.6	{ <7.0 >4.6
Bromothymol Blue	>7.6	>7.6	>6.0	>6.0
Phenol Red	>8.4	>8.4	<6.8	<6.8
Cresol Red	>8.4	>8.4	<7.2	<7.2
Thymol Blue	<9.4	<9.4	<8.2	<8.2
Range of the $p_H$	8.4—9.4	8.4—9.4	6.0—6.8	6.0—6.8

<sup>1</sup>) Part of the thesis approved for the degree of Doctor of Philosophy of Lucknow University in 1958.

### Discussion

The  $p_H$  in different regions of the alimentary canal of *Corcyra* larva has been found to be in conformity with the findings of other workers on *Lepidoptera*.  $p_H$  of the fore-gut was found to be the same as that of the mid-gut. During the course of the work it was noticed that there was some regurgitation of the fluids from the mid-gut to the fore gut, as was evidenced by the presence of enzymes amylase and invertase in the contents of the fore-gut although absent in the walls. Since no buffer system is so far known to exist in the fore-gut of insects, the only probable reason which may account for the same  $p_H$  appears to be regurgitation of the fluids from the mid-gut.

The  $p_H$  of the mid-gut of *Corcyra* larva is alkaline, there does not appear to be any correlation between the  $p_H$  of the mid-gut and the food of the insect, as the available data shows that inspite of the wide variety of feeding habits of lepidopterous insects (e. g., carnivorous, phytophagous, nectar feeding and even wax feeding) the  $p_H$  continues to remain alkaline. The only available exception to the rule appears to the acidic  $p_H$  of adult *Bombyx mori* L. (JAMESON & ATKINS, 1924), the validity of this record has already been questioned by WATERHOUSE (1949), although he himself has not included the  $p_H$  of that moth in his paper, but he does refer to the work of ITAYA (1936) who has recorded the secretion for alkaline fluid from the mid-gut of silkworm. The alkalinity of the mid-gut of lepidopterous insects may probably be also due to the merocrine type of secretion in the mid-gut, but the author at present has no experimental proof to offer.

There does not appear to be any rule for the range of  $p_H$  neither on the basis of the food taken nor on the basis of the families in which the order Lepidoptera is divided, insects of same family or same feeding habits have different  $p_H$  e. g., *Corcyra cephalonica* STAINT. and *Galleria mellonella* L. both belong to the family *Galleriidae* but the  $p_H$  in the alimentary canal of both the insects is widely different, it is 8.4—9.4 in *Corcyra* and 7.0—8.0 in *Galleria* (ROY, 1937). Same is the case in *Heliothis obsoleta* FABR. and *Euxoa segetum* SCHIFF. both belong to the family *Noctuidae*, but have different  $p_H$  in their mid-gut. It is 8.0 in *Heliothis* (SWINGLE, 1931) and 9.7 in *Euxoa* (SKRJABINA, 1936).  $p_H$  of the hind-gut of *Corcyra* larva is weakly acidic. It appears that the products excreted by the Malpighian tubules containing uric acid in large quantities go to reduce the  $p_H$ .

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## Summary

The hydrogen-ion concentration of the fore- and mid-gut of *Corcyra* larva is strongly alkaline (8.4—9.4) and that of the hind-gut weakly acidic (6.0—6.8). The acidity in the hind-gut is due to the mixing of the acidic contents of the Malpighian tubules.  $p_H$  of the gut is not dependent upon the type of food of insect. Insects of the same family also differ in their  $p_H$ .

## Zusammenfassung

Die Wasserstoffionenkonzentration im Vorder- und Mitteldarm von *Corcyra*-Larven ist stark alkalisch (8,4—9,4) und die des Enddarmes schwach sauer (6,0—6,3). Die Azidität des Enddarminhalt ist auf die Vermischung mit den stark harnsäurehaltigen Exkretionsprodukten der Malpighischen Gefäße zurückzuführen. Der  $p_H$ -Wert des Darmes zeigt keine Abhängigkeit vom Futter der untersuchten Tiere. Vertreter der gleichen Familie weisen verschiedene  $p_H$ -Werte auf.

## Резюме

Концентрация ионов водорода в передней и средней кишке личинок *Corcyra* является сильно щелочной (8,4—9,4), а в прямой кишке — слабо кислой (6,0—6,3). Кислотность содержания прямой кишки объясняется смешением содержания с продуктами выделения мальпигиевых сосудов, содержащих много мочевой кислоты. Показатель  $p_H$  кишечника не проявляет зависимости от корма исследованных насекомых. Представители того же семейства имеют различные показатели  $p_H$ .

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\* Not seen in original.