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Effects of Epinephrine, JH and Corpora Cardiaca Extract on the Level of Various Sugars in *Lohita grandis* Gray (Hemiptera: Pyrrhocoriedae)

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Epinephrine was detected in the fat body of *Lohita grandis*. Exogenous treatment of epinephrine has been shown to be hyperglycemic in nature, causing marked depletion of glycogen contents from fat body and ovary resulting elevation of haemolymph sugar (particularly glucose) level. This diabetogenic action of epine phrine has been shared with the effects of JH and corpora cardiaca extracts. The extent of glycogen mobilization rate from fat body and ovary appeared maximum in corpora cardiaca extract treated insects followed by epinephrine and JH treatments.

Key Words: Epinephrine, JH, Corpora cardiaca extract, Sugars, *Lohita grandis*

Introduction

Presence of many vertebrate hormones in insects and their effects have been studied extensively (Novak 1966). Occurrence and effects of exogenous insulin in insects both in vivo and in vitro have received much attention of the workers (Dixit & Patel 1964, Hasegawa & Yamashita 1965, and Ishay et al. 1976). Ostlund (1954) reported presence of nor-epinephrine, dopamine and traces of epinephrine in some insects but any definite effects of epinephrine in insects is yet to be reported. Epinephrine, in addition to it's important roles as a stress hormone, takes part in the metabolism of carbohydrates in vertebrates. In insects role of juvenile hormone and corpora cardiaca extract in carbohydrate metabolism have been receiving increasing attention among the workers (Gilbert 1964, Orr 1964, and Mordue & Goldsworthy 1969).

It seemed interesting to study the occurrence of endogenous epinephrine in a bug especially in view of the fact that several members of this order display considerably higher glucose levels in the haemolymph than other insect orders (Wyatt 1967). With a view to these facts the present work investigates the possibility of the occurrence of

epinephrine in a bug *Lohita grandis* and the effects of exogenous treatment of epinephrine, JH and corpora cardiaca extracts on the levels of total sugars, glycogen, trehalose and glucose in the fat body, ovary and haemolymph.

Material and Methods

Experimental animals (*L. grandis*) were reared in the laboratory at 25±2°C and 75% RH and provided with 5% sugar solution with the plant extract on which the insects normally feed on. Only mature females were used in this experiment; they were injected with Epinephrine (Bengal Immunity Co. Ltd.) at the dose of 10 and 20 µl/insect and sacrificed at 12, 24, 36, and 48 hr interval after injection. Haemolymph was collected by a fine graduated capillary tube, previously rinsed with phenylthiourea solution.

Total carbohydrates was estimated following the method of Koehler (1952). For the determination of glycogen, protein was precipited by 5% TCA and estimated following the method of Carrol et al. (1956). Trehalose and glucose were estimated enzymatically using trehalase and glucose oxidase (Dahlman 1973). Effect of exogenous administration of epinephrine were compared with that of juvenile hormone analogue (JHI) and corpora cardiaca extract injections at the dose of 15 µl/insect (for JHI, the analogue was dissolved in double distilled acetone; for CC extract, one pair gland/15 µl insect normal saline was considered as standard dose). In all cases a control was maintained by injecting insect normal saline in same doses. In case of estimations from haemolymph whole blood was used, for other determinations fresh tissues were used. All experiments were replicated 9 times to minimize errors.

Estimation of epinephrine was done spectrophotometrically following the method of Euler (1950).

Results

In both nymphs and adults epinephrine was detected only in the fat body (28±4 µg/100mg wet wt).

Effects of exogenous administration of epinephrine were compared with that of JHI and CC extract treatments. Of the two doses of epinephrine 20 µl/insect appeared more effective (figure 1). All these treatments caused considerable decline of total sugar level in the fat body and ovary while the level was elevated in the haemolymph. Epinephrine in the fat body resulted 6–13% decline of total sugars in comparison to 11–35% and 20–35% by JHI and CC extract respectively. In the ovary highest depletion of sugar level was detected by the application of CC extract (14–25%) followed by epinephrine (11–22%) and JHI (2–14%). Mobilization of fat body glycogen appeared maximum in CC extract treated insects (21–37%) in respect of 15–37% by epinephrine and 9–18% by JHI. (Figure 1 A, D). Glycogen depletion from ovary appeared highest in CC extract treated cases (28–52%) followed by epinephrine (9–33%) and JHI (9–28%) (Figure 1 B, E). All these treatments however caused 50–133% increase of haemolymph glucose levels (Figure 1 C, E).

Discussion

Detection of some of the vertebrate hormones in various non-endocrine insect tissues like the occurrence of insulin secreting cells in the gut epithelium of some hymenopteran insects (Ishay et al. 1976) and in this investigation, presence of epinephrine in the fat body of *L. grandis* often suggest that in addition to definite endocrine glands some

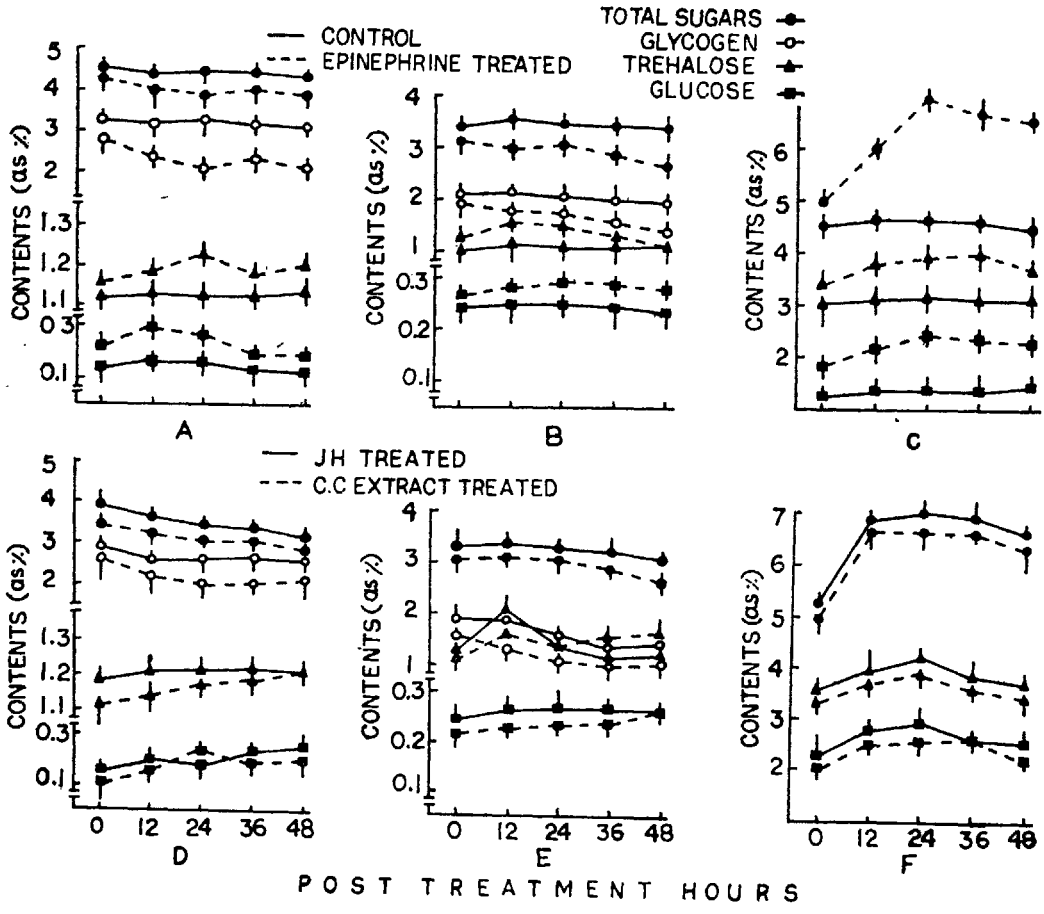

Figure 1 A–F Total sugars, glycogen, trehalose and glucose contents in fat body; ovary **(B, E)** and haemolymph **(C, F)** of female *L. grandis* under control, epinephrine (20 µl/insect) treated *(A, B, C)* and JHI and CC extract treated *(D, E, F)* conditions (Data represent mg/100mg wet wt in case of tissues and mg/100µl in case of haemolymph)

non-endocrine cells may function as endocrine cells.

In order to evaluate the possible role of epinephrine in the metabolism of sugars, the effects were compared with that of CC extract and JHI administration since both JH and CC hormone play an important role in the metabolism of carbohydrate in insects (McCarthy & Ralph 1962). Both these hormones caused substantial depletion of glycogen from fat body and ovary. This diabetogenic action of JHI and CC extract was comparable with that of epinephrine administration (Mordue & Goldsworthy 1969 and Goldsworthy et al. 1979). This hyperglycemic action of epinephrine confirmed that the mode of action of this hormone is same in insects as in vertebrates. The present findings however did not explore the possible pathway of epinephrine synthesis in this bug or

the precursor of epinephrine. However Ostlund (1958) suggested the occurrence of relatively higher amount of dopamine in insects which might be the precursor of this hormone.

With regard to the target of insect epinephrine action it seemed clear that it acted on stored glycogen to liberate free glucose and thus maintained a proper metabolic level of glucose and possibly other sugars according to the physiological needs.

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