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Nutritional Role of Lipids in Different Dietary Regimes of the Surface Grasshopper, *Chrotogonus trachypterus* Blanch (Orthoptera: Acrididae) During Nymphal and Adult Development

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Abstract

The surface grasshopper, *Chrotogonus trachypterus* is the polyphagous pest and found to occur in all *kharif* crops and grasses during the rainy season in Jodhpur district. During the present investigation studies were conducted on nutritional role of lipids in different dietary regimens (viz, Cabbage, Lucerne and Cotton) of the surface grasshopper, *Chrotogonus trachypterus* (Blanch). In the present study the data reveals that the concentration of total lipid in the dry leaves of cabbage comes to be 62.54 mg/g in adults, 58.69 mg/g in lucerne and 53.21 mg/g in cotton, respectively. The amount of total lipid ingested by cabbage fed grasshopper during the entire period were maximum (33.88%) and its followed by lower amount utilized by lucerne (29.45%) and cotton fed diets (25.18%), respectively, It was concluded that the results shows the regimen cabbage has higher lipid content in comparison to lucerne and cotton and more part of it is transmitted to the gut, haemolymph and fat body of the grasshopper *C. trachypterus.* Considering the quantitative analysis of lipid during metabolism in surface grasshopper among three dietary regimens, preferential nature of the surface grasshopper (nymph and adult) was Cabbage (*Brassica oleracea*) > Lucerne(*Medica sativa*) > Cotton(*Gossipyum hirsutum*)

Keywords: Cotton, Lucerne, Cabbage, *Chrotogonus trachypterus*, Insect Development.

Introduction

Surface grasshopper represents a major group of insect's pests in India. Grasshopper consume considerable amount of foliage during their nymphal developmental stage and as adults. When they are abundant they can damage economically important crops. Surface grasshopper requires warm, sunny conditions for optimal growth and reproduction, food and optimal weather condition also facilitate growth and development of surface grasshopper.

The main function of lipids in the living organism is to act as a concentrated food reserve and one gram of fat yield twice as many calories and twice as much metabolic water as the same weight of carbohydrate yield. However, even in death by starvation, lipid was found present in the body and this is presumably structural material. Lipids are often found in association with proteins and polysaccharides as lipoproteins and lipopolysaccharides. During recent years increasing attention has been paid to the possibility that the insect fat body may act as a site of intermediate metabolism, which is distinct from its more passive role of serving as a depot for the storage of fats, proteins and carbohydrates.

Insects which feed during adult life can acquire lipid reserves after adult emergence as occurs in the desert locust, *Schistocerca gregaria,* where as, insects which do not feed, as adults must acquire their lipid reserve at an earlier stage, as in the *Angoumois,* grain moth. Many insects characteristically accumulate lipid in high concentration at physiological stages of development for preceding periods of non-feeding such as pupation or diapause and also in maturing females for deposition in eggs.

Perusal of literature revealed that there have been a very few studies on the nutritional role of lipids of surface grasshopper. Therefore, present study in proposed to develop the lipids metabolic pool of three dietary regimens in surface grasshopper. These pools can be used in devising the management strategies for polyphagous pest.

In this study, detailed work was undertaken on the nutritional role of lipids in the food, gut content, haemolymph and excreta of surface grasshopper. The major aspects of present study is lipid utilization profiles in three dietary regimens namely cabbage, lucerne and cotton.

Material and Methods

The nymph and adults of *C*. *trachypterus* were collected from grasses in the vicinity of the Zoology Department, J.N.V. University, Jodhpur. These grasshoppers were kept in a big cage, the bottom of which was provided with 10 cm layer of moist soil. The soil in the cage was regularly moistened. The grasshoppers were then left for culture and breeding. The culture of grasshoppers was maintained at room temperature 27°C.

Estimation of Lipids

Quantitative Analysis

The soluble fat in dry food and excreta was estimated by employing the "Soxhlet Unit Method". The vacuum dried material was extracted in petroleum ether for three hours on water bath. The yellowish fat from the material was collected in round bottom flask and the percentage of fat was expressed in mg/gm.

Preparation of Petroleum Ether Extracts

The fresh or dry leaf material was taken in Whatman extraction thimble. The thimble was kept in the condenser of Soxhlet apparatus. Petroleum ether was used as solvent. The solvent was kept in the receiving flask. The condenser was attached to the water tap with the help of rubber tubes for continuous inflow and outflow of water. The receiver was kept on thermostatically controlled electrically operated water bath for boiling the solvent. The extraction process was continued for 6 hours. The quantity of solvent was kept constant through replenishment of the evaporated solvent. The material obtained after extraction was kept in porcelain crucible and kept on water bath for total evaporation of solvent. The semi-solid material left behind was considered as technical material.

From this extract, a weighed amount was taken and diluted with ethanol. This formed the stock solution, further, dilution were made from this stock solution with distilled water.

Results and Discussion

Lipids in phytophagous insects are usually in the form of triglycerides that is esters formed by the combination of glycerol's with fatty acids. Each of which comprises a long straight hydrocarbon chain usually 14 to 20 carbon atoms. The composition varies to some extent with the diet in some insects but in others it is quite independent of the difference in diet. The effect of the diet on the kind of fatty acids deposited in the fat body is seen especially **in** insects on a high fat diet, such as those living on oily seeds e.g. mustard aphids.

The ingestion of lipids or conversion of other substrates into lipoidal form, the breakdown in the digestive tract and its reconstitution in the fat body would all be to no avail unless the insect had an efficient mechanism for binding this potential ATP to a body site, where it could be utilized. The most general energy consuming processes in insects are flight, oogenesis and moulting (Gilbert, 1967).

Detailed information is available on the lipids present **in** the locusts and grasshoppers. But nobody has studied the relationship between lipids present in the dietary regimens, gut, excreta, haemolymph and fat body. These investigations were therefore designed to provide basic information on the lipids present in three dietary regimens (cabbage, lucerne and cotton leaves), gut, excreta, haemolymph and fat body of the nymph and adult of surface grasshopper feeding on these respective regimens. The concentration of lipids of three dietary regimens, percent utilization, percent transmission to gut, fat body and haemolymph.

The result shows that lipid concentration in *C*. *trachypterus* nymph when fed on cabbage leaves was (58.62 mg/g), followed by lucerne leaves (53.91 mg/g) and in cotton leaves (48.10 mg/g) (Table 1). Whereas in *C*. *trachypterus* adult, the concentration was (62.54 mg/g), (58.69 mg/g) and (53.21 mg/g) with cabbage. lucerne and cotton leaves (Table 2), respectively, which were significantly different from each other.

In case of excreta, the lipid concentration values of the nymph and adult was 19.10 mg/g and 21.19 mg/g (with cabbage leaves), 15.18 mg/g and 17.29 mg/g (with lucerne leaves) and 11.60 mg/g and 13.40 mg/g (with cotton leaves) respectively, which were significantly different from each other.

The present utilization of lipids by nymph and adult of surface grasshopper during metabolism was maximum in cabbage leaves, being 32.58 and 33.88 percent, respectively which were followed by lucerne and cotton leaves (28 15 and 29.45), (24.11 and 25 18) percent, respectively (Table 1 and 2). The percent utilizations was significantly different in the three dietary regimens.

The forgoing observations thus indicate that regimen cabbage has higher lipid content in comparison to lucerne and cotton and more part of it is transmitted to the gut, haemolymph and fat body of the grasshopper, *C*. *trachypterus.* Considering the quantitative analysis of lipid during metabolism in surface grasshopper among three dietary regimens, preferential nature of the surface grasshopper (nymph and adult) was

Cabbage > Lucerne > Cotton

The total lipid in the form of cholesterol is most wide spread in all the organs, although the highest concentration is found in nerve and glandular tissues of the surface grasshopper adults. Our results are in conformity with the findings of several workers such as Strong (1964) and Kilby (1965), in *Myzus persicae.* Mehrotra *et aL* (1972), *Schistocerca gregaria,* Henna *at at* (1983), in *Spodoptera exigua.* Our findings are further in agreement with those of Prasad and Phadke (1991), Sachan and Sachan (1991) and Febvay *et al.* (1992 and 1993) who have

interpreted similar correlation between aphid population and content.

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Table-1
Percent Utilization of Lipids in Dry Matter (in the Leaves) of Cabbage, Lucerne and Cotton When Fed to Nymph of *C. trachypterus*

S. No.	Dietary Regimens	Lipid Precent in								Percent Utilization			
		Dietary regimen (mg/g)				Excreta (mg/g)							
		R_1	R_2	R_3	Mean	R_1	R_2	R_3	Mean	R_1	R_2	R_3	Mean
1	Cabbage	58.62	58.60	58.64	58.66	19.10	19.12	19.08	19.10	32.58	32.62	32.53	32.58
2	Lucerne	53.90	53.93	53.91	53.91	15.17	15.20	15.18	15.18	28.14	28.18	28.15	28.15
3	Cotton	48.10	48.08	48.12	48.10	11.60	11.58	11.62	11.60	24.11	24.08	24.14	24.11

Table-2
Percent Utilizatin of Lipids in Dry Matter (in the Leaves) of Cabbage, Lucerne and Cotton When Fed to Adult of *C. trachypterus*

S. No.	Dietary Regimens	Lipid Precent in								Percent utilization			
		Dietary Regimen (mg/g)				Excreta (mg/g)							
		R_1	R_2	R_3	Mean	R_1	R_2	R_3	Mean	R_1	R_2	R_3	Mean
1	Cabbage	62.60	62.53	62.51	62.54	21.20	21.18	21.21	21.19	33.86	33.87	33.93	33.88
2	Lucerne	58.70	58.68	58.71	58.69	17.30	17.32	17.27	17.29	29.47	29.51	29.41	29.45
3	Cotton	53.21	53.20	53.23	53.21	13.40	13.42	13.38	13.40	25.18	25.22	25.13	25.18