SUMMARY

Insects are of incalculable importance to man. They are our major rivals for domination of this planet, and yet paradoxically they are also vital to our survival on it. On the one hand, they destroy our food – both before and after harvest, damage the wooden structure of our houses, and transmit our most devastating diseases. But on the other hand, they pollinate our crops, control many of our pests, and return much of our wastes to the soil. We need to know about how insecticides act physiologically and about how they enter and are degraded in the insect’s body – problems for which the study of insect physiology is vital.

*Chilo partellus* is one of the major polyphagous pests on full grown crop of Jowar, maize etc. Larvae feed on leaves and damage the leaves. Later caterpillar bores into the stem and damage the central pith of the stem. Since *Chilo partellus* is a stem borer, it is difficult to control this pest. *Chilo partellus* belong to order Lepidoptera and family Crambidae.

The life cycle of *Chilo partellus* is completed in about 40 to 45 days, in which embryogenesis period is of 5 to 7 days, larval growth 20 to 25 days, metamorphosis (pupal stage) 10 days and adult development 4 to 5 days.

Lipids have assumed considerable functional significance during the evolutionary history of the class insecta. They are essential structural components of the cell membrane and cuticle. They provide a rich source of metabolic energy for periods of sustained energy demand. They facilitate water conservation both by the formation of an
impermeable cuticular barrier and by yielding metabolic water upon oxidation and they include important hormones and pheromones. Insect larvae are known to accumulate lipids, glycogen and proteins during development. This material can be used during metamorphosis and adult development. The reserve fat of insects stored is usually in the form of triglycerides. The triglycerides are then utilized for energy production and other purposes. Lipase is the enzyme which is responsible for hydrolysis of triglycerides. Therefore, the present study attempts to provide information on lipase activity during embryogenesis, larval growth, metamorphosis, adult development and in fat bodies of *Chilo partellus* which may be useful in controlling this most serious pest of maize.

Lipolytic activity was determined by the method of Hayase and Tappel (1970) and Koichi Itaya (1977). Protein was determined by the method of Lowry *et al*, (1951).

a) Embryogenesis:

1) The embryonic developmental period of *Chilo partellus* is of 6 days.
2) The partial characterization of enzyme revealed optimum pH 6 and 8, temperature 37°C and incubation time 30 minutes. The rate of reaction increased linearly upto 1 per cent enzyme concentration. The apparent Km observed was 0.5 mM.
3) The egg lipase hydrolysed triglyceride and released fatty acids.
4) Gradual increase in lipolytic activity from first to 4-day eggs indicates carbohydrate catabolism during early embryogenesis as a source of energy.
5) Rapid increase in lipase activity from 4 to 5-day suggest the lipid catabolism at the later stage of embryogenesis which provides energy and structural components to the developing embryo.

6) The maximum activity observed in 5-day eggs indicates maximum utilization of lipids for release of energy and supply of structural components to the developing embryo. Sharp fall from 5 to 6-day egg suggests the less requirement of energy and structural components to the embryo.

7) Due to the presence of lipases in the eggs the proportion of triglycerides vary with the physiological state of the developing eggs. Thus lipase plays an important role during the embryogenesis of *Chilo partellus*.

8) The gradual increase in the total protein from 1 to 6-day eggs indicates synthesis of new proteins which provide structural components to the developing embryo.

b) Larval growth:

1) The larval developmental period of *Chilo partellus* is of 20 days with 5 instars.

2) The partial characterization of enzyme revealed optimum pH 7.5, optimum temperature 37°C, 10 minutes incubation time is the initial velocity and the maximum lipase activity was observed at 30 minutes incubation time. The rate of reaction increased linearly upto 1 per cent enzyme concentration. The apparent Km observed 0.5 mM.

3) Increase in the lipolytic activity from 1 to 11-day (first 3 instars) indicates the active feeding period of larval development and energy may be supplied by triacylglycerol catabolism.

4) The fall in the lipase activity from 11 to 20-day larvae (4th and 5th instars) suggests the less active stage of larval development.
During this period the reserve fat may be stored in the form of triacylglycerides in fat bodies which may act as reserve source for pupal-adult development.

5) The decline in the rate of reaction at each moult indicates the less active period requiring less energy. The moulting may be associated with the changes in other tissues and alteration of insect activity.

6) Thus due to presence of lipase in living tissue the proportion of triacylglycerides vary with the physiological state of the developing larvae.

7) The gradual increase in total protein upto third instar, indicates synthesis of new proteins which provides structural components to the somatic growth of developing larva. After third instar the protein content lowered and remained relatively constant, which may be due to the less utilization of protein for the structural elements. The increase in the total protein in the fifth instar indicates storage of protein in the fat body which are utilized during metamorphosis.

c) Metamorphosis :

1) Pupal developmental period of *Chilo partellus* is of 10 days.

2) Partial characterization revealed optimum pH 6, temperature 37°C, incubation time 30 minutes, enzyme concentration 1 per cent and substrate concentration 5 per cent.

3) The gradual increase in lipase activity from 1 to 4-day pupae indicates the histolysis and active role of lipase.

4) Decline in the rate of reaction from 4 to 7-day pupae suggests decrease in the rate of histolysis.
5) Maximum enzyme activity noted at 7-day pupae indicates maximum histolysis and beginning of histogenesis.

6) Decrease in lipase activity from 7 to 10-day pupae indicates gradual increase in histogenesis and depletion of lipid.

7) The gradual decrease in the total protein from 1 to 4-day pupae indicates the histolysis of most of larval organs. The gradual increase in the total protein from 4 to 7-day pupae indicates gradual increase in the protein synthesis and utilization of such new proteins as structural component for the development of imaginal organs of adult.

d) Adult Development:

1) Adult developmental period of *Chilo partellus* is of 4 days.

2) Partial characterization revealed optimum pH 7.6, temperature 37°C, incubation time 30 minutes, enzyme concentration 1 per cent and substrate concentration 5 per cent.

3) The linear increase in lipase activity from 1 to 2-day indicates the utilization of triglycerides during flight in search of virgin female in male and in the development of eggs (oogenesis) and oviposition in female.

4) The maximum lipolytic activity observed in 2-day male adult suggests that the active physiological role of male in search of virgin female and mating. The flight requiring energy is derived from breakdown of triglycerides.

5) The maximum enzyme activity observed in 2-day female adult suggests active role of lipase in oogenesis and oviposition. The
oogenesis and oviposition requiring energy and structural components are derived from breakdown of lipid and mainly from triglycerides.

6) Lipase activity in male is 1.4 times more as compared to female, it may be due to the active role of male in search of virgin female and mating.

7) The gradual increase in total protein from 1 to 2-day adult indicates the synthesis of yolk proteins (vitellogenins) in the fat body of female which are afterwards translocated to the developing oocytes. In male, the newly synthesized proteins are associated with reproductive functions like spermatogenesis and secretion of accessory glands. The amount of proteins in female is more as compared to male, it may be due to the formation of yolk proteins (vitellogenins) during oogenesis.

e) Fat body:

1) Larval developmental period of *Chilo partellus* is of 25 days and metamorphosis period is of 10 days.

2) Partial characterization revealed optimum pH 8 in larval fat body and pH 7.6 in pupal fat body, temperature 37°C, incubation time 30 minutes, enzyme concentration 1 per cent and substrate concentration 5 per cent.

3) The gradual increase in lipase activity in larval fat body from 8 to 11-day larvae suggests that during this early feeding period the larvae are most active, the energy and structural components may be derived from triacylglycerol catabolism.
4) Sharp fall from 11 to 12-day larvae suggests the possibility of sudden inactive larval stage requiring minimum energy.

5) The gradual increase in lipase activity from 12 to 20-day larvae indicates gradual feeding and developing stage which requires the energy and structural components.

6) Decrease in lipolytic activity from 20 to 25-day larvae suggests gradual inactivation of larva entering into pupal stage which requires minimum energy and structural components.

7) Maximum enzyme activity noted at 11-day larvae suggests most active feeding larval stage requiring more energy and structural components for larval growth.

8) During metamorphosis, gradual increase in fat body lipase activity from 1 to 2-day pupae indicates gradual increase of histolysis.

9) The sharp increase in lipase activity from 2 to 3-day pupae suggest the extensive histolysis.

10) Decline in lipase activity from 3 to 4-day pupae suggest the decline in histolysis and the beginning of the histogenesis. During histolysis hydrolysis of triglycerides provides energy for metamorphosis and materials for histogenesis.

11) Sharp fall in enzyme activity from 4 to 5-day male pupae and 4 to 6-day female pupae suggest the depletion of lipid.

12) The slow decrease in enzyme activity from 5 to 10-day male pupae and 6 to 10-day female pupae may be due to the depletion of lipid and complete histogenesis.

13) Maximum enzyme activity noted in fat body of 4-day pupae suggest extensive lipolysis which provides maximum energy and material for histogenesis.
14) The gradual increase in the protein in larval fat body from 8 to 21-day indicates synthesis and release of proteins into the haemolymph. Sharp increase in protein from 21 to 25-day indicates storage of protein in the fat body which is used in the assembly of adult tissues at the time of metamorphosis. The gradual decrease in total protein in pupal fat body from 1 to 4-day pupae indicates breakdown of fat body protein during histolysis which are used during histogenesis. Slight increase fat body proteins from 4 to 8-day pupae indicates the storage of proteins in the fat body which are used for reproductive functions of adult stage.

f) Life cycle:

Maximum lipase activity during embryogenesis indicates intensive metabolism which provides energy and structural components to the developing embryo. Larval stage is the feeding stage and during this feeding period deposition of all mass necessary for final adult development takes place. As compared to the embryogenesis, the prolonged larval stage shows slightly less lipase activity. During metamorphosis lipid reserves were used for imaginal adult development (histolysis and histogenesis). So, the lipase activity in metamorphosis is slightly more as compared to later larval developmental stage and adult. The adult developmental stage is short and non-feeding stage, it shows decrease in lipase activity which provide energy for mating flight and mating in male and oogenesis and oviposition in female.

While concluding the present work the author is conscious of the fact that though this thesis is contributing to the basic kinetic properties of the lipase (enzyme) and its functional role during the various physiological processes, much remains to be studied.
To make an end is to make a beginning
The end is where we start from.

T. S. Eliot.