Histomorphological investigations on the fat body in *Melanogryllus desertus* (Orthoptera: Gryllidae)

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**Abstract.** In this study, adult individuals of *Melanogryllus desertus* were dissected in insect physiologic saline using a stereomicroscope. Fat body was studied using both light and scanning electron microscopy. Fat body was mainly composed of trophocytes. Few oenocytes were determined among trophocytes in the periphery of fat body. Lipid was stored in large vacuoles of trophocytes. Glycogen was also demonstrated in these cells.

**Key words:** Black cricket, *Melanogryllus desertus*, fat body, trophocyte, oenocyte.

**Introduction**

Fat body is present under the epidermis however in some insects, it also surrounds the digestive and reproductive organs (Martins et al. 2011a). Fat body has many functions such as energy storage and synthesis of proteins, lipids and carbohydrates. Trophocytes are the primary cells of the fat body storing lipids as droplets or in large vacuoles that may occupy most of the cytoplasm (De Oliveira & Cruz-Landim 2003, Hoshizaki 2013). In addition to trophocytes, two or three cell types (oenocytes, urocytes and mycetocytes) are found (Dean et al.1985, Hoshizaki 2013). Oenocytes have an ectodermal origin and usually associated with the epidermis. However, they are scattered among the trophocytes in many species (Wigglesworth 1972, Dean et al.1985). Urocytes contain large crystallid spherules of uric acid. These cells are present in Collembola, Thysanura, Blattodea and larval Apocrita. Mycetocytes contain microorganisms that are localized in the fat body of cockroaches and some Hemiptera (Hoshizaki 2013).

*Melanogryllus desertus* (black cricket) is a species distributed in South Europe, North Africa, southern of Siberia, middle Asia, middle and west Anatolian region of Turkey (Lodos 1975). In this study, fat body morphology and some functions of fat body such as storage of lipid and carbohydrate were demonstrated in *M. desertus*.

**Material and methods**

Crickets were reared in the Invertebrate Culture and Research Laboratory at Ege University Campus, Bornova-Izmir, Turkey (temperature: 26±2°C; relative humidity: 45±5 %; photoperiod: natural). They were fed with lettuce and chicken grain in the jars twice a week. Cotton plugged glass tubes filled with water were put into the jars to supply the water needs of the insects. Also, small Petri dishes with their surface covered with moist cotton for mated females to lay eggs on were placed in the jars. The first nymphs emerged within 10-12 days. They became adult crickets nine nymphal stages later. The first nymphs emerged within 10-12 days. They became adult crickets nine nymphal stages later. Adult crickets were dissected in insect physiologic saline by using a stereomicroscope.

Fat bodies were quickly fixed in Bouin’s solution for 24 hours. After dehydration with graded ethanol, specimens were put in xylol for transparency and embedded in paraffin. Paraffin blocks were serially sectioned at 5 μm thickness using a microtome (Baird&Tatlock). Tissues were stained with Mayer’s Haematoxylin & Eosin (H&E) to determine histological view and Periodic Acid Schiff (PAS) to detect glycogen. Histologic sections were photographed using a Olympus CX 31 photomicroscope.

**Results**

Small and oval shaped fat bodies that located the near of the midgut have a granular appearance in scanning electron micrographs. Its general view is showed in Fig. 1a. It is mainly composed of different sized of trophocytes (Fig. 1b).

In preparations stained with Hematoxylin & Eosin, a large number of trophocytes with large vacuoles were determined in the whole fat body (Fig. 2a). Large vacuoles in the trophocytes indicating the lipid presence was determined (Fig. 2b). Few oenocytes were determined among trophocytes in the periphery of fat body (Fig. 2c).

While glycogen intensely accumulated in small sized trophocytes (Fig. 3a), it was only present in the cytoplasmic strand between lipid droplets of large trophocytes (Fig. 3b). By the way, oenocytes in the fat body of *M. desertus* weakly reacted for PAS histochemical test (Fig. 3a).

**Discussion**

According to insect order, fat body may contain a variety of cell types such as trophocytes, urate cells, mycetocytes and oenocytes. In order Diptera, only trophocyte and oenocyte are present (Martins et al. 2011b). In order orthoptera, trophocytes and oenocytes are found (De Oliveira & Cruz-Landim 2003). Coupland (1957) reported the presence of both trophocyte and oenocyte in the fat body of locust, *Schistocerca gregaria*. Clustered or single oenocytes are found as scattered among trophocytes in the periphery of fat body (Martins & Ramalho-Ortiago 2012). In *Melanogryllus desertus*, fat body is mainly composed of trophocytes. Oenocytes were also determined as scattered among trophocytes.
Figure 1. SEM photographs of fat body, a) General view of fat body (FB), b) Detailed view of fat body. Note the trophocytes (T) with small and large sizes.

Carvalho et al. (2013) mentioned that intense vacuolization in the cytoplasm of trophocytes in *Anticarsia gemmatalis* (Lepidoptera: Noctuidae) was due to the presence of lipid droplets. Some authors called these cells as adipocyte because of the presence of lipid droplets which are largely triglycerides (Arresse & Soulages 2010). They were also called fat body cells (Coupland 1957, Odhiambo 1967). In *Schistocerca gregaria*, fat body cells have enormous lipid globules (Odhiambo 1967). Large vacuoles including the lipid in the trophocytes was determined in the fat body of *Melanogryllus desertus*. Glycogen and triglyceride serve as energy reserves in animal cells. Although the amount of reserves accumulated in the fat body shows differences among insect species, lipid is always the main constituent of fat body (Arresse & Soulages 2010). Trophocytes are the chief cells that stores lipids in insects (Martins et al. 2011b). Lipid storage in the large vacuoles of the trophocytes indicated their crucial role as energy reserve in *M. desertus*. In preparations which stained with Periodic Acid Schiff (PAS), glycogen was also demonstrated in trophocytes. Odhiambo (1967) reported the presence of large amounts of glycogen in the little cytoplasm of fat body cell in *Schistocerca gregaria*. Martins

Figure 2. Histological section of fat body. a) General view of fat body, b) Trophocytes (T) with large vacuoles accumulating lipid (asterisk), c) Oenocytes (O) in the peripheral region of fat body (H&E).
& Ramalho (2012) reported a weak or non-positivity for polysaccharides in the oenocytes. In M. desertus, oenocytes showed a weak reaction with PAS.

In conclusion, histological examinations showed that fat body is mainly composed of a large number of trophocytes. Few oenocytes are located in the peripheral region of fat body. This study will be helpful to more comprehensive works related to the fat body in M. desertus.

References


