Adv. Odonatol. 5 : 67-70 December, 1991

LIPID STORAGE IN THE MALPIGHIAN TUBULES OF *AESHNA CYANEA* LARVAE (ANISOPTERA : AESHNIDAE)

S. KUKEL and H. KOMNICK

Institut für Cytologie
Rheinische Friedrich-Wilhelms-Universität Bonn,
Ulrich-Haberland-Str. 61 a,
5300 Bonn 1, Bundesrepublik Deutschland

The intermediate segments of the Malpighian tubules of *Aeshna* larvae are composed of lipocytes densely filled with triglyceride droplets. The lipid droplets arise in the first instar larva from a redistribution of unconsumed mesenteronic yolk lipid. Later on, the renal lipid store receives substantial contributions from dietary lipids and is finally depleted during emergence of the imago.

Aeshna larvae have a high capability for the intestinal absorption of unsaturated fatty acids liberated by hydrolysis of dietary lipids (KOMNICK, 1988). Major lipid stores and reserves of the larval body are the adipocytes of the fat body, the midgut enterocytes and the hemolymph as judged from the accumulation of lipid droplets in these cells and from the large blood volume (one third of the body weight ; MOENS, 1975) in conjunction with the high lipid load carried by lipophorin (BAUERFEIND & KOMNICK, 1989). This contribution shows that the Malpighian tubules provide an additional substantial lipid store of the larval body.

The Malpighian tubules of *Aeshna* larvae are lined by ionocytes, lipocytes and mucocytes, which separately occur in the distal, intermediate and proximal segments, respectively (Fig. 1a). The intermediate segments comprising the lipocytes are, dependent on the larval stage, of considerable length and may extend over one half of the tubular length.

The lipocytes are densely filled with lipid droplets, which are readily extracted by lipid solvents (Fig. 1b). The droplets may greatly vary in size approximately ranging from 1 to 10 µm (Fig. 2a, b). They deeply stain with osmium tetroxide (Fig. 1a, 2) and, hence, are rich in unsaturated fatty acids.

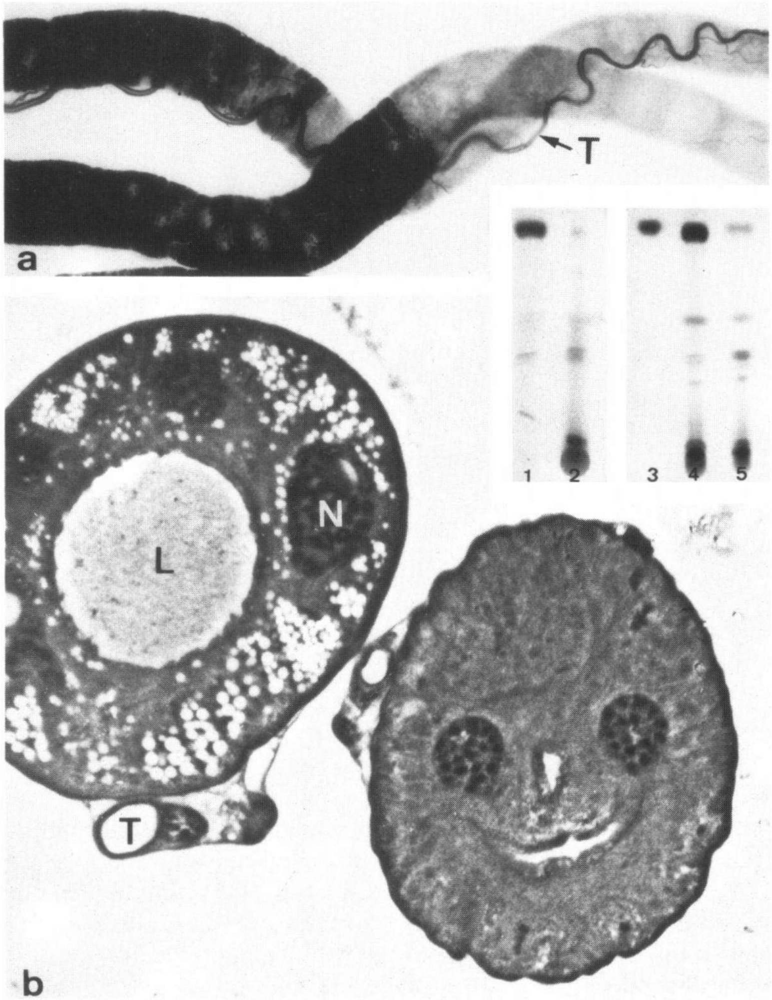

Fig. 1a : whole mount of Malpighian tubules showing intermediate segments stained black with osmium tetroxide for unsaturated lipids. The distal segments composed of ionocytes are unstained. × 200.

b : cross section of distal segment with ionocytes (right) and intermediate segment with lipocytes after lipid extraction (left). × 1.300. L : tubular lumen ; N : nucleus ; T : trachea.

Inset : Thin layer chromatography of lipid droplets isolated from the Malpighian tubules by homogenization and centrifugation (lane 1) and homogenized Malpighian tubules after lipid droplet isolation (lane 2). Triglycerides, largely reduced in the renal tissue after lipid droplet isolation, represent the prominent lipid class of the droplets. Lane 3 : Triglyceride standard (triolein). Lipid extractions (chloroform-methanol, 2 : 1) of Malpighian tubules isolated from final instar larvae after 3 weeks of starvation (lane 4) and adults two days after emergence from regularly fed larvae (lane 5). The triglycerides are greatly reduced in the imagoes.

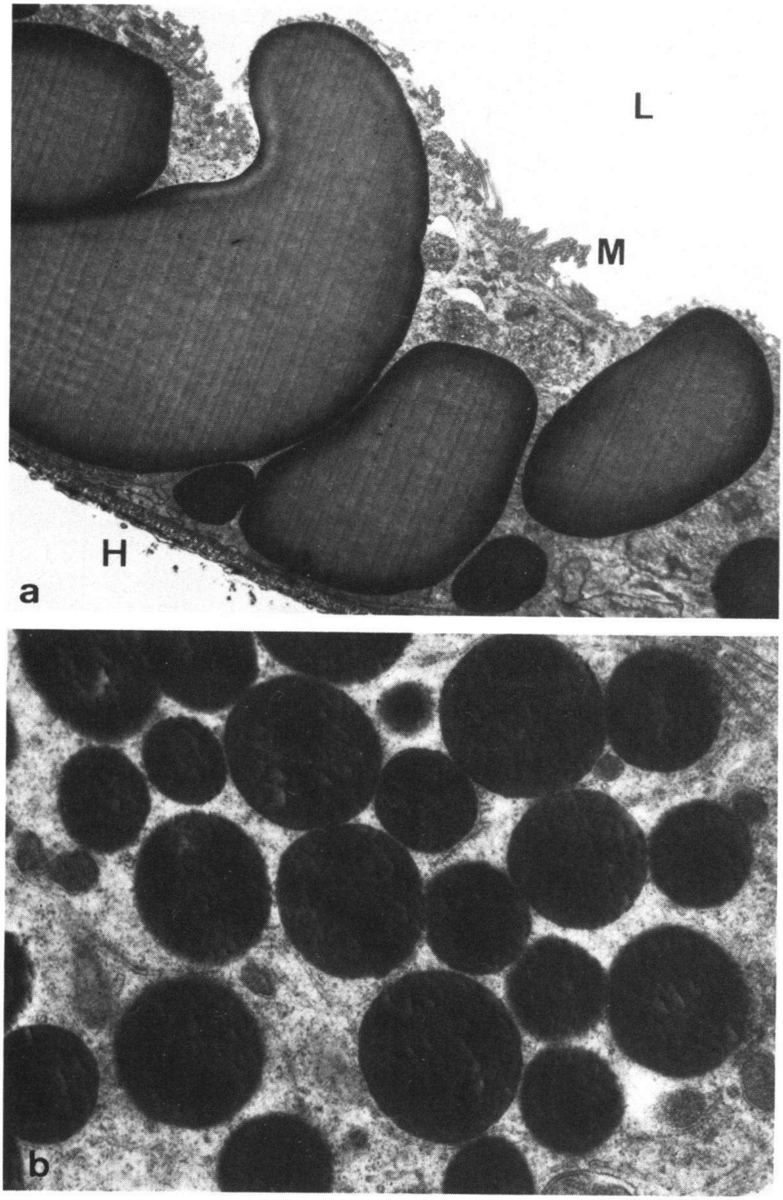

Fig. 2a and b : electron micrographs of tubular cross sections showing lipocytes densely filled with large and small lipid droplets. a × 4.500 ; b × 18.500. H : hemolymph ; L : tubular lumen : M : microvilli.

Thin layer chromatography of mechanically isolated lipid droplets reveals that they mainly consist of triglycerides (Fig. 1b, inset).

First instar larvae possess 3 primary Malpighian tubules which are devoid of lipid stores immediately after moult from the pronymph. However, renal lipid droplets appear approximately after one day before the larvae start feeding. They result from a redistribution of unconsumed egg yolk lipid retained in the midgut.

With progressing instars the Malpighian tubules increase in length and number amounting to at least 200 in the final instar (KUKEL and KOMNICK, 1989). Simultaneously, the renal development leads to an increase in the length and number of intermediate segments composed of lipocytes, so that the Malpighian tubules represent a substantial lipid store of the larvae. This store is supplemented during larval life from dietary lipid and almost completely depleted during emergence of the adult. Re-filling does not occur during imaginal life as judged from microscopical inspection of osmium tetroxide or Oil Red stained tubules and from thin layer chromatography (Fig. 1b, inset).

A similar lipid storage has been described for the Malpighian tubules of *Drosophila* larvae (WESSING & EICHELBERG, 1969).

REFERENCES

BAUERFEIND, R. & H. KOMNICK, 1989. Biochemical and morphological characterization of lipophorin of Aeshna cyanea larvae. *Adv. Odonatol.* 5 : 5-10.

KOMNICK, H., 1988. Intestinal absorption of defined lipids by the larval dragonfly Aeshna cyanea (Insecta, Odonata). Mono- and polyunsaturated free fatty acids and their homotriglycerides. *J. Insect Physiol.* 34 : 105-110.

KUKEL, S. & H. KOMNICK, 1989. Development, cytology, lipid storage and motility of the Malpighian tubules of the nymphal dragonfly, Aeshna cyanea (Müller) (Odonata : Aeshnidae). *Intern. J. Morphol. Embryol.* 18 : 119-134.

MOENS, J., 1975. Changes of hemolymph volume in larvae of Anax imperator Leach and Aeshna cyanea (Müller) during starvation in different experimental media (Anisoptera : Aeshnidae). *Odonatologica* 4 : 219-224.

WESSING, A. & D. EICHELBERG, 1969. Elektronenmikroskopische Untersuchungen zur Lipid-Speicherung in den Nierentubuli von Drosophila melanogaster. *Z. Zellforsch.* 94 : 129-146.

Received October 3, 1989 / Accepted May 21, 1990