Adv. Odonatol. 5 : 45-48 December, 1991

PEROXISOMES AND THEIR PUTATIVE ROLE IN THE MIDGUT EPITHELIUM OF LARVAL *AESHNA CYANEA* (ANISOPTERA : AESHNIDAE)

V. FABER and H. KOMNICK

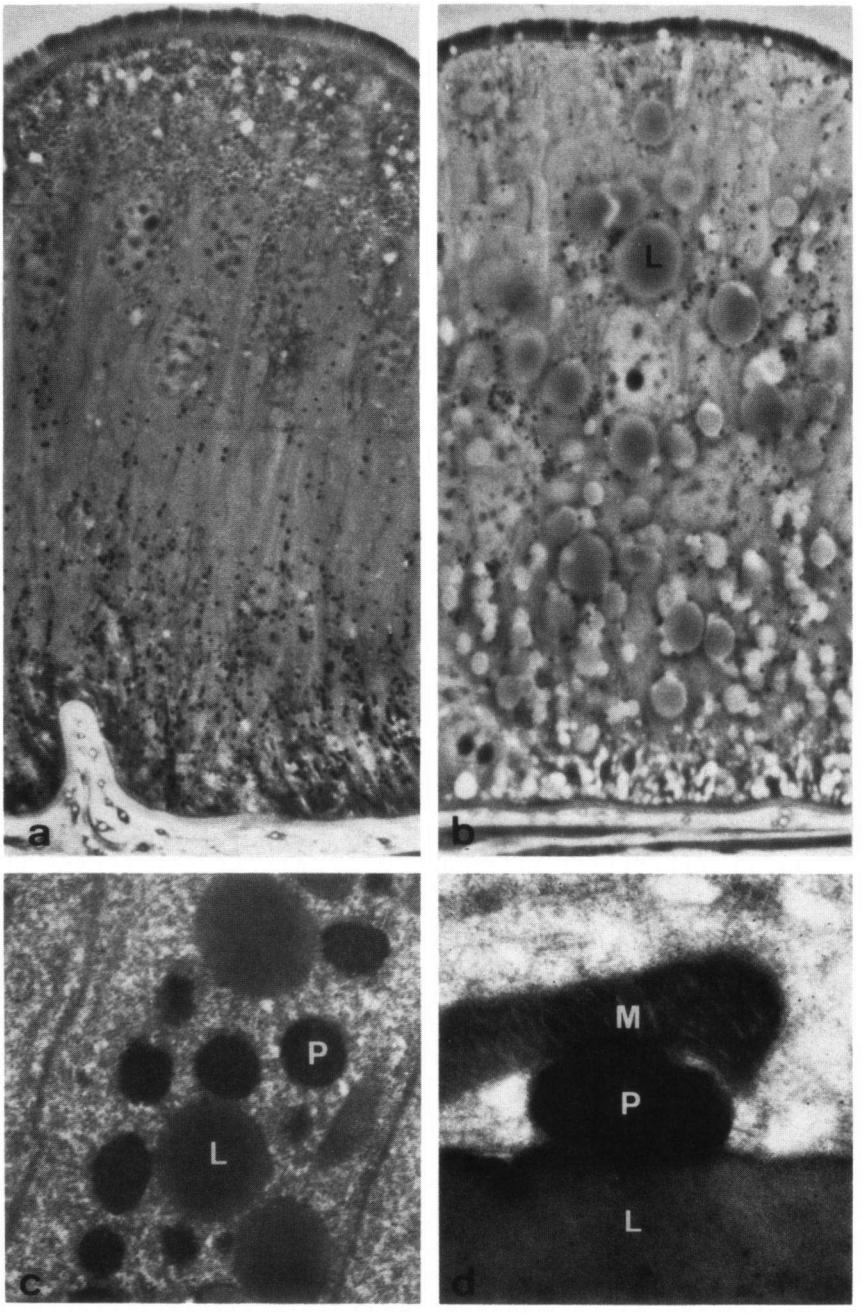
Institut für Cytologie,
Rheinische Friedrich-Wilhelms-Universität Bonn,
Ulrich-Haberland-Str. 61 a,
5300 Bonn 1, Bundesrepublik Deutschland

The midgut enterocytes of *Aeshna* larvae are rich in peroxisomes as identified by electron microscopy and catalase histochemistry. Long-chain (erucic acid, C20 : 1 cis) and trans (elaidic acid, C18 : 1 trans) fatty acids promote the proliferation of peroxisomes. Hence, these may be involved in the modification of unusual dietary fatty acids.

Aeshna larvae indiscriminately absorb unsaturated long and very long-chain fatty acids from the diet. However, according to HANSON *et al.* (1985) oleic acid represents the prevalent fatty acid of the body lipids of dragonfly larvae. This raises the question of whether the midgut is able to chain-shorten absorbed fatty acids on their way across the epithelium. A morphological approach to this question is the search for cell organelles known to be involved in chain-shortening such as mitocheondria and peroxisomes .

We have previously shown that the midgut enterocytes are rich in mitochondria (KOMNICK & KUKULIES, 1987). However, according to several authors (e.g. OSMUNDSON, 1982), very long-chain and trans fatty acids are poor substrates of mitochondrial β-oxidation in contrast to peroxisomes.

Peroxisomes can easily be identified in the midgut epithelium on the electron microscopic level by their fine structure and their histochemical catalase staining (NOVIKOFF *et al.*, 1972). This method also allows the visualization of peroxisomes on the light microscopic level as black dots (Fig. 1a, b). They prevail in the absorptive cells but are rare in the regenerative nidal cells. They often form clusters around lipid droplets (Fig. 1b) or are densely intermingled with lipid droplets (Fig. 1c). Frequently peroxisomes are observed in close contact with lipid droplets and mitochondria (Fig. 1d). Such


a
L
b
P
L
c
M
P
L
d

constellations appear very favourable for the functional interrelations of these organelles.

In fasting larvae peroxisomes predominantly occupy the basal zone of the enterocytes (Fig. 1a), while after a fat meal they extend into the apical direction (Fig. 1b).

We have determined the area density of peroxisomes in different nutritional states. Figure 2 shows that long-term feeding of lipid-rich natural food, long-chain fatty acid and trans fatty acid cause a significant proliferation of peroxisomes — a finding which is consistent with similar results on mammalian hepatocytes (e.g. NEAT *et al.*, 1980 ; OSUMI & HASHIMOTO, 1984).

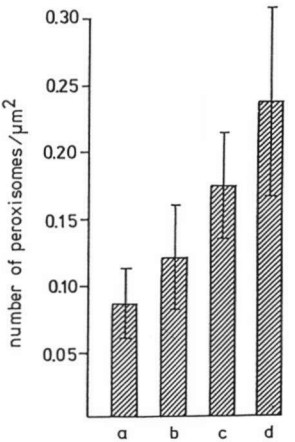


Fig. 2. Area density of enterocytic peroxisomes under different nutritional conditions : (a) long-term starvation ; followed by long-term feeding with (b) natural food (Tubifex) ; (c) erucic acid (C20 : 1 cis) and (d) elaidic acid (C18 : 1 trans).

The synopsis of these results suggests that the peroxisomes of *Aeshna* midgut enterocytes may play a similar role in shortening dietary long-chain fatty acids as demonstrated for the peroxisomes of mammalian hepatocytes and enterocytes (KAWAMURA *et al.*, 1981 ; THOMASSEN *et al.*, 1985).

Fig. 1. Cross sections of the midgut epithelium in the states of lipid clearance (a) and lipid accumulation after ingestion of trierucin (b), showing numerous peroxisomes in the basal region (a) and around lipid droplets (b) × 1.200. c : peroxisomes intermingled with lipid droplets. × 22.000. d : a peroxisome in close contact with a lipid droplet on one side and a mitochondrium on the other. × 60.000. a-c histochemical catalase staining. L lipid droplet ; M mitochondrium ; P peroxisome.

REFERENCES

KAWAMURA, N., H. W. MOSER & Y. KISHIMOTO, 1981. Very long chain fatty acid oxidation in rat liver. *Biochem. Biophys. Res. Commun.* 99 : 1216-1225.

KOMNICK, H. & J. KUKULIES, 1987. Cytology of the midgut epithelium of Aeshna larvae (Insecta, Odonata). *Zoomorphology* 107 : 241-253.

NEAT. C. E., M. S. THOMASSEN & H. OSMUDSEN, 1981. Effect of dietary fat on peroxisomal β-oxidation. *Biochem. J.* 196 : 149-159.

NOVIKOFF, A. B., P. M. NOVIKOFF, C. DAVIS & N. QUINTANA, 1972. Studies on microperoxisomes. II. A cytochemical method for light and electron microscopy. *J. Histochem. Cytochem.* 20 : 1006-1023.

OSMUDSEN, H., 1982. Peroxisomal β-oxidation of long fatty acids : effects of high fat diets. *Ann. NY Acad. Sci.* 386 : 13-29.

OSUMI, T. & T. HASHIMOTO, 1984. The inducible fatty acid oxidation system in mammalian peroxisomes. *Trends Biochem. Sci.* 9 : 317-321.

THOMASSEN, M. S., P. HELGERUD & K. R. NORUM, 1985. Chain-shortening of erucic acid and microperoxisomal β-oxidation in rat small intestine. *Biochem. J.* 255 : 301-306.

Received October 3, 1989 / Accepted May 21, 1990