The Chromophore of the Visual Pigment in Some Insect Orders

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Z. Naturforsch. **39 c,** 196–197 (1984);
received December 15, 1983

Retinal, Rhodopsin, Xanthopsin, Insect Vision

The chromophore of the visual pigment in different insect orders has been identified. The novel chromophore 3-hydroxy-retinal was found in Diptera and Lepidoptera, while in the other groups investigated retinal is the chromophore of the visual pigment.

It has recently been shown that the visual pigment (xanthopsin) of the fly, *Calliphora*, has a novel chromophore [1]. The chemical and spectral properties of this chromophore make its identity as 3-hydroxy-retinal most likely [2]. This is particularly surprising as it has been accepted as proven that the chromophore of the fly visual pigment is retinal (*e.g.* [3]). Since, amongst the insects, the fly has been the most intensively investigated in this respect (with the exception of the neuropteran, Ascalaphus [4]) it would appear that the previous studies of the chromophore in other insect species (*e. g.* [5, 6]) also require reinvestigation.

The following results are based on high performance thin layer chromatography (HPTLC) of eye or head extracts treated with NH_2OH to form the oxime of the respective chromophore aldehyde (for details see [1]).

Retinal was found in the following insect groups: Odonta (*Aeschna cyanea*); Caelifera (*Locusta migratoria*); Ensifera (*Gryllus bimaculatus*); Blattodea (*Blatta orientalis*); Heteroptera (*Gerris najas, Notonecta glauca*); Hymenoptera (*Apis mellifica, Vespa germanica*).

3-Hydroxy retinal was found in the following groups: Diptera (*Calliphora erythrocephala, Chrysomya rufifacies, Musca domestica, Drosophila melanogaster, Rhagoletis cerasi, Eristalomya tenax, Nephrotoma ferruginea);* Lepidoptera (*Ephestia kühniella, Galleria mellonella, Macroglossum stellatarum*). One exception was discovered amongst the diptera: namely the simuliidan *Willhelmia* sp. in which the chromophore was identified as retinal rather than 3-hydroxy-retinal. However, there are reasons for considering this a secondarily acquired characteristic (Vogt and Kirschfeld, in preparation).

The occurrence of the new type of chromophore amongst the diptera and the lepidoptera suggests that 3-hydroxy-retinal could be a common characteristic of the Mecopteroidea (Mecoptera, Diptera, Trichoptera, Lepidoptera) which are regarded as a monophyletic group [7]. The common ancestors may have become able to split 3-hydroxy-xanthophylls and to use the resulting C_{20} fragments as chromophores for the visual pigment. In extracts of both fly and *Ephestia* eyes hydroxy-xanthophylls (zeaxanthin, lutein) could be identified. While flies are able to hydroxylise β-carotene (and maybe retinal as well) in the 3-position (demonstrated by the occurrence of zeaxanthin and the intermediate monohydroxy product, cryptoxanthin, in flies raised on a pure β-carotene diet [8]), *Ephestia* apparently cannot, since animals raised on a diet containing β-carotene and lutein yield only β-carotene and lutein and no trace of cryptoxanthin (even in whole body extracts). This points to a hydroxy xanthophyll as a necessary precursor of the chromophore in *Ephestia*, and fits to the general finding that in most lepidoptera the carotenoid composition simply reflects that of the food [9]. However, to substantiate the above hypothesis that 3-hydroxy-retinal may be a phylogenetic marker of the Mecopteroidea, further investigations, particularly of the mecoptera and trichoptera, are required.

Acknowledgement

I thank Ms Gonnert for excellent technical assistance, Prof. K. Kirschfeld, Drs. G. Mickoleit, H. Schmalfuss, and R. Hardie for discussions.

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0341-0382/84/0100-0196 $ 01.30/0

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