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Research article

Structural and RNAi characterization of the German cockroach lipophorin receptor, and the evolutionary relationships of lipoprotein receptors

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Abstract

Background: Lipophorin receptors (LpRs) have been described in a number of insects, but functional studies have been reported only in locusts and mosquitoes. The aim of the present work was to characterize the LpR of the cockroach *Blattella germanica*, not only molecularly but also functionally using RNAi techniques, and to place LpRs in a phylogenetical context among lipoprotein receptors.

Results: We cloned a putative LpR from *B. germanica* (BgLpR) using RT-PCR methods. Two isoforms of BgLpR that differ from each other by an insertion/deletion of 24 amino acids were obtained from the fat body and the ovary. A phylogenetical analysis of lipoprotein receptors showed that BgLpR grouped with other sequences annotated as LpR in a cluster placed as a sister group of vertebrate low density lipoprotein receptors (LDLR) + lipoprotein receptor-related proteins 8 (LPR8) + vitellogenin receptors (VgR) + very low density lipoprotein receptors (VLDLR). The two BgLpR isoforms are expressed in different adult female tissues (fat body, ovary, brain, midgut, muscle) and in embryos. In ovaries and fat body, the two isoforms are similarly expressed during the first gonadotrophic cycle. mRNA levels in the fat body increase in parallel to vitellogenesis, whereas they decrease in the ovaries. BgLpR protein levels increase in parallel to vitellogenesis in both organs. Treatment with juvenile hormone increases BgLpR protein. RNAi experiments show that females with lower BgLpR expression have less lipophorin in the growing oocytes with respect to controls.

Conclusion: The two isoforms of BgLpR are structurally similar to other LpRs. Phylogenetical analyses show that LpRs and the group formed by vertebrate LDLR + LPR8 + VgR + VLDLR, diverged from a common ancestor and diversified in parallel. The different expression patterns in the fat body and the ovary, comparing mRNA and protein, indicate that the corresponding mechanisms regulating BgLpR expression are different. Experiments with JH III suggest that such a hormone regulates the expression of BgLpR posttranscriptionally. RNAi experiments indicate that BgLpR is a functional lipophorin receptor.