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Perturbing gene expression with baculovirus

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Alan Shirras

Abstract

A novel baculovirus misexpression system is shown to be functional in insect and vertebrate embryos.

Significance and context

Genetic interactions during *Drosophila* development have been extensively studied by analysis of loss-of-function mutations and by gene misexpression using P-element-mediated transformation. Although several developmentally important genes are conserved in other arthropod species, and their expression patterns have been characterized, establishing their function has been difficult because of the paucity of easily identifiable mutations and the lack of compatible misexpression systems. Oppenheimer *et al.* show that recombinant baculovirus can be used as a vector for misexpression of genes in a range of species, allowing questions about gene interactions to be answered in otherwise genetically intractable organisms.

Key results

Baculovirus was chosen as a vector because it is relatively safe and easy to use, has a broad host range and has a large capacity for DNA inserts. Initial experiments - injecting viruses containing the *Escherichia coli lacZ* gene attached to the *hsp* promoter into embryos of *Drosophila*, the red flour beetle *Tribolium*, and *Xenopus laevis* - demonstrated expression of α-galactosidase in all three species. Expression was detectable in *Drosophila* and *Tribolium* within 2 hours of injection and a degree of region-specific expression was achieved, depending on the site of injection. Specific regions of *Xenopus* could also be targeted for α-galactosidase expression when embryos were injected after the blastula stage. The interaction between *wingless* (*wg*) and *engrailed* (*en*) has been well characterized previously in *Drosophila* (Figure 1). Expression of *wg* using the baculovirus system confirmed that ectopic *wg* induces expression of *en* in neighboring cells of the ectoderm. Ectopic *Drosophila wg* expression in *Tribolium* produced a similar effect, but only when *wg* was expressed in cells just posterior to the normal En stripe. This suggests that an *en*-competent domain, similar to that found in *Drosophila*,also exists in *Tribolium*.The ectopic induction of *en* was shown to occur only within a defined developmental stage, and this is also analogous to the situation in *Drosophila*.

Figure 1 Induction of *engrailed* (*en*) expression by Wingless (Wg) protein at the anterior parasegment boundary in *Drosophila*. The *wg* gene is expressed at the posterior parasegment boundary and the protein diffuses to neighboring cells. Only the cells on the posterior side respond by expressing *en*, however, as they are within the *en*-competent domain. Ectopic *wg* expression will induce *en* expression only within this domain.

Links

Supplementary material to *Curr Biol* **9**:1288-1296 includes more detailed methodology. The interactive fly and GeNet, the gene networks database have further information on *Drosophila wg* and *en* and their interaction during development. Nipam Patel's homepage at the University of Chicago has some information on research in his lab. A Lab manual for baculovirus techniques is available online.

Reporter's comments

This paper, and another in the same issue of *Current Biology* using recombinant Sindbis virus, represents a major step forward in the analysis of genetic interactions during development of non-model species by describing generally applicable systems for ectopic expression. In addition to the *Xenopus* work by Oppenheimer *et al*., both labs describe some success in using these systems in other non-insect species, opening up the possibility of a wide-ranging study of the conservation of developmental mechanisms.

Table of links

Current Biology

Supplementary material to *Curr Biol* **9**:1288-1296

The interactive fly

GeNet, the gene networks database

Nipam Patel

Lab manual for baculovirus techniques

References

1. Oppenheimer DI, MacNicol AM, Patel NH: Functional conservation of the *wingless-engrailed* interaction as shown by a widely applicable baculovirus misexpression system. Curr Biol. 1999, 9: 1288-1296. 0960-9822

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