Insect homeotic transformation

SIR — Strepsiptera is a small order of insects with unusual morphological, physiological and behavioural characteristics. Molecular and morphological data support Strepsiptera as sister-group to Diptera. We suggest that a homeotic mutation resulting in ectopic expression of Ultra bithorax \((Ubx)\) protein transformed the second thoracic segment \((T2)\) to a metathorax and the third \((T3)\) to a mesothorax in the ancestral strepsipteran lineage.

We determined the sequence of regions of nuclear 18S ribosomal DNA for representatives of Strepsiptera, all holometabolous insect orders, and outgroups. Details of data acquisition and phylogenetic analysis will be presented elsewhere. Relationships resulting from the molecular data are largely concordant with the most recent morphologically based phylogeny, except for the placement of Strepsiptera as sister-group to Diptera. We have found new morphological characters which support this hypothesis. Strepsiptera possess some ground-plan characters of supraordinal groups to which Diptera belong (loss of ovipositor, absence of labial en- dite lobes and spermatophore). Moreover, in all male Strepsiptera, Mecoptera (scorpionflies) and basal Diptera, abdominal segment 9 is enlarged and ring-like.

Similar morphological modifications of T2 and T3 occur on opposite segments in Diptera and Strepsiptera (see figure). We postulate that thoracic modifications derived in the immediate ancestor of these taxa were subsequently transformed to opposite thoraces in the ancestral strepsipteran lineage. This transformation might be caused by a homeotic mutation resulting in ectopic expression of \(Ubx\) in T2 and suppression in T3 in strepsipteran embryonic or larval stages. \(Ubx\) product in Drosophila is associated with specialization of T3 into a metathorax. When suppressed by the mutations bithorax and postbithorax, the halteres are transformed into another full-sized wing and T3 is transformed into another mesothorax.

Conversely, Contrabithorax mutations causing ectopic expression of \(Ubx\) in T2 result in a transformation of the T2 wing to a haltere (occasionally with some veins extant — as is found in Strepsiptera) and may transform T2 into a metathorax.

Are Strepsiptera \(Ubx/Ubx\) \(\text{bx}\)? Over-expression of \(Ubx\) in T2 and suppression in T3 would account for some of the unusual morphology of this group. We favour the transformation hypothesis because it more parsimoniously explains character distribution than to postulate parallelism, and despite potential lability, has a plausible genetic basis. This hypothesis could be further tested by \textit{in situ} hybridization of \(Ubx\) probes in strepsipteran embryos and instars. Strepsiptera may be one of the best examples of homeosis occurring in nature and causing drastic changes in the morphology of a group, which has led in part to its subsequent specialization and diversification.

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