Minimine Makes Miniflies

The normal fruit fly (Drosophila) is about an eighth of an inch long. Now, Herschel Mitchell, professor of biology, has discovered that injecting the larvae of the fruit fly with a substance found in bee venom, called "minimine," will keep the mature flies to one-quarter that size. The miniflies mature normally in every other way, live a normal lifespan of about 30 days, and produce regular-size offspring.

Minimine was discovered and isolated by Mitchell while studying the regulatory systems of biological processes. He is investigating the effects of various interesting substances, such as components of bee venom, on these systems. Analysis of these components is part of a new field of polypeptide study that is going on in laboratories throughout the world. This includes the analyses of various natural poisons from insects, toads, frogs, and fishes, and their effects on nervous systems and living tissues.

Mitchell and his colleague Peter Lowy, senior research fellow in biology, are attempting to learn how minimine induces miniaturization. Part of the answer is that after the injection of the substance the normally voracious fruit fly larva stops eating.

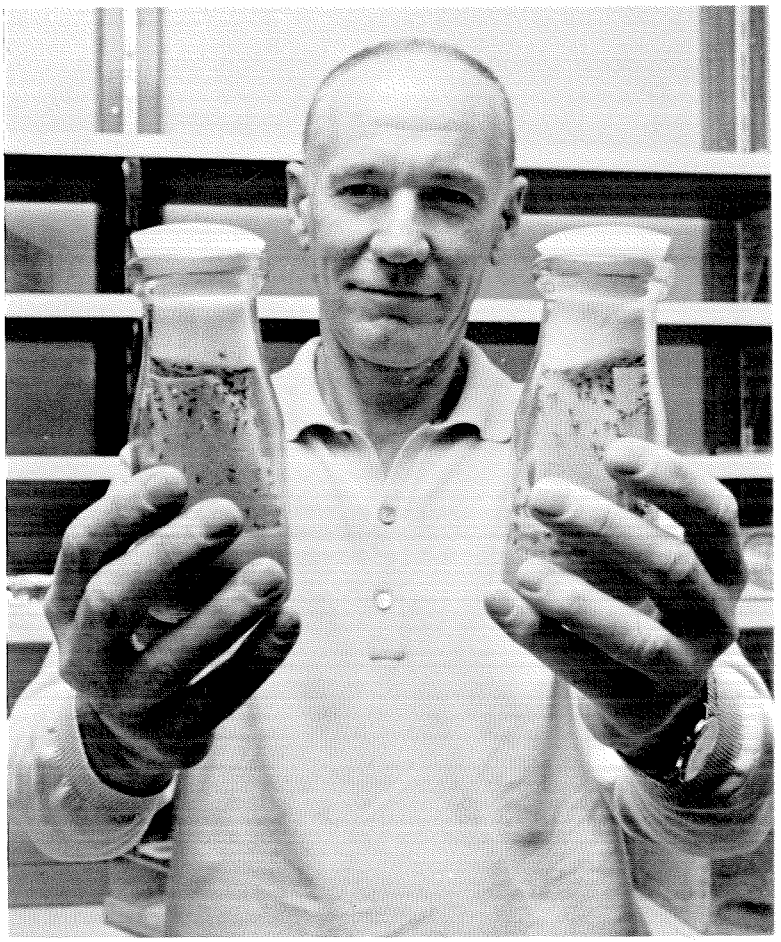
The critical point for the injection of minimine, which is a polypeptide (small protein), is a little more than two days after the larva has hatched from an egg. At this point the larva has everything it needs to become a fly. It will die if injected before this time or if given too large a dose of minimine at this point.

Not only does the larva stop eating after the injection, but it also becomes very lethargic. After nearly two days more, it evolves about on schedule into a pupa. It remains in that stage for four and a half days—a few hours longer than for a normal fly—and then emerges as a fertile minifly that eats and acts normally in every way. The same results can be achieved by simple starvation of the larva, but—in contrast to the "minimined" larva—the starved larva is very active and tries to find food.

About 3 to 5 percent of the venom consists of minimine, which is known to have a number of effects on living tissues; for example, it affects the permeability of the membranes and probably also affects muscular activity. It also inhibits the action of mitochondria, the energy-producers in cells.

Mitchell and his colleagues undertook a systematic study of bee venom after observing that another of its peptides, melittin, also has interesting effects on fruit flies. The major component of bee venom, melittin, accounts for about 50 percent of its dry weight. It induces very strong muscular contractions on injection and is lethal in very small doses. It is a potent inhibitor of acetylcholine esterase, an essential enzyme in the nervous system, and also has disruptive effects on cell membranes in general.

There are about 15 different peptides in bee venom. Of the four that have been isolated, three—melittin, apamin, and MCD-peptide—have pharmacological effects on mammals, and two—melittin and minimine—affect the fruit fly. In his studies of biological control mechanisms, Mitchell is particularly interested in substances that may alter the genetic controls. His work is supported by the National Science Foundation and the Gordon Ross Medical Foundation of Pasadena.



Injecting the larvae of fruit flies with minimine is part of Herschel Mitchell's research into the effects of polypeptides on biological control mechanisms.