To study effects of solutes in water on feeding rates, larvae are allowed to fill their guts with light-colored kaolin, then transferred to a solution containing dark charcoal powder. The distance the charcoal powder pushes the kaolin down the gut indicates the relative ingestion rate.

Feeding mechanisms and nutrition of mosquitoes

R. H. Dadd

Characteristics of the mosquito larva gut that may affect the toxicity of biological control agents are studied by mixing indicator dyes with kaolin in the water and watching the color changes as the dye moves through the gut. These larvae, fed metacresol purple to measure pH, show highly alkaline frontal midguts, while the rear portion and gastric sac appear nearly neutral.

Because mosquito larvae are filter feeders, questions arise as to the ingestibility of materials applied for mosquito control compared with that of natural minute particles (detritus, microorganisms, and the like) in breeding waters. Such questions apply to chemical larvicides that are microencapsulated or formulated as dusts, but perhaps they are more relevant to the efficiency with which larvae ingest biological agents—bacterial, viral, fungal, or nematode preparations that are currently the object of intense research as potential adjuncts to chemical insecticides.

Food ingestion and its regulation in larval mosquitoes were studied to clarify the effects of particle size, concentration, and shape on rates of mosquito ingestion of particulate solids; the role of viscous colloids in enhancing liquid ingestion; and the regulation of filtering activity, and, hence, particle ingestion by substances in ambient water that affect taste and thereby act as feeding stimulants.

Current aims are to learn how much water mosquitoes ingest compared with solid particles and to find out if local concentrations of feeding stimulants attract mosquito larvae over a distance. If such attraction were found to occur, particulate control agents might be more efficiently ingested when combined with powerful feeding stimulants.

Ingestion studies were instrumental in perfecting chemically defined dietary media for the investigation of mosquito nutrition, an area of physiology important in assessing fluctuations in mosquito populations. Results from the studies also provide a body of resource data should a need arise for standardized rearing of mosquitoes at specified levels of nutrient definition in laboratory experiments. The information might also be used in attempting to improve crude media for small-scale or mass rearings.

These nutritional studies have defined and substantially quantified all required nutrients for *Culex pipiens*, including two, asparagine and arachidonic acid, that appear to be needed by no insects other than mosquitoes. The basal diet for *Cx. pipiens* can, with varying success, support the development of many other mosquito species. Several species, notably the important disease vector *Culex tarsalis*, were also found to depend on arachidonic acid for normal growth. Dietary asparagine is essential for several, but not all, other species examined.

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