ENTOMOLOGY

Artificial Feeding and Rearing of the Aphid, *Myzus persicae* (Sulzer), on a Completely Defined Synthetic Diet

SINCE the classic study of Hamilton[1] in 1935 on the artificial feeding of *Myzus persicae* (Sulzer), many attempts have been made to feed and maintain various aphid species on gels, or on liquids, sometimes under pressure, accessible to the insects via various natural and artificial membranes[2–8]. Although limited uptake of some fluid was demonstrated or could be inferred from slight increases in the survival of the aphids in these studies, no instances of prolonged survival, growth or of development have been reported.

We have also found that *M. persicae* ingests sugary fluids via a membrane. These solutions, with and without neutral red or phosphorus-32 as indicators of uptake, were presented to the aphids in simple cages or in choice-chambers, with the fluids above a membrane of stretched 'Parafilm'—a waxy material made by Marathon, American Can Co., Menasha, Wisconsin. We have been able to demonstrate greater rates of feeding, survival, and nymphal production of aphids fed on 10–20 per cent sucrose solutions, which were also those preferred by *M. persicae*, than on concentrations outside this range. Maintenance of body-weight, the production of salivary sheaths and of honeydew droplets were further found to be related to uptake.

In one experiment with 60 apterous adult *M. persicae* per treatment, the 50 per cent survival-time was 3·5 days on water only, 6·5 days on an 18 per cent sucrose solution and 13 days on a completely synthetic diet having the composition given in Table 1. The average number of nymphs produced per adult was 5 on water, 9 on the sucrose solution, and 19 on the nutrient diet.

Table 1. COMPOSITION OF THE LIQUID DIET FED TO *Myzus persicae*

L-Amino-acids and amides* (mgm.)		Vitamins* (mgm.)	
Alanine	100	Thiamin	2·5
Arginine	270	Riboflavin	2·5
Asparagine	550	Nicotinic acid	10·0
Aspartic acid	140	Pyridoxine	2·5
Cysteine	10	Folic acid	0·5
Glutamic acid	140	Calcium pantothenate	5·0
Glutamine	150	Meso-inositol	50·0
Glycine	40	Choline chloride	50·0
Histidine	40	Biotin	0·1
Isoleucine	30	Ascorbic acid	100·0
Leucine	40		
Lysine	120	Sucrose	18 gm.
Methionine	10	K_3PO_4	500 mgm.
Phenylalanine	10	$MgCl_2.6H_2O$	200 mgm.
Proline	40	Cholesterol	20 mgm.†
Serine	80	Water (to make)	100 ml.
Threonine	140	H_3PO_4 (to give)	pH 7
Tryptophan	40		
Tyrosine	40		
Valine	40		

* Relative amounts of amino-compounds and of vitamins based on analyses of pea juice (ref. 9) and on those found satisfactory in locust nutrition (ref. 10), respectively.
† Approximate amount dissolved by boiling in water.

Appreciable numbers of honeydew droplets were excreted by the adult aphids and by their progeny when fed on the 18 per cent sucrose solution and on the diet.

Seventy-one nymphs born to the experimental adults feeding on the diet were in turn confined on a membrane with access to the diet. More than 50 per cent survived for two weeks, during which time all moulted at least twice. Of 40 which survived 16–17 days, 11, 14 and 7 had developed into diminutive fourth instar apterous and alatiform nymphs and apterous adults, respectively.

Improvements clearly need to be made in the chemical and physical properties of the membrane–diet system before rates of feeding, growth, development and reproduction normal for the aphids on their host plants may be reached. However, the limited successes so far achieved indicate the immediate practicability of the artificial feeding method for nutritional and behavioural studies *per se*, as well as for other investigations, such as of form determination and of virus transmission phenomena, which would be facilitated greatly by a prolonged maintenance of aphids divorced from their host plant.

This work was supported in part by U.S. Public Health Service grant *E*-3947 (*R*1).

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Mosquito Attraction and Repulsion

THERE is uncertainty in the literature as to the exact signals and responses that guide mosquitoes to a warm-blooded host[1]. Reports of specific chemical attractants (for example, lysine[2]) lack confirmation.

Our experiments indicate that *Aedes aegypti* can be steered almost quantitatively to a target, provided: (1) they are activated by breath or carbon dioxide (this is mainly non-directional); and (2) the target is both wet and slightly warm[3]. Some experiments were made in a wind tunnel 2 × 2 × 10 ft. long with air at about 28° C. and 25 per cent relative humidity moving at about 0·5 ft./sec. About 18 in. from the upstream end, three targets were presented, each a cylinder 3 cm. in diameter and 7 cm. long, covered with black woollen cloth and warmed if required (usually to about 35° C.) by an internal heating element. About 25 adult, female *Aedes aegypti* were placed in the tunnel and given at least a day to acclimatize, with water and sugar provided, but no previous blood meal. If human breath or carbon dioxide was suddenly added to the air stream, the insects flew actively and continued to do so for several minutes.

Under these conditions, the number of insects alighting on each target was counted during three 5-min. intervals with the results shown in Table 1.

Table 1. NUMBER OF ALIGHTMENTS

Interval	1	2	3	Total
Warm, wet target	157	103	98	358
Cold, wet target	12	3	7	22
Warm, dry target	2	1	4	7

In other experiments, a stream of warm, humidified air was released into the air stream from a slit. By adding a little inert smoke the location of the 'convection current' could be made visible. Fig. 1 is a time