

Research Note

The effect of adult foods on the egg development of houseflies, *Musca domestica*, with notes on an autogenous strain

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It has been described that the adult flies of some strains of species in Calliphoridae (Williams *et al.*, 1977) and Sarcophagidae (Denlinger, 1971; Chadha and Denlinger, 1976) do not require any proteinaceous adult diet for egg maturation. Therefore, these flies are regarded as autogenous insects. The adult houseflies have been generally described to require a dietary source of both protein and carbohydrate for egg maturation (Derbeneva-Ukhova, 1935; Glaser, 1923; Kobayashi, 1934; Lea, 1972; West, 1951). However, we have investigated the effect of adult foods on the follicle development and the fecundity of houseflies, and found the different nutritional requirement among strains within the species. The results are reported in this paper.

Three strains of houseflies were used for the present experiments. The strain, Lab em-7-em, has been established in the laboratory as susceptible one to insecticides (Hiroyoshi, 1964), while the flies of Misaki strain were originally collected from a field in 1973 as the resistant flies to organophosphorus insecticides (Hayashi *et al.*, 1973), and thereafter kept with sugar in the adult stage in the laboratory. The flies of the Yumenoshima strain were also collected from a field in 1982 and 1983 and have been shown to be resistant to organophosphorus insecticides (Yasutomi and Shudo, 1982). Approximately 300 larvae were reared in a glass pot (12×15 cm, diameter × height) containing 200 g of medium, which was made of wheat bran: granules of insect diet Oriental Yeast Co. Ltd., Tokyo: fish powder: dry yeast: water (1:1:0.1:0.02:2), under 16L: 8D photoperiod at 25°C. Newly emerging houseflies (0–6 hr) were collected in a cage (30×30×30 cm) and given either sugar cube and sugar solution (4%) or baby milk powder and sugar solution for the investigation of nutritional requirement of adult female flies. Adult female flies fed on the different adult foods were dissected 7 days after emergence and then the developmental stages of follicles were scored on a basis of ten stages classified by Adams (1974).

Although all flies of the Lab em-7-em strain fed on proteinaceous adult foods have accomplished their egg maturation within 4 days after emergence (Agui *et al.*, 1985), a large number of females fed on sugar diet alone showed a drastic delay of follicle development (Fig. 1-A). Similar results were observed in the Yumenoshima flies collected in 1981 and 1982 (Fig. 1-B). Thus, the female flies of both strains, Lab em-7-em and Yumenoshima, and designated as anautogeny. Strictly speaking, the designation as "anautogenous strain" for both Lab em-7-em and Yumenoshima strains might not be appropriate, since approximately 20% of females in both strains accomplished the egg maturation under sugar diet alone (Fig. 1-A, B). On the other hand, the Misaki strain was defined as complete autogeny. The egg maturation of almost all female flies in the Misaki strain was accomplished by sugar diet alone (Fig. 1-C). However, the female flies of the Misaki strain were inclined to require proteinaceous adult foods in the 2nd egg cycle (Agui unpublished observation). The autogenous character in the Misaki strain may be established by the successive breeding with sugar feeding since 1973 when the original flies of this strain were collected from a field (Hayashi 1983).
Fig. 1 Follicular development in different strains of the housefly 7 days after emergence, when given sugar diet alone. The follicle stages of ovaries were scored on a basis of ten stages classified by Adams (1974): Stage 1 is the germarium, stage 2–3 means pre-vitellogenic phase, stage 4–8 vitellogenic phase and stage 9–10 post-vitellogenic phase. Yolk deposition in the follicle starts at stage 4 and eggs mature at stage 10.

Table 1 Effects of adult foods on the number of eggs in the first egg cycle of houseflies.

<table>
<thead>
<tr>
<th>Strains</th>
<th>No. of eggs (mean±SD (n))</th>
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<tr>
<td></td>
<td>Milk-fed</td>
</tr>
<tr>
<td>Lab em-7-em</td>
<td>48.2±6.1 (10) ^a</td>
</tr>
<tr>
<td>Misaki</td>
<td>36.6±8.3 (15) ^b, ^c</td>
</tr>
<tr>
<td>Yumenoshima</td>
<td>38.6±8.7 (30) ^b, ^e</td>
</tr>
<tr>
<td>Misaki (sugar selection)</td>
<td>—</td>
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</table>

The number of eggs represents the mean±SD of eggs in one of the paired ovaries 7 days after emergence.
Significantly different at $p<0.01-0.001$ between $^a$ and $^b$. No significant difference between $^c$ and $^d$. Significantly different at $p<0.05$ between $^e$ and $^f$.

Interestingly, the proportion of autogenous flies in the Yumenoshima strain increased progressively from ca. 20% to 70–93% by the successive breedings with sugar diet. As the results, the autogenous strain was established from the Yumenoshima flies. The establishment of autogenous houseflies by sugar-fed selection has also been reported by Larsen et al. (1966). These flies had shown the longer preoviposition period and laid fewer eggs than the females of anautogenous strain. In our results of Table 1, the female flies of the Lab em-7-em strain fed on milk were gravid with the largest number of eggs among the three strains. When the fecundities were compared in the female flies of the autogenous Misaki strain reared with either sugar or milk, there were no differences in the number of eggs of the first egg cycle. The flies of the autogenous Yumenoshima strain, which was established by the successive breeding with sugar diet, were gravid with smaller number of eggs than the original Yumenoshima flies.

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REFERENCES


摘 要

イエバエにおける卵発達に対する成虫餌の影響と無蛋白性産卵系統についての記載

三系統のイエバエにおいて、成虫期の栄養条件が卵発達と卵数におよぼす影響を調べた。Lab em-7-em, Yumenoshima 系統は、糖のみの給餌では卵胞の発達が進まない、いわゆる anautogeny の傾向を強く示した。しかし、約20%は autogenous な個体が混じった。Misaki 系統は完全な autogeny であった。Yumenoshima 系統の成虫を29世代糖のみの給餌で累代飼育した成虫は高率（93%）で autogenous な個体が選抜された。一方、第一次卵数は、ミルク給餌のLab em-7-em で一番多く、Misaki と Yumenoshima 両系統間では栄養要求が違うにもかかわらずその差はなかった。選抜の結果得られた autogenous な Yumenoshima 系統の卵数は減少した。