Human Blood Feeding Activity of Female Hybrids between Culex pipiens pipiens and Culex pipiens quinquefasciatus
(Diptera: Culicidae)

Manabu YOSHII1, Mariko MINE2, Kenji KUROKAWA3, Tsutomu ODA1, Katsutomo KATO4, Yasunori OGAWA4, Yuuki ESHITA4, Keikichi UCHIDA7

Abstract  Human blood feeding activity was examined in females of hybrids between Culex pipiens pipiens and Culex pipiens quinquefasciatus during long photoperiod at 25°C. Blood feeding rates of hybrids were lower than in Culex pipiens quinquefasciatus and Culex pipiens pallens, and higher than in Culex pipiens pipiens, because no females fed on human blood in Culex pipiens pipiens.

Health Science Research 20(1): 91-93, 2007

Key Words: Culex pipiens pipiens, Culex pipiens quinquefasciatus, hybrids, human blood feeding

Received 7 Jun 2007
Accepted 27 August 2007

INTRODUCTION

Human Bancroftian and dog filariae (Dirofilaria immitis) are transmitted by the mosquito of the Culex pipiens complex in Japan. The Culex pipiens complex consists of three taxa: Culex pipiens quinquefasciatus Say, Culex pipiens pallens Coquillet, and Culex pipiens molestus Forskal. Culex pipiens quinquefasciatus is distributed throughout the Ryukyu and Ogasawara Islands. Culex p. pallens and Cx. p. molestus are found north of Kagoshima (31°34′N), throughout the main Kyushu Islands, and northward, but not in more southern parts such as Okinawa13). Although these three mosquito taxa are morphologically similar, except for some minor details such as the structure of the male genitalia, they show marked differences in physiological and behavioral characteristics. We have studied those characteristics such as diapause, the insemination rates, and survival at high temperature with various strains4-6). Culex p. pallens is assumed to originate from hybrids between Cx. p. pipiens and Cx. p. quinquefasciatus2). We have studied insemination rate and diapause state in hybrids between Cx. p. pipiens and Cx. p. quinquefasciatus7-8), as first step helping to clarify the physiological characteristics in the hybrids, because the characteristics were scarcely found. In the present paper, we examined human blood feeding rates by hybrids.

MATERIALS AND METHODS

An Indonesian strain of Cx. p. quinquefasciatus and a German strain of Cx. p. pipiens were used in this study. The strain (Ja) of Cx. p. quinquefasciatus from Jakarta was collected in Jakarta City (06°11′S), Indonesia in July 1982, and maintained for 55 to 57 generations. Hibernating females representing Cx. p. pipiens (Ha) were collected in the cellar of a house in Hamburg (53°33′N), Germany in February 1989. The Cx. p. quinquefasciatus Japanese strain (Ok) was col-
collected in Naha City (25°4′N) Okinawa in March 1980 and maintained for 64 to 66 generations. The Cx. p. pallens strain (Na) was collected in Nagasaki City (32°4′N), Japan in December 1979 and maintained for 67-69 generations. The name of hybrids were written with the abbreviation of OH or JH when the hybrid was produced from Ok strain and Ha strain or when the hybrid from Ja strain and Ha strain. The name of HN shows hybrid between Ha and Na in strain.

All colonies were maintained in insectaries at 25 °C and relative humidity of 70-80% under a 16-hr lighting schedule (L:D = 16:8), using 2000 LUX fluorescent lighting. These mosquitoes were fed on mice at night.

One hundred first instar larvae were placed in an enamel tray (22 cm × 28 cm × 4 cm) with Ca 1,500 ml water. Equal amounts of brewer's yeast and finely ground mouse-food pellet powder were mixed and given as larval food. A water suspension of 0.2 g of this mixture was added to each tray every day. About 700 larvae were reared to pupae at 25 °C. When two days old, 100 male and 100 female pupae of each strain were put individually into 2 ml of salmon blood solution was added to each tray every day. About 700 larvae were reared to pupae at 25 °C. Two days after emerging, newly emerged adults of each sex were isolated from each other for a further two days, maintained in a netted cage (20 cm × 20 cm × 30 cm), and provided with a constant source of 2% sugar solution. When two days old, 100 male Cx. p. p. pipiens were released into a cage containing 100 females of Cx. p. quinquefasciatus. In this experiment, the hybrid of the 3rd generation was used.

Following the procedures described above, hybrid strains between Cx. p. pipiens and Cx. p. quinquefasciatus or Cx. p. pallens were established and allowed to interbreed. The first instar larvae were bred to adults in a long photoperiod (L:D = 16:8) and a short photoperiod (L:D = 10:14) at 21 °C. The mosquitoes were fed on the arm of a man for 30 minutes at 7 PM to 7:30 PM at night 8 days after emergence, and thereafter, the number of fed females was counted by using aspirator.

RESULTS AND DISCUSSION

Table 1 shows the human blood sucking and egg-laying rates in each line. Culex p. pallens and Cx. p. quinquefasciatus sucked blood well from humans, and most mosquitoes that sucked blood laid eggs, while Cx. p. pipiens did not suck human blood at all. Hybrids between Cx. p. pipiens and Cx. p. quinquefasciatus or between Cx. p. pipiens and Cx. p. pallens sucked human blood, though the blood-sucking rates were low. However, the blood-sucking rates in these hybrids markedly differed from those in Cx. p. quinquefasciatus and Cx. p. pallens. Many hybrid mosquitoes laid eggs. Culex p. quinquefasciatus and Cx. p. pallens are known to have a taste for human blood, that is, they are anthropophilic. This taste for human blood is a factor associated with major vector mosquitoes for Wuchereria bancrofti. On the other hand, Cx. p.

<table>
<thead>
<tr>
<th>Name of Strain</th>
<th>Female</th>
<th>Male</th>
<th>No. (%)* of females feeding</th>
<th>(%)</th>
<th>No. (%)** of females oviposited after feeding</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na</td>
<td>p. pallens</td>
<td>Na</td>
<td>35</td>
<td>35</td>
<td>26</td>
<td>74.3</td>
</tr>
<tr>
<td>Ok</td>
<td>quinquefasciatus</td>
<td>Ok</td>
<td>45</td>
<td>45</td>
<td>38</td>
<td>84.3</td>
</tr>
<tr>
<td>Ha</td>
<td>pipiens</td>
<td>Ha</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OH</td>
<td>quinquefasciatus × pipiens</td>
<td>Ok</td>
<td>19</td>
<td>19</td>
<td>12</td>
<td>63.2</td>
</tr>
<tr>
<td>JH</td>
<td>Ja</td>
<td>Ha</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>100.0</td>
</tr>
<tr>
<td>HJ</td>
<td>Ha</td>
<td>Ja</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>33.3</td>
</tr>
<tr>
<td>HN</td>
<td>pipiens × pallens</td>
<td>Na</td>
<td>16</td>
<td>16</td>
<td>11</td>
<td>68.8</td>
</tr>
</tbody>
</table>

* Initial number of females before feeding was 100 in all cases.
** Initial number of females before oviposition were No. of females feeding in each strain.
1) Significant (p < 0.01) by χ²-test between Na and OH, JH, HJ, HN, respectively.
2) Significant (p < 0.01) by χ²-test between OK and OH, JH, HJ, HN, respectively.
3) Significant (p < 0.001) by χ²-test between Ha and OH, JH, HJ, HN, respectively.
pipiens in Europe is known to have a taste for avian blood\textsuperscript{12}. Our results were consistent with these findings. In this study, the blood-sucking rate in each hybrid was not so high as that in Cx. p. quinquefasciatusciatus but not so low as that in Cx. p. p. pipiens, being roughly intermediate between them. Thus, the hybrids may not have a marked taste for human blood. A previous study on the diapause of hybrids between the same lines showed a shallow diapausing state under a short day condition\textsuperscript{8}. This finding together with our results suggests that the physioecological characteristics of the hybrids are intermediate between the characteristics of Cx. p. pipiens and those of Cx. p. quinquefasciatusciatus. However, the fertilization rate in hybrids between the same lines at high temperature (30°C) was high, being similar to that in Cx. p. quinquefasciatusciatus, and did not show a decrease as is observed in Cx. p. pallens\textsuperscript{8}. Therefore, the physioecological characteristics of the hybrids are not always intermediate and may considerably vary. This may be mainly due to the lines of Cx. p. pipiens and Cx. p. quinquefasciatus used in the experiment. Gillett (1971) reported that Culex pipiens (Cx. p. pipiens) will play a part of transmission of West-Nile-Virus\textsuperscript{12}. Based on the results of this experiment, even if Cx. p. pipiens with West-Nile-Virus produced in Europe invades Japan, these mosquitoes may not immediately attack humans but may rather feed on avian blood.

REFERENCES CITED