Age composition of incriminated malaria vector in a rural foothills in West Bengal, India

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Two 1 yr surveys carried out at a gap of 10 yr revealed nine anopheline species from malaria endemic foothills area of Ayodhya - Baghmindi range of West Bengal, India, with 8.4 per cent populations of Anopheles culicifacies. An. culicifacies was incriminated as vector of Plasmodium falciparum with sporozoite rate of 1.23 per cent. Studies on age composition indicated that proportion parous and daily survival rate of An. culicifacies were assessed to be 0.50 and 0.84 respectively. The survival rate per gonotrophic cycle averaged over the two year was 0.61. Rainy season was found to be the favourable period for transmission.

Key words Anopheles culicifacies - malaria - transmission - vector

The hill top and foothills area of Ayodhya-Bagmundi range (average altitude 2200 ft) of Purulia district, West Bengal, India, a dry place, is highly endemic for malaria. Plasmodium falciparum comprises more than 60 per cent of the total cases1,2, and more than 42 per cent cases were reported to be chloroquine resistant3. The area is covered with dense and moderate forests with some isolated villages inhabited mostly by tribes. There is no information about the malaria vector from foothill areas of the range. Two-year surveys during May 1995 - April 1996 and after a gap of 10 yr i.e., during May 2005 - April 2006 were conducted and indoor-resting mosquitoes were collected from human habitations by hand collection method using aspirators4,5 employing 32 man-hour per season per year (total 192 man-hour in 2 yr). Species composition of anophelines and their man-hour densities in different seasons in the study area are presented in Table 1. Man-hour densities of Anopheles culicifacies were markedly higher during rainy season in comparison to other seasons. Salivary glands of all the 9 species of anophelines including 488 wild caught An. culicifacies were dissected and examined for sporozoites. Of them, 6 An. culicifacies (2 specimens out of 170 dissected during 1995 - 1996 and 4 specimens out of 318 dissected during 2005 - 2006) were found naturally infected with sporozoites of P. falciparum (confirmed by ELISA test). All the sporozoite positive specimens were available during rainy season. Per cent caught of An. culicifacies was significantly higher (P<0.05) during rainy season (when it was compared by normal deviate ‘Z’ test) than those in winter (Z=4.33) and summer (Z=7.08) probably due to increasing number of temporary breeding sites and it was also higher (P<0.05) in winter than that in summer.
(Z=3.4) (Table I) because winter is the post-monsoon season and retains some of the temporary habitats. Overall sporozoite rate was calculated to be 1.23 per cent. There was no significant difference in sporozoite rate between 1995 - 1996 (1.18%) and 2005 - 2006 (1.26%). So An. culicifacies was incriminated to be the vector of malaria for the first time from Badria village at the foothills region of Ayodhya-Bagmundi range though this species had been incriminated from the hilltop of the same range. The malarial situation remained unchanged for a period of 10 yr in the present study area.

Age composition of An. culicifacies was studied on the basis of number of ovariolar dilatations, following Polovodov$^a$ that is number of gonotrophic cycles passed, as described by Chandra et al$^7$. For individual mosquito the ovariole with highest number of dilatation was considered. Seasonal and overall abundance of An. culicifacies, their duration of gonotrophic cycle, patity status, proportion parous and daily survival rate$^8$ are presented in Table II. No seasonal difference was noted regarding proportion parous and daily survival rate. Of the 6 sporozoite positive specimens, 2 were $P_3$ and 4 were $P_4$ regarding their parity status. A total of 96 (58 $P_3$+38 $P_4$) An. culicifacies passed 3 and/or 4 gonotrophic cycles of which 76 (79.2%), 14 (14.6%) and 6 (6.2%) were available in rainy, winter and summer seasons respectively (Table II). Per cent availability of this risk group was higher ($P<0.05$) in rainy season than those in winter ($Z=6.67$) and summer ($Z=7.95$) which is indicative to the fact that all the sporozoite positive specimens were encountered in the rainy season. High abundance of vector, less duration of gonotrophic cycle and high proportion of risk group favoured a higher disease transmission during rainy season. Overall, 19.67 per cent of the vector population passed three or more gonotrophic cycles in nature that is equal to or more than 12 days old. Mosquitoes of greater physiological age are of greater epidemiological importance$^7$. So existing age structure of An. culicifacies population indicated that they were the potential vector of malaria at the present study area and one of the vital causes for its high incidence.

<table>
<thead>
<tr>
<th>Season</th>
<th>Number collected &amp; dissected (Per cent)</th>
<th>Duration of gonotrophic cycle (in h)</th>
<th>No. of vectors with parous state</th>
<th>Proportion parous</th>
<th>Daily survival rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainy (R)</td>
<td>332(68.03)</td>
<td>78(3.25)</td>
<td>NP 45 45 31</td>
<td>0.50</td>
<td>0.81</td>
</tr>
<tr>
<td>Winter (W)</td>
<td>126(25.82)</td>
<td>132(5.5)</td>
<td>NP 28 22 10 4</td>
<td>0.51</td>
<td>0.89</td>
</tr>
<tr>
<td>Summer (S)</td>
<td>30(6.15)</td>
<td>78(3.25)</td>
<td>NP 4 4 3 3</td>
<td>0.48</td>
<td>0.80</td>
</tr>
<tr>
<td>Total/mean*</td>
<td>488(100)</td>
<td>96(4.0)*</td>
<td>NP 77 71 58 38</td>
<td>0.50*</td>
<td>0.84*</td>
</tr>
</tbody>
</table>

NP, nulliparous; *, mean values
The survival rate (log transformed) of *An. culicifacies* as a function of parous state

The relationship between the survival rate and the parity state is presented in the Fig. The slope of the regression equation following Zar\(^9\) was -0.194 (± 0.049 SE). The survival rate per gonotrophic cycle averaged over the two years was 0.61 (deduced from the observed data) and 0.62 (calculated from the regression equation), reflected consistency in observed and expected values.

Other anophelines like *An. subpictus*, *An. vagus*, *An. annularis* and *An. aconitus* were available in a high to moderate percentage (30% - 5%) in the present study area. Though these species were incriminated as malaria vectors previously from different parts of West Bengal, India\(^{10-14}\), none of them were incriminated in the present study.

In conclusion, *An. culicifacies* was found to be the potential vector of malaria in the study area in both the surveys done 10 yr apart, and the rainy season was the favourable period for transmission.

**References**


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