COMPARATIVE INFECTIVITY OF TWO STRAINS OF PLASMODIUM FALCIPARUM TO ANOPHELES QUADRICIMAULATUS SAY, ANOPHELES FREEBOMI AIKEN, AND ANOPHELES ALBIMANUS (WIED.)

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Studies on the comparative infectivity of Plasmodium falciparum to Anopheles quadrimaculatus and A. albimanus have been reviewed previously (Collins, 1962). Studies on the comparative infectivity of P. falciparum to A. quadrimaculatus and A. freebomi have been reported only once. In this instance, Burgess and Young (1946) reported one comparative feeding on the McLendon strain of P. falciparum in which the A. freebomi had 1.18 times the number of oocysts per gut as did the A. quadrimaculatus.

Reported here are the results of comparative studies using two strains of P. falciparum from widely separated geographical origins and A. quadrimaculatus, A. albimanus, and A. freebomi.

METHODS AND PROCEDURES. The Thailand strain of P. falciparum is a multi-resistant strain which has been described by Young, et al., (1962). It was originally isolated from a person who had served in a U. S. Naval Unit in Thailand. The McLendon strain was isolated from a resident of South Carolina in 1940 by Young, McLendon and Smarr (1943).

The A. quadrimaculatus (Q-1 strain) was originally from the Southeastern United States and has been maintained in the laboratory since 1944. The A. albimanus (A-9 strain) was originally from El Salvador and was obtained through the courtesy of Dr. H. G. Sirokovski, Shell Development Company, Modesto, California. The colony has been maintained since 1960. The A. freebomi (F-1 strain) was from Marysville, California, and has been maintained in the laboratory since 1944.

The patients were adult males being treated for neurosyphilis. Two patients were infected with the Thailand strain by intravenous inoculation of fresh parasitized blood from a donor patient. Patient A first showed parasites four days after inoculation. Gametocytes were found 8 days later. Patient B first showed parasites 10 days after inoculation and gametocytes 9 days later. All comparative feedings were during the first wave of sexual parasites.

For the McLendon strain, the patient used in the Q-1 and A-9 comparisons was infected by intravenous inoculation of parasitized blood which had been preserved frozen in a dry ice chest (-78° C.) for slightly over 5 years (1,921 days). The asexual parasites were first found 9 days after inoculation. Gametocytes appeared 7 days later. The comparative feedings (Q-1/A-9) were during the first gametocyte wave.

The 15 Q-1/F-1 comparative feedings on the McLendon strain were done at various times on 11 different patients. They were made on the first to the fifth gametocyte waves.

No antimalarials were given patients during the study period.

Three to five-day-old adult female mosquitoes were caged in lots of 100 to 150 in pint ice cream carton cages and allowed to feed through the screened top on a patient's leg. Engorged mosquitoes were incubated in these cages at 78° F. to 80° F. and fed 5 percent honey water daily in a...
cellulose sponge. Eight to 10 days after
the feeding, the mosquitoes were dis-
sected and the guts microscopically exam-
inied for the presence of oocysts.

RESULTS. The results of the comparative
infectivity studies using the Thailand
strain of P. falciparum are shown in
Table 1. The A. freeborni (F-1) had a
higher percentage of infection than the
mosquitoes had 2.34 times the gut infection
index as the standard Q-1 mosquitoes.
The gut infection index of the Q-1 mos-
quitoes was 1.15 times that found in the
A-9 mosquitoes. By combining the results
of the comparative feedings on the
McLendon strain, the F-1 mosquitoes
were estimated to have a gut infection in-
dex 2.64 times that of the A-9 mosquitoes.

Table 1.—Comparative infectivity of P. falciparum (Thailand strain)
to 3 species of Anopheles.

<table>
<thead>
<tr>
<th>Mosquitoes</th>
<th>Comparative feedings</th>
<th>Mosquitoes dissected</th>
<th>Percent infection</th>
<th>Gut infection index</th>
<th>Gut infection index ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. quadrimaculatus Q-1</td>
<td>10</td>
<td>248</td>
<td>68.5</td>
<td>668</td>
<td>(F-1/Q-1) 0.62</td>
</tr>
<tr>
<td>A. freeborni</td>
<td>F-1</td>
<td>133</td>
<td>57.3</td>
<td>8266</td>
<td>(F-1/Q-1) 1.2</td>
</tr>
<tr>
<td>A. quadrimaculatus Q-1</td>
<td>15</td>
<td>353</td>
<td>55.1</td>
<td>746</td>
<td>(Q-1/A-9) 0.22</td>
</tr>
<tr>
<td>A. albimanus</td>
<td>A-9</td>
<td>359</td>
<td>0.0</td>
<td>1.2</td>
<td>(Q-1/A-9) 3558</td>
</tr>
<tr>
<td>A. freeborni</td>
<td>F-1</td>
<td>99</td>
<td>86</td>
<td>8183</td>
<td>(F-1/A-9) 0.6</td>
</tr>
<tr>
<td>A. albimanus</td>
<td>A-9</td>
<td>178</td>
<td>0.6</td>
<td>2.3</td>
<td>(F-1/A-9) 3558</td>
</tr>
</tbody>
</table>

A. quadrimaculatus (Q-1) mosquitoes,
which in turn had a higher percentage of
infection than the A. albimanus (A-9) mos-
quitoes. The gut infection index (average
number of oocysts per 100 guts) followed
the same pattern. The F-1 mosquitoes
had 12.4 times as many oocysts per gut as
did the Q-1 mosquitoes. The A-9 mosqui-
 toes were so lightly infected that only one
individual out of a total of 339 dissected
was positive and it had only four oocysts.

The results of the comparative feedings
on the McLendon strain of P. falciparum
are shown in Table 2. The percentage of
infection was again greater in the F-1 than
in the Q-1 mosquitoes which in turn was
greater than that found in the A-9 mosqui-
toes. The gut infection index followed
a similar pattern. However, the differ-
ences were not as great as those found
with the Thailand strain. The F-1 mos-
quitos demonstrated that A. quadrimaculatus
when fed simultaneously with a Panama
strain of A. albimanus, proved more sus-
ceptible to a conoidigenous United States
(1950) showed that the reciprocal rela-
tionship also existed, in that a Panama
strain of A. albimanus when fed simul-
taneously with a United States strain of
A. quadrimaculatus proved more suscepti-
ble to a conoidigenous Panama strain of
P. falciparum.

A summary of the findings with the
two strains of P. falciparum presented here
and the Colombia strain presented pre-
viously (Collins, 1962) is shown in Table
3. The A. quadrimaculatus, which is our
standard has been given the designation
of 100. None of the strains of P. falciparum
studied can be considered as coin-
mosquitoes. However, the marked differences in infectivity indicate a much closer relationship of the McLendon and Colombia strains of *P. falciparum* to the A-9 strain of *A. albimanus* than is found between the Thailand strain of *P. falciparum* and this mosquito.

With the two strains tested using the F-1 mosquitoes, it was found that this mosquito is more heavily infested than the other species. The F-1 strain of *A. freeborni* appears to be similar to the Q-1 strain of *A. quadrimaculatus* in that it is susceptible to infection by *P. falciparum* from widely separated geographical origin.

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Summary. Comparative studies on the infectivity of strains of *Plasmodium falciparum* from South Carolina, U. S. A., and from Thailand, to *Anopheles freeborni*, *A. quadrimaculatus*, and *A. albimanus* indicated that the first was the more heavily infected. The *A. albimanus* varied greatly in susceptibility and was least infectious to the *P. falciparum* strain from Thailand.

References


