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Short Report

Plasmodium falciparum infection does not increase the precocious mortality rate of *Anopheles gambiae*

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During the few days following an infective blood meal with *Plasmodium* sp., an excessive mortality of mosquito vectors has been reported by some researchers (BUXTON, 1935; MAIER, 1973; GAD *et al.*, 1979; KLEIN *et al.*, 1986). On the other hand, other researchers have not observed any particular mortality during exflagellation, ookinete development and penetration, or at the beginning of the oocyst growth (DE BUCK & SWELLENGREBEL, 1935; BOYD, 1940; WILKINSON *et al.*, 1972; MAIER *et al.*, 1987). It is very likely that the different species of *Plasmodium* do not behave similarly; some of them may be pathogenic for the vector, others not. It is also possible that species of mosquito differ in their response to infection.

We tried to determine whether the most important human malaria parasite, *Plasmodium falciparum*, produced specific mortality during the first 5 d following infection of one of its main vectors, *Anopheles gambiae*.

A colony of *A. gambiae* Gilles, indigenous to the Bobo-Dioulasso area (Burkina Faso), has been maintained in the insectary for several years; wild-caught specimens from the same area were regularly added. Adults were kept at 28°C with 80% relative humidity and had permanent access to sugar solution. The day of emergence was designated day 0; on days 2 and 3 the female mosquitoes were allowed to feed on a rabbit.

Experimental infection took place on day 5, using the method of RUTLEDGE *et al.* (1964); infected blood was placed in a reservoir, covered with Parafilm®, maintained at 37°C, and exposed to mosquitoes for 5 min. Each experimental series consisted of batches of 100 mosquitoes which fed at the same time on (i) uninfected human blood as a control, or (ii) blood from a gametocyte carrier. The selection of mosquitoes for feeding on control or infected blood was random.

P. falciparum was obtained in venous blood from naturally infected children living in the Bobo-Dioulasso area. The blood of the same child was used to infect each single experimental series.

Dead mosquitoes were counted every day between days 6 and 10 (1 to 5 d after infection). On days 10 and 15, mosquitoes were permitted to feed on a rabbit. On day 18 (13 d after infection), surviving mosquitoes were examined by an enzyme-linked immunosorbent assay (as modified by VERHAVE *et al.*, 1988), to detect *P. falciparum* circumsporozoite antigen and to calculate the infection index of the different experimental series.

Table 1. Numbers of *Plasmodium falciparum* gametocytes (per mm³ of infected blood meal) and infective indexes of *Anopheles gambiae s.s.*

Experiment no.	No. of gametocytes	No. of infected mosquitoes
1	250	13/28 (46%)
2	75	4/30 (13%)
3	50	14/39 (36%)
4	50	3/17 (18%)
5	40	7/18 (39%)
6	40	4/21 (19%)
7	20	10/28 (36%)
8	20	6/35 (17%)
9	20	3/26 (12%)
10	10	2/35 (6%)
Mean	57·5	66/277 (24%)

Table 2. Cumulative number of dead *Anopheles gambiae s.s.* during the first five days following infection with *Plasmodium falciparum*

	Days of infection 1	2	3	4	5
No. dead					
control[a]	24	46	67	93	127
infected[b]	39	78	110	152	207
Mortality (%)					
control	4·0	7·7	11·2	15·5	21·2
infected	3·9	7·8	11·0	15·2	20·7
Difference of percentages (control−infected)	+0·1	−0·1	+0·2	+0·3	+0·5

[a]Total number of control mosquitoes=600.
[b]Total number of infected mosquitoes=1000.

The sporozoite index in the 10 infected series ranged from 6% to 46%, with a mean of 24% (Table 1). During the 5 d following infection, the difference in mortality between infected and control mosquitoes was lower than 0·5% (Table 2) and was never statistically significant (values of P always $\geq 0{\cdot}82$). There was no evidence of any relationship between mortality and gametocytaemias, nor between mortality and sporozoite indexes.

In conclusion, no special mortality of *A. gambiae* was observed due to infection with *P. falciparum* in conditions close to the natural situation, during the 5 days after the blood meal. This observation implies excellent tolerance of *P. falciparum* by *A. gambiae*.

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