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DEVELOPMENT OF FALCIPARUM MALARIA IN A PANAMANIAN SUBSPECIES OF HOWLER MONKEY*

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Abstract. After adaptation to Colombian and then Panamanian *Aotus trivirgatus*, the Panama II strain of *Plasmodium falciparum* was infective for *Alouatta villosa trabeata* Lawrence. Five serial trophozoite passages were demonstrated, with parasitemias reaching 35,000 per mm³; four animals experienced multiple recrudescences, terminating as long as 175 days after inoculation.

Previous attempts to induce infections of *Plasmodium falciparum* in howler (*Alouatta*) monkeys met with little success.[1-3] We now report infectivity of the *Aotus trivirgatus*-adapted Panama II strain[4] to a coindigenous subspecies of *A. villosa*, yielding parasite growth at significant levels and establishment of serial passage in normal hosts.

MATERIALS AND METHODS

The Panama II strain was acquired in July 1972 through the kindness of Dr. W. E. Collins, USPHS, Chamblee, Georgia after the second transfer in Colombian *A. trivirgatus*. Since that time we have carried a line in intact or splenectomized night monkeys of local origin. The laboratory procedures have been published elsewhere.[5]

The species designation for the howler monkey, *Alouatta villosa* (= *A. palliata*), follows Hall and Kelson[6] and other authors.[7,8] All of these subjects originated from Barqueta, Chiriqui Province in southwestern Panama, and the subspecies was identified as *A. v. trabeata* Lawrence (Mendez, Gorgas Memorial Laboratory, pers. commun.) consistent with descriptions given for this group of middle American primates.[9]

RESULTS

At our 18th *A. trivirgatus* passage of the parasite, a combined intraperitoneal/intravenous subinoculation was made to each of two *A. v. trabeata*. One, 8008, experienced an infection (Table 1), while the corecipient remained negative throughout 54 days of observation. Four subsequent serial passages were made intraperitoneally.

Monkey 8008 showed a 1-day prepatent period, having received 738 × 10^6 parasites. The onset of patency among the remaining subjects, requiring 5 to 20 days, did not relate to the inoculum size (0.8 × 10^6 to 70 × 10^6). Peak counts oc-

TABLE 1
Infections of Plasmodium falciparum *in* Alouatta villosa trabeata

Host no.*	Prepat. and (subpat.) pds. days	Patent pd. days	Maximum parasitemia per mm³	Total period examined days
8008	1	5	<10	
	(54)	16	10,680	
	(21)	45	6,420	
	(13)	20	7,220	238
8009	5	18	14,910	
	(31)	15	1,060	
	(37)	25	5,490	166
8011	11	16	35,060	
	(19)	21	14,180	
	(6)	12†	33,060	85
8013	17	20	5,820	
	(11)	47	4,600	
	(30)	3	120	
	(25)	21	3,370	203
8014	19	22†	6,520	41

* Listed in sequence of serial passage.
† At death.

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curred by the 1st to 3rd weeks. All four animals surviving the initial patent period experienced 2 to 4 recrudescences, with parasites last detected 85 to 175 days after inoculation. Intensities of these recurrences were variable, although parasites persisted for more than 6 weeks in two monkeys.

Immature gametocytes were seen irregularly in two animals during the course of the heaviest parasitemia episodes.

DISCUSSION

The reasons for the development of *P. falciparum* in *A. villosa* may have been due to several factors associated with the parasite or the host. In prior attempts to establish infections of indigenous falciparum malaria with *A. v. trabeata* the Taliaferros used inocula that came directly from human volunteers, producing only immediate and brief high parasitemias.[1] The isolate for the present series was also of Panamanian origin, but in contrast had been first adapted to *A. trivirgatus*. Malayan and African *A. trivirgatus*-adapted falciparum strains have yielded low grade infection in another indigenous howler, *A. v. aequatorialis* Festa.[2]

Alouatta v. trabeata acclimates well to laboratory conditions (in contrast to *A. v. aequatorialis*) and has demonstrated a relatively long captive life span, even with the daily handling necessary in malaria investigations. These attributes add to the feasibility of the experimental system.

A total of four species of New World monkeys now have been shown to be capable of supporting passage lines of *P. falciparum*.[10]

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