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The responses of *Anopheles gambiae*, and other mosquitoes in Burkina Faso, to CO_2—the start of a search for synthetic human odour

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When two odour-baited entry traps were placed side-by-side, one emitting just CO_2 and one emitting the same concentration of CO_2 plus human odour, the only mosquito species showing a 'preference' was *Anopheles gambiae* s.l., 66% of which chose the human odour. When the traps were placed about 20 m apart, CO_2 alone caught less *An. gambiae* s.l., *An. funestus* and *Mansonia uniformis* (50%, 40% and 66% of the human-odour catches, respectively) but twice as many *An. pharoensis*. When CO_2 doses were varied, all species gave similar dose–response curves but the behaviour of each was seen to differ when the catches were compared with those on human bait. *Anopheles arabiensis* chose CO_2-baited traps with a higher probability than *An. gambiae* s.s., supporting the theory that *An. arabiensis* is less anthropophilic.

The primary aim of the present project was to develop a human-odour-baited trap to sample the biting fraction of populations of malarial vectors. The trap developed so far, the OBET (odour-baited entry trap), catches a consistent fraction of both a standard human-biting catch (HBC) and a light-trap catch when baited with odour emanating from a sleeping man plus enough CO_2 to emit a standard concentration of 0.15%. (The amount of CO_2 typically released from a man in the experiments was 0.06%–0.12%.) What remains is to replace the person with a standard blend of chemicals equivalent to a human bait.

It was also found that CO_2 released through the OBET on its own is a powerful mosquito attractant. This gas could provide a useful standard odour, against which the efficacy of candidate artificial odours can be tested, as was done for the development of odour-baited traps and targets for tsetse in Zimbabwe. The aim of the present study was to test the response of mosquitoes to CO_2, using OBET in the village of Noungou, approximately 30 km north-east of Ouagadougou, Burkino Faso. Although the malarial vectors *Anopheles gambiae* s.l. and *An. funestus* were of prime interest, *An. pharoensis*, *Mansonia uniformis* and *Culex quinquefasciatus* were also analysed.

Carbon dioxide was used to attract mosquitoes both in the presence and in the absence of human odour. In a direct choice test between CO_2 and human odour in two OBET placed side-by-side, only *An. gambiae* s.l. made a choice significantly different from random, 66% choosing the human bait. When the human-baited trap and the CO_2-baited trap were placed about 20 m apart (with equal CO_2 concentrations), CO_2 alone attracted 50% of the numbers of *An. gambiae* s.l., 40% of the *An. funestus*, 60% of the *M. uniformis* and

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200% of the *An. pharoensis* caught with human odour. The dose–responses were essentially similar for all species: a linear increase in catch with increasing dose on a log–log scale. The slopes of the dose–response curves were not significantly different for any of the species, although there was a difference in the relative numbers caught. If the dose–response data are considered in relation to a standard human-biting catch (HBC), however, the behaviour of each species was quite different. At one extreme, even the highest dose of CO_2 tested did not catch more *An. gambiae* s.l. than one HBC and, at the other extreme, a dose of CO_2 equivalent to that released by a man caught as many *Mn. uniformis* as one HBC and higher doses caught proportionally more. *Anopheles pharoensis* and *Cx. quinquefasciatus* showed a threshold response: only doses of CO_2 greater than the equivalent released by man caught significant numbers of mosquitoes, and these higher doses were significantly more attractive than one HBC. *Anopheles funestus* did not respond to CO_2 on its own in sufficient numbers to assess a dose–response. Within the *An. gambiae* species complex, *An. arabiensis* chose the CO_2-baited trap with a higher probability than *An. gambiae* s.s., in support of the theory that *An. arabiensis* is truly less anthropophilic than *An. gambiae* s.s., and that it is not simply an opportunist feeder (i.e. feeding readily on man or cattle, according to availability). The results are encouraging in that the target species, the malarial vectors, appear to be highly attracted to human odours in addition to CO_2.