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SHORT COMMUNICATION

Entomological evaluation of ivermectin mass treatment against onchocerciasis

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To evaluate the impact of onchocerciasis control programmes on the annual transmission potential, it is customary to monitor the man-biting rate of vector *Simulium* (Diptera: Simuliidae) and the number of *Onchocerca* (Nematoda: Onchocercidae) infective larvae found in them (Walsh *et al.*, 1978). In addition to the transmission of *Onchocerca volvulus* (Leuckart) causing human onchocerciasis, *Simulium* females may also be the vectors of various other species of *Onchocerca* which parasitize wild or domestic animals. The larvae of other *Onchocerca* spp. are difficult to distinguish from those of *O.volvulus*. Therefore, using routine methods in the field, it is not easy to determine the efficiency of a mass host chemotherapy campaign targeting only one *Onchocerca* species. To evaluate the impact of ivermectin on natural transmission of *O.volvulus*, we tried to improve the usual entomological index of infection by measuring lengths of *Onchocerca* larvae found in female blackflies (Simuliidae) collected on human bait.

Annual mass treatment with ivermectin has been carried out since 1987 in the Vina Valley, a savanna region of North Cameroon, involving about 20,000 people (Prod'hon *et al.*, 1991). Ivermectin was given to eligible people at the target dosage of 150 μg per kilogram of body weight. Coverage with the treatment was higher than 60% (Prod'hon *et al.*, 1991). According to Traoré-Lamizana & Lemasson (1987), the principal vectors of onchocerciasis in Vina valley are *Simulium damnosum* Theobald *sensu stricto* and *S.sirbanum* (Vajime & Dunbar). Entomological surveys of man-biting Simuliidae were performed 1 month before treatment, then done again during the 2 months following the campaign. *Simulium* females were dissected and larvae of *Onchocerca* were observed and counted as described by Philippon (1977). All third stage larvae found in the blackfly head, considered to be infective larvae, were stretched by heat exposure, then measured using an eye-piece micrometer. Infective larvae were recorded per 1000 parous blackflies. Infective larva lengths were represented by frequency of larvae observed in 20 μm size-classes from 400 to 1180 μm. The distributions of larva lengths before and after treatment were compared.

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A total of 42,881 *Simulium damnosum sensu lato* females were collected and dissected: 13,886 before ivermectin mass treatment of the human population and 28,995 post-treatment. From *Simulium* dissections, 1914 entire infective larvae of *Onchocerca* were measured (Table 1). The blackfly infection rate decreased significantly from 112.2 per 1000 parous *S.damnosum s.l.* before treatment to 52.1 after treatment ($P < 10^{-5}$).

As shown graphically in Fig. 1, the frequency distribution of larva lengths differed before and after treatment ($\chi^2 = 240$; d.f. = 14; $P < 10^{-6}$). In the pre-treatment sample, the mean length of larvae was 716 ± 3 μm compared with 775 ± 4 μm in the post-treatment sample.

Substantial reduction of *O.volvulus* transmission by ivermectin treatment of the human host population has been demonstrated both under experimental (Cupp *et al.*, 1986; Prod'hon *et al.*, 1987, 1991; Cupp *et al.*, 1989) and field conditions (Remme *et al.*, 1989; Trpis *et al.*, 1990). Whereas experimental trials were based on the development of carefully identified *O.volvulus* larvae in a particular *Simulium* species, field epidemiological studies considered the overall rate of any *Onchocerca* spp. infective larvae found in the head of captured blackflies. Careful morphological examination of infective larvae should distinguish between most of the *Onchocerca* species (Bain & Chabaud, 1986), but specific identification remains difficult under routine field conditions and larval length is not a suitable character for species identification.

The observed shift towards more of the larger size classes of *Onchocerca* infective larvae in blackflies after ivermectin treatment of the human host population could be due to several possibilities which should be investigated. The most likely cause(s) might be: (a) replacement of human *O.volvulus* by larger *Onchocerca* spp. as the prevalent infective larvae in *S.damnosum s.l.* females; (b) substitution between strains of *O.volvulus* with different size frequencies of infective larvae; (c) positive effects of iver-

Table 1. Size-classes of *Onchocerca* infective larvae found in the head of *Simulium damnosum s.l.* females captured on human bait in the Vina Valley of North Cameroon, before and after mass chemotherapy of the human population with ivermectin.

Range of length (μm)	400-420	440-460	480-500	520-540	560-580	600-620	640-660	680-700	720-740	760-780	800-820	840-860	880-900	920-940	960-980	1000-1020	1040-1060	1080-1100	1120-1140	1160-1180	Total
No. of infective larvae																					
Pre-treatment	2	0	3	10	61	140	169	166	132	152	101	42	22	12	14	19	8	1	2	1	1057
Post-treatment	0	0	4	5	58	68	45	59	54	142	191	65	78	19	24	37	4	3	0	1	857

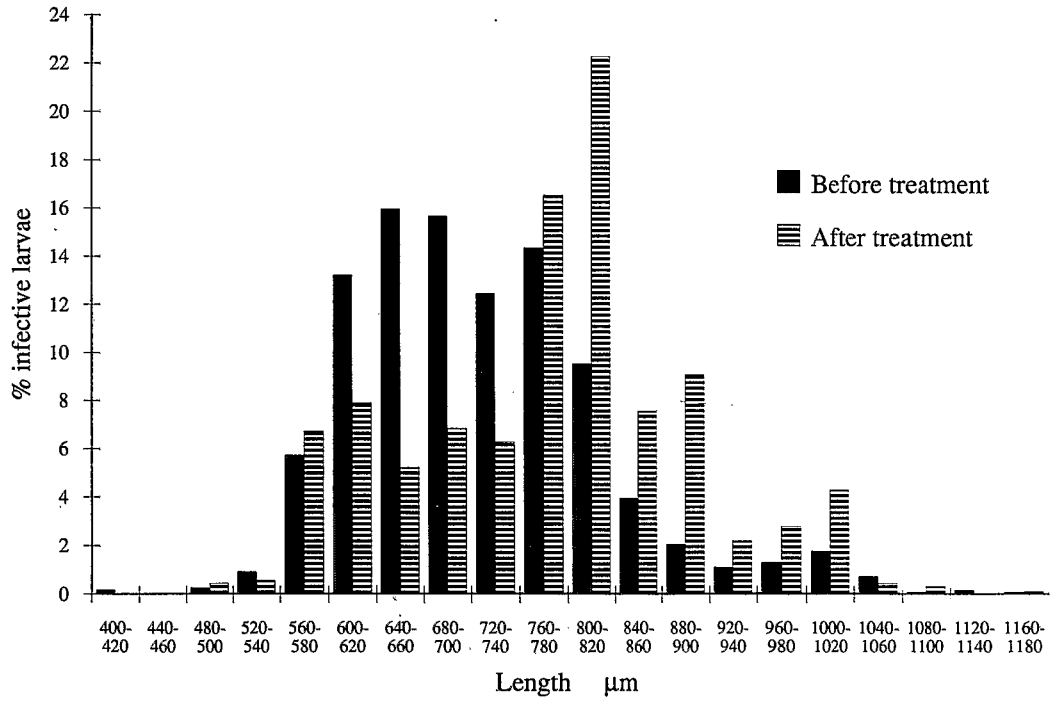

Fig. 1. Frequency distribution of size-classes of *Onchocerca* infective larvae found in the head of *Simulium damnosum s.l.* females captured on human bait in the Vina Valley of North Cameroon, before and after the mass treatment of the human population with ivermectin.

mectin on the size of *O.volvulus* infective larvae, despite halving of the infection rate.

Bearing in mind the normal length range of *O.volvulus* infective larvae reported for Cameroon strains by Duke (1967), Franz & Renz (1980), Eichner & Renz (1990) and Wahl *et al.* (1991), we propose that, in the savanna of northern Cameroon, size-classes between 600 and 740 μm are the most sensitive to changes induced by ivermectin mass treatment. Apparently, the epidemiological impact of ivermectin is reflected by changes in the frequency distribution of infective larval length, increasing the mean length, with little effect on the absolute size range of *Onchocerca* infective larvae occurring naturally in the *S.damnosum* complex.

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