Synthetic-fibre filters for preventing dracunculiasis: 100 versus 200 micrometres pore size.

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Abstract

Filtering of drinking water to remove the copepod intermediate hosts of *Dracunculus medinensis* is a primary strategy for control of guinea-worm disease. Since filters of different porosities are used, we tested the efficiency of synthetic-fibre filters of 100 μm and 200 μm pore size in removing the various stages of 3 species of copepods from water samples. The 200 μm mesh retained the larger copepodid stages including adults (C III-VI), but permitted passage of smaller copepodids and all naupliar stages. The 100 μm mesh retained all but the earliest naupliar stages (N I-II) which are unlikely to harbour guinea-worm larvae.

Introduction

Dracunculiasis is a severely debilitating disease threatening an estimated 120 million people with 3·32 million cases annually in Africa alone (WATTS, 1987). The disease is acquired by drinking water containing cyclopoid copepods infected with third-stage larvae of the parasite *Dracunculus medinensis*. Filtering drinking water is an effective prophylactic measure against dracunculiasis, but selecting a mesh of optimum pore size for filtration depends upon several criteria. To be effective, filters must not only remove the copepod intermediate hosts to prevent disease but must also have a cost, durability and filtration rate acceptable to the local populations.

Although filters with a pore size of 100 μm have been recommended (DUKE, 1984), our examination of filters from several areas where drancunculiasis is endemic demonstrates variation in both pore size and weave. Single samples of filter material received from Pakistan, Nigeria, and Burkina Faso had pore sizes of 200, 216-220, and 20-200 μm, respectively. The Pakistan filter was a nylon monofilament gauze, but the others were polyfilament gauzes. In view of the wide range of meshes used and their importance in removing infected copepods, we compared the efficacy of 100 μm and 200 μm pore size monofilament polyester in removing the various stages of 3 species of copepods that we maintain in hay infusion cultures (*Acanthocyclops vernalis* from Canada, and *Thermocyclops emini* and *Mesocyclops aspericornis* from Cameroon).

Materials and Methods

Polyester fabrics with mesh openings of 100 μm and 200 μm were obtained from Schweizerische Seidengazefabrik AG, Thal, Switzerland*. Two 60 ml samples were taken from laboratory colonies of the 3 species of copepods. Each sample was poured through the 200 μm filter, which was then backwashed to recover the retained copepods. The 200 μm filtrate was then passed through the 100 μm filter, which was similarly backwashed. The copepods collected in each of the 3 volumes were preserved by adding formalin to a final concentration of 10%. The duplicate samples were then pooled for counting, stage identification and measurement of copepods by microscopy. The number of copepods and their stages retained by the 100 μm filter (Table) is the sum retained by both the 100 μm and 200 μm filters, since the 100 μm filter would retain those copepods trapped by the larger filter.

Results and Discussion

The 200 μm mesh filters removed only the largest copepodid stages (C III-V), including adults (C VI); however, these stages accounted for less than 20% of the number of all stages of copepods present (Table). All naupliar stages (N I-VI) present in the cultures of these 3 copepod species passed through the 200 μm filter. An infected nauplius illustrated by MULLER (1971) appears to be a 4th or 5th stage nauplius of *A. vernalis*, based on its size (EWERS, 1930). Nauplii of these 2 stages readily pass through the 200 μm mesh filter (Table). Such immature copepods ingest only 1 *D. medinensis* larva, but that larva continues to develop to the infective stage, while development of the copepods to the larger adult size is apparently prevented (ONABAMIRO, 1956). On the other hand, the 100 μm mesh filters retained all except the first 2 naupliar stages, which in 2 of our samples represented over 50% of the copepod population. The small size of N I-II nauplii (<200 μm) makes it unlikely that they will ingest guinea-worm larvae, which are 600 μm long. Although the frequency with which immature copepods acquire infection under natural conditions is unknown, it is theoretically possible for infected immature stages to survive long enough in stored water for the guinea-worm larvae to become infective. Nevertheless, the actual role of immature copepods in transmitting dracunculiasis needs further investigation.

Although the sizes of known vector species vary markedly, the 100 μm filter should remove all copepod stages capable of ingesting and nurturing infective larvae. Even though 100 μm filters cost approximately ⅓ more than the 200 μm material, this cost may be offset by greater durability (higher tensile strength). Flow rates for both materials are similar, but the smaller mesh may not be acceptable if it is more prone to clogging. Our laboratory results have shown the 100 μm mesh filter to be more effective in

*Use of trade names and commercial sources is for identification only and does not constitute endorsement by the Public Health Service or the Department of Health and Human Services of the USA.

Table—Efficacy of 100 μm and 200 μm mesh polyester monofilament filters in removing copepods from water

Species	Filter Size (μm)	Effect	Copepod stages: Nauplii I	II	III	IV	V	VI	Copepodids I	II	III	IV	V	VI♀	VI♂	No.	Length (range in μm)	%
Acanthocyclops	200	Retained									+	+		+	+	40	≥690	11·5
vernalis	100	Retained[a]			+			+	+	+	+	+		+	+	317	166-700[b]	90·8
	100	Passed	+	+												32	138-166	9·2
Thermocyclops	200	Retained										+	+	+	+	20	≥777	10·1
emini	100	Retained[a]	+	+	+	+	+	+	+	+		+	+	+	+	87	132-133	44·2
	100	Passed	+	+												110	110-189	55·8
Mesocyclops	200	Retained									+			+		15	≥820	19·7
aspericornis	100	Retained[a]		+			+				+			+		37	138-276	48·7
	100	Passed	+													39	122-193	51·3

[a]Copepod stages and numbers given include totals for organisms retained by the 200 μm polyester filter.
[b]Includes one C VI male.

removing copepods from drinking water, but the impact of cost, durability, and filtration rate must be assessed under field conditions before final recommendation can be made.

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