

## Research Note

# Infectivity of *Echinostoma friedi* miracidia to different snail species under experimental conditions

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### Abstract

The infectivity of *Echinostoma friedi* (Trematoda: Echinostomatidae) miracidia was studied experimentally in a range of laboratory-reared snails that coexist in the same natural locality, namely *Radix peregra*, *Lymnaea fuscus*, *L. truncatula* (Lymnaeidae), *Gyraulus chinensis*, *Helisoma duryi* (Planorbidae) and *Physella acuta* (Physidae), and snails from different geographical origins acting naturally or experimentally as intermediate hosts of *Schistosoma* spp., namely *Planorbarius metidjensis* (from Málaga, Spain), *Biomphalaria glabrata* (Guadeloupe), *B. alexandrina* (Egypt) (Planorbidae), *Bulinus cernicus* (Mauritius), *B. globosus* (Zambia), *B. natalensis* (South Africa) and *B. truncatus* (Niger) (Bulinidae). Six species of snails were found to be susceptible, with the rate of infection ranging from 0 to 36.7%. The highest infection was detected in *R. peregra*. The low host specificity of *E. friedi* might have an epidemiological significance as a requisite for a recent establishment in a new geographical area.

The miracidial host specificity of digenetic trematodes plays a major role in their transmission dynamics and is of great epidemiological importance. Several species of the genus *Echinostoma* are known to use different snail species as first intermediate hosts (Huffman & Fried, 1990), but species-specific interactions between *Echinostoma* spp. and their first intermediate hosts have been poorly studied. In this context, the study of their first intermediate host spectrum may be useful in furthering our understanding of the transmission dynamics of echinostomes.

*Echinostoma friedi* (Trematoda: Echinostomatidae), a 37-collar spined species of the 'revolutum' group, was described as an intestinal parasite of small mammals in the Albufera Natural Park (Valencia, Spain). The freshwater snail *Radix peregra* acts as the natural first intermediate host (Toledo *et al.*, 1998), though other

sympatric snail species, such as *Lymnaea fuscus* and *Gyraulus chinensis*, have been shown to act as first intermediate host under experimental conditions (Toledo *et al.*, 2000, Muñoz-Antoli *et al.*, 2002). However, these studies showed that the host–parasite compatibility differs between snail species on the basis of the respective rates of infection.

In the present paper, the infectivity of *E. friedi* miracidia under experimental conditions towards a range of snail species belonging to different families and from different geographical origins is studied. This work constitutes an initial step in the study of how the miracidial host specificity is achieved and its consequences in the transmission dynamics of the parasite.

*Echinostoma friedi* (originally obtained from the Albufera Natural Park of Valencia, Spain) was maintained in the laboratory using *R. peregra* as the first intermediate host and this and other snail species (from the same geographical origin) as the second intermediate host. Golden hamsters were used as experimental definitive hosts. Faeces of experimentally infected hamsters were filtered to obtain eggs. Miracidia were

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obtained after hatching eggs incubated at 25°C in spring water in darkness.

Infection-free laboratory-reared snail species from the same and different geographical origins and belonging to the Lymnaeidae, Physidae, Planorbidae and Bulinidae (see table 1), were individually exposed to five newly hatched (maximum age: 30 min) miracidia of *E. friedi* for 24 h in 3 ml of spring water at  $20 \pm 1^\circ\text{C}$ . All snails used were in the shell size range 3–3.5 mm (length for lymnaeids, physids and bulinids; diameter for planorbids) at the time of infection. After exposure, snails were kept under a day:night rhythm of 12:12 h at  $20 \pm 1^\circ\text{C}$  and were fed with washed lettuce *ad libitum*. Periodical examinations to detect intramolluscan larval development or cercarial shedding were made, and  $\chi^2$  tests were used to analyse statistical differences between the rates of miracidial infection in different snail species.

Table 1 shows the rate of miracidial infection obtained in each snail species. Interestingly, *E. friedi* is able to infect and develop in snail species belonging to three different families (Lymnaeidae, Planorbidae and Bulinidae). However, the percentage of infection varied among the snail species, ranging from 0 to 36.7% (table 1). The maximum rate of infection occurred in *R. peregra*, whereas the snail species *Physa acuta*, *Helisoma duryi*, *Planorbarius metidjensis*, *Biomphalaria alexandrina*, *Bulinus natalensis*, *B. globosus* and *B. truncatus* did not become infected. Application of the  $\chi^2$  test only showed significant differences in the rate of infection between *R. peregra* and *L. truncatula* ( $P(\chi^2 = 7.4) < 0.05$ ; df: 1), *Radix peregra* and *Bulinus cernicus* ( $P(\chi^2 = 11.9) < 0.05$ ; df: 1), and *G. chinensis* and *B. cernicus* ( $P(\chi^2 = 5.6) < 0.05$ ; df: 1). Considering those snail species sympatric with the parasite, *E. friedi* miracidia were able to infect four of six species used in the experiment. However, significant differences were only

observed between *R. peregra* and *L. truncatula* as previously mentioned.

Miracidial host specificity has been used for taxonomic purposes within the 37-collar spined 'revolutum' group (Kanev, 1994; Kanev *et al.*, 1995). However, recent studies have shown that this cannot be considered as a characteristic feature discriminating species within this group of trematodes without carefully designed experiments and/or extensive field collections (Kostadinova & Gibson, 2000). Moreover, Kostadinova *et al.* (2000) and Maldonado *et al.* (2001) demonstrated that the first intermediate host spectrum of the species of the 'revolutum' group may be broader than previously expected. The present study confirms this, since *E. friedi* miracidia were able to infect and develop in snail species belonging to three different families and from different geographical origin, although the rates of infection can be considered low for all these species. This is difficult to explain but it has been shown that an increase in parasite overdispersion due to low specificity may result in lower prevalences of infection in each snail species (Eppert *et al.*, 2002). The low rates of natural *E. friedi* infections detected by Toledo *et al.* (1998) could support this fact.

It should be noted that all the snail species that co-exist with the parasite in the same natural habitat, except *P. acuta* and *H. duryi*, were susceptible to infection. Moreover, the rates of infection were similar in all the susceptible species surviving the pre-patent period. It is known that the degree of host-parasite compatibility is not only based on infection rates, but also on the survival of infected molluscs, production of cercariae and infectivity to the definitive host (Gasnier *et al.*, 2000). However, this broad spectrum of snails that can act as first intermediate hosts for *E. friedi* miracidia suggests recent establishment of the parasite in its natural habitat. During adaptation to a new snail intermediate host, the parasites could have lost their original host specificity. A similar situation has been recently described for *Schistosoma mansoni* in Egypt (Hassan *et al.*, 2003). Furthermore, this can also support the low rates of infection obtained in the present work.

Interestingly, all specimens of *L. truncatula* and *B. cernicus* that became infected died before shedding cercariae and this could be explained by two hypotheses: (i) the lack of compatibility between host–snail association, without a correct balance between energy resource utilization by the parasite intramolluscan larval stages and snail host (Sorensen & Minchella, 2001); and/or (ii) a real damage or negative effect on the normal life-history traits of snails by the development of parasite intramolluscan stages (Thomas *et al.*, 2000). However, this point should be explored further since these studies could provide information of interest for biological control of snails and the host–parasite relationships in the trematode/snail interactions.

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Table 1. The number of snail species used in relation to the infectivity of miracidia of *Echinostoma friedi*.

Snail species	Geographical origin	Number snails infected/exposed (%)
<b>Lymnaeidae</b>		
<i>Radix peregra</i>	Spain*	22/60 (36.7)
<i>Lymnaea fuscus</i>	Spain*	14/60 (23.3)
<i>Lymnaea truncatula</i>	Spain*	9/60 (15.0) <sup>†</sup>
<b>Physidae</b>		
<i>Physella acuta</i>	Spain*	0/60 (0)
<b>Planorbidae</b>		
<i>Gyraulus chinensis</i>	Spain*	16/60 (26.7)
<i>Helisoma duryi</i>	Spain*	0/60 (0)
<i>Planorbarius metidjensis</i>	Málaga, Spain	0/60 (0)
<i>Biomphalaria glabrata</i>	Guadeloupe	12/60 (20.0)
<i>Biomphalaria alexandrina</i>	Egypt	0/60 (0)
<b>Bulinidae</b>		
<i>Bulinus cernicus</i>	Mauritius	6/60 (10.0) <sup>†</sup>
<i>Bulinus natalensis</i>	South Africa	0/60 (0)
<i>Bulinus globosus</i>	Zambia	0/60 (0)
<i>Bulinus truncatus</i>	Niger	0/60 (0)

\* Snail strains from the Albufera Natural Park, sympatric with the parasite.

<sup>†</sup> All infected specimens died before cercariae were shed.

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