Short Communication

EFFECT OF DESICCATION ON FRESHWATER SNAIL, *INDOPLANORBIS EXUSTUS*, INTERMEDIATE HOST OF SCHISTOSOMIASIS

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(Received May 10, 1982. Accepted July 30, 1982)

SUMMARY: Under laboratory conditions, snail *Indoplanorbis exustus* exhibited a strongly positive linear correlationship between duration of desiccation to mortality and body-weight loss and also body-weight loss to mortality. The adult stage of snail is highly resistant to desiccation, whereas the juvenile stage is highly susceptible. Reasons for decrease in susceptibility to desiccation with increase in shell diameter were suggested.

The pulmonate snail, *Indoplanorbis exustus*, is a principal intermediate host for *Schistosoma nasale*, *S. spindale* and *S. indicum*, the causative agents of schistosomiasis in animals (Malek and Cheng, 1974). Use of desiccation as one of the methods for control of freshwater snails has been recommended (WHO, 1965). In the present study, we attempted to work out the relationship between duration of desiccation to body-weight loss and mortality as also body-weight loss to mortality in three age groups of this snail. We also tried to establish the lower and upper critical limits for duration of desiccation and body-weight loss of the snail.

Field-collected and laboratory-maintained snails (Juvenile, 3 to 6-mm diam., young mature, 9 to 12-mm diam. and adult snails, above 13-mm diam.) were exposed to various durations of desiccation in petri dishes in a controlled environment room (30±2°C and 70±5% R.H.). Weight loss and mortality of the snails were recorded at the end of each experiment.

The data on duration of desiccation to mortality and body weight loss to mortality were plotted on logarithmic probability paper. The exposure time and weight loss that would be fatal to 50% of the snails (LD$_{50}$) was calculated by probit analysis (Finney, 1971) for each age group (Figs. 1 and 2, Table I). The duration of desiccation and body weight loss were transformed into log values and plotted on ordinary graph paper (Fig. 3). The data on all of the above aspects were statistically analyzed to establish the correlationship between...
them by the method described by Goldstein (1964).

In juvenile snails, 10% mortality was observed at 3 hr of exposure period and 18% body weight loss, whereas 100% mortality was achieved in 33 hr with 59% body weight loss. The young mature snails withstood 10 hr of desiccation with 12.2% body-weight loss. Ten percent mortality was initiated at 22 hr of desiccation and 20% of body weight loss, while 170 hr exposure and 65.9% body weight loss resulted in 100% mortality. The adult stage of snails survived desiccation up to 60 hr and 14.4% weight loss. Seventy hours of exposure with 23.4% body weight loss resulted in 10% mortality, while 300-hr exposure and 68.2% weight loss was detrimental to them.

The juvenile, young mature and adult stages of snails exhibited steep rise in the rate of body weight loss up to 37% (1.68%/hr), 54% (0.63%/hr) and 56% (0.58%/hr), respectively. Beyond these exposures, there was an abrupt decline in the rate of body-weight loss (0.62%/hr in juvenile, 0.09%/hr in young mature and 0.06%/hr in adult stages of snails).

Figures 1, 2 and 3 exhibit linear correlation between duration of desiccation versus mortality, body-weight loss versus mortality and duration of desiccation versus body weight loss.

Our present studies clearly indicate that the adult stage of *I. exustus* is most resistant and the juvenile stage is highly susceptible to desiccation. Sturrock (1970) also studied effect of desiccation on survival of *Biomphalaria glabrata*. He observed that the adult stage of this snail is less susceptible to desiccation than the juvenile. The median lethal limits for juvenile and adult *Lymnaea columella* are 6.60 and 47 hr, respectively (Harris and Charleston, 1977). This indicates that *I. exustus* is more tolerant to desiccation than *L. columella*.

In all the three stages of *I. exustus*, there is a higher rate of body-weight loss during the initial period of exposure to desiccation. This is due to the high
Fig. 2. Relationship between body weight loss and mortality of *Indoplanorbis exustus*.

Fig. 3. Relationship between duration of desiccation and body weight loss of *Indoplanorbis exustus*.

activity of the snails during this period and thus greater exposure of the body surface to desiccation. Later, the rate of body-weight loss becomes lower since the snail gradually retracts its body into interior coils of the shell and this contraction of the body increases with prolonged exposures. Storey (1972) observed a high rate of weight loss during initial period of exposure to desiccation in *Lymnaea peregra*. In the present study, we observed that with increase
TABLE I

Median lethal dose and regression analysis of the data on desiccation of
Indoplanorbis exustus

<table>
<thead>
<tr>
<th>Aspects of desiccation</th>
<th>Stage of snail</th>
<th>LD&lt;sub&gt;50&lt;/sub&gt;</th>
<th>Regression equation</th>
<th>95% confidence limit of slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>Juvenile</td>
<td>13.6 hr</td>
<td>Y = 0.89 + 3.62 X</td>
<td>3.62 ± 0.31</td>
</tr>
<tr>
<td></td>
<td>Young mature</td>
<td>56.0 hr</td>
<td>Y = -0.17 + 2.96 X</td>
<td>2.96 ± 0.17</td>
</tr>
<tr>
<td>Mortality</td>
<td>Adult</td>
<td>108.0 hr</td>
<td>Y = 0.15 + 3.32 X</td>
<td>3.32 ± 0.21</td>
</tr>
<tr>
<td>Weight loss</td>
<td>Juvenile</td>
<td>42.7%</td>
<td>Y = -10.54 + 9.55 X</td>
<td>9.55 ± 0.91</td>
</tr>
<tr>
<td></td>
<td>Young mature</td>
<td>44.5%</td>
<td>Y = -5.11 + 6.13 X</td>
<td>6.13 ± 0.76</td>
</tr>
<tr>
<td>Mortality</td>
<td>Adult</td>
<td>48.0%</td>
<td>Y = -4.38 + 5.57 X</td>
<td>5.57 ± 0.65</td>
</tr>
<tr>
<td>Duration</td>
<td>Juvenile</td>
<td>—</td>
<td>Y = 1.68 + 0.44 (X - 1.18)</td>
<td>0.44 ± 0.05</td>
</tr>
<tr>
<td></td>
<td>Young mature</td>
<td>—</td>
<td>Y = 1.66 + 0.54 (X - 1.80)</td>
<td>0.54 ± 0.09</td>
</tr>
<tr>
<td>Weight loss</td>
<td>Adult</td>
<td>—</td>
<td>Y = 1.76 + 0.27 (X - 2.22)</td>
<td>0.27 ± 0.02</td>
</tr>
</tbody>
</table>

in the size of the shell, the susceptibility of snails to desiccation decreases. Harris
and Charleston (1977) also reported similar findings in case of L. columella.

The higher tolerance of the adult stage of snails than other stages is due
to varying rates of evaporation of water from their body. This can be explained
in two ways. Water is initially lost from the body at a given rate. This rate
becomes slower as the surface dries out and the snail retracts into the shell.
Now water has to diffuse from deeper parts of the snail body. In larger snails,
water would have to diffuse further, hence, they are likely to conserve weight
or water for a duration longer than smaller snails.

Secondly, in snails there is a tough epithelial layer on the head and foot
regions. When the snail withdraws its body into the shell in response to desic-
cation, blood present in the cephalic and podial regions is forced into deeper
layers of the body due to the pressure exerted by contraction of the foot. Now
water has to diffuse from the central core of the body for evaporation due to
desiccation. As the thickness of the epithelial layer increases with age, larger
snails are at an advantageous position than the smaller ones in conserving
moisture.

A perusal of Table I reveals that the correlation coefficient (r) values vary
from zero and thus indicate strong correlation between various aspects studied.
The χ² test for goodness of fit demonstrates that the population of test animals
was not significantly heterogenous. The LD<sub>50</sub> values furnished clearly indicate
that the adult stage of the snail is resistant to desiccation, whereas the juvenile
stage is susceptible.

The authors are grateful to Dr. P. K. Ramachandran, Director, Defence
Research and Development Establishment, Gwalior (India) for constant encour-
agement given to us during these studies.


<table>
<thead>
<tr>
<th>Correlation Coefficient</th>
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<tr>
<td>0.98</td>
<td>3.4</td>
</tr>
<tr>
<td>0.98</td>
<td>3.2</td>
</tr>
<tr>
<td>0.99</td>
<td>3.0</td>
</tr>
<tr>
<td>0.98</td>
<td>3.3</td>
</tr>
<tr>
<td>0.99</td>
<td>3.4</td>
</tr>
<tr>
<td>0.61</td>
<td>5.4</td>
</tr>
<tr>
<td>0.98</td>
<td>.03</td>
</tr>
<tr>
<td>0.95</td>
<td>.01</td>
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<tr>
<td>0.92</td>
<td>.02</td>
</tr>
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REFERENCES