Does the epiphragm reduce the rate of water loss in the pulmonate land snail *Cornu aspersum?*

D.R. Unkard

Email: g01U1234@campus.ru.ac.za

Introduction

Terrestrial snails can lose water from the mantle cavity via respiration, by evaporation through the aperture of the shell, and across the shell (Machin, 1975; Perrott, Levin and Hyde, 2007). Although terrestrial pulmonates are tolerant of water loss (Machin, 1975), these animals minimize loss of fluid using behavioural, structural and physiological mechanisms (Asami, 1993). One morphological mechanism is to retract the body inside the shell and then seal the shell opening (aperture) with an epiphragm which is made of solidified mucus (Perrott, Levin and Hyde, 2007).

The brown garden snail *Cornu aspersum* is native to western Europe although it has been introduced to many parts of the world including South Africa where it can be a pest (Herbert, 2010). Like other terrestrial pulmonates this species seals its body inside its shell with an epiphragm during periods of inactivity. The aim of this experiment was to determine how effective this seal is in reducing the rate of water loss in *C. aspersum.*

Materials and Methods

Twenty inactive *Cornu aspersum* of similar size (shell height 20 ± 0.3 mm) with intact epiphragms were collected from gardens in Grahamstown. The epiphragms of 10 snails were removed gently with a scalpel and all snails were weighed to two decimal places of a gram. Each snail was put on an aluminium dish, and then dishes with snails were placed in an incubator at 25 ^{o}C and 70% relative humidity for 24 hours. During this time all snails were inactive. After 24 hours the snails were re-weighed. Water loss was determined by calculating loss in snail weight.

A one way Anova followed by an all pair-wise comparison (Holm-Sidak method) using SigmaStat version 3.5 was carried out to determine whether snail mass differed significantly between the start and end of the experiment, and between treatments.

Results

The masses of the two groups of snails (Figure 1) at the start of the experiment (T = 0 hr) were not significantly different (Table 1). Over the 24 hours the mean weight loss of the snails with an intact epiphragm was only 0.135 g (1.11% of their body mass), and there was no significant difference between the mass of the snails at the start and end of the experiment (Table 1). By contrast, those snails without an epiphragm lost a significant amount of weight, 1.302 g (10.7 % of their body mass) (Figure 1;

Table 1). The mean mass of the two groups of snails at the end of the experiment (11.997 ± 0.409 g with an epiphragm vs 10.784 ± 0.168 g without an epiphragm) was significantly different (Figure 1; Table 1).

Discussion

The result from this experiment has demonstrated that when the aperture of the shell of *Cornu aspersum* is sealed by an epiphragm the amount of water lost by this species of snail at 25 ^{o}C and 70% RH is decreased significantly. The slight and insignificant decrease in the mass of snails with an epiphragm may have been due to water loss across the shell as has been shown to occur in this species (Machin, 1967). Therefore the findings of the experiment in this study support those of Machin (1967). Snails without an epiphragm lost just over 10% of their body weight which suggests that if they did not secrete such a seal, snails would eventually desiccate and die. This finding confirms the importance of the epiphragm to snails that are hibernating or aestivating. During such times their relative impermeability will mean that the snails will not lose much water enabling them to survive long periods of inactivity even in desert conditions (Machin, 1967). This ability is enhanced over time because the longer a snail remains dormant, the thicker the epiphragm becomes (Machin, 1967) further emphasizing the importance of this structure. The ability of this species to reduce water loss during dormancy may have contributed to its successful spread in South Africa.

References

Asami, T. 1993. Interspecific differences in desiccation tolerance of juvenile land snails. *Functional Ecology* **7:** 571-577.

Herbert, D.G. 2010. The introduced terrestrial Mollusca of South Africa. *SANBI Biodiversity Series* **15.** South African National Biodiversity Institute, Pretoria. 108pp.

Machin, J. 1967. Structural adaptation for reducing water-loss in three species of terrestrial snail. *Journal of Zoology*. **152:** 55-65.

Machin, J. 1975. Water relationships. In: *Pulmonates*, eds V. Fretter and J Peake. Volume 1, pp. 105-163. Academic Press, London.

Perrott, K.K., Levin, I.I. and Hyde, E.A. 2007. Morphology, distribution and desiccation in the brown garden snail (*Cantareus asperses*) in northern New Zealand. *New Zealand Journal of Ecology*, **31:** 60-67.

Table 1. All pairwise comparison of weights of snails. epi = epiphragm present; no epi = epiphragm removed. N = 10 snails per treatment.

Comparison	Difference of means	t	P	P<0.05
T = 0 epi vs. T = 24 no epi	1.348	8.894	<0.001	Yes
T= 0 no epi vs. T = 24 no epi	1.302	8.591	<0.001	Yes
T = 24 epi vs. T = 24 no epi	1.213	8.003	<0.001	Yes
T = 0 epi vs. T = 24 epi	0.135	0.891	0.760	No
T= 0 no epi vs. T = 24 epi	0.0890	0.587	0.807	No
T = 0 epi vs. T= 0 no epi	0.0460	0.304	0.763	No

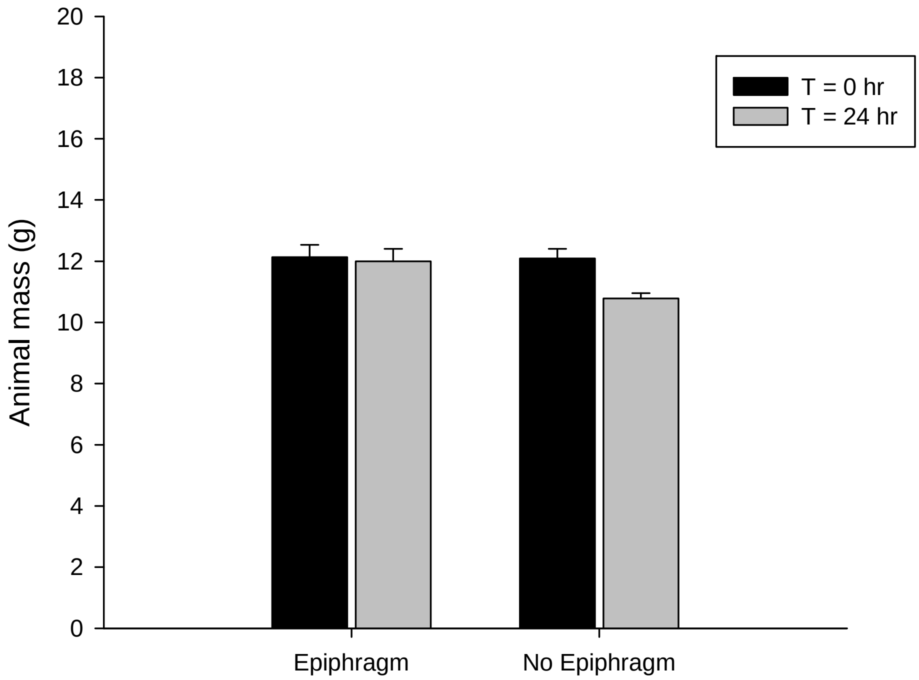

Figure 1. Mean (± S.D.) mass (with shell) of snails with and without an epiphragm after 24 hours at 25 °C. N= 10 per treatment.