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Influence of Substrate Humidity on Desiccation Resistance Capacity in *Subulina octona* (Mollusca, Subulinidae)

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ABSTRACT

The aim of this study was to verify the influence of substrate humidity on desiccation resistance of Subulina octona, continuously exposed, for 48 h, to the temperature of 35 °C. Forty individuals conditioned in 2 plastic boxes, one box containing black earth humidified with 40 ml water and the other one containing dry black earth were used. The retraction of cephalopodal mass inside the shell and the number of dead individuals was evaluated. Snails from dry and humid substrate boxes showed cephalopodal mass retraction of 9.9 cm±2.88 and 2.78 cm±3.17, respectively, after 12 h of exposure; 8.55 cm±1.3 and 6.33 cm±2.91, after 24 h; 11.07 cm±4.19 and 7. 27 cm±2.7, after 36 h, 9.12 cm±2.15 and 6.47 cm±2.11, after 48 h. Every individual of dry substrate box died whereas every individual of humid substrate box survived. These results showed that substrate humidity was an influent factor regarding desiccation resistance in S. octona.

Key words: Land snail, desiccation, cephalopodal mass retraction, substrate, humidity

INTRODUTION

A conspicuous ecological characteristic of terrestrial pulmonate mollusks is an intense dependence of humidity, which is reflected on its behavior, activity period, habitat preference and procreation activity (Elwell and Ulmer, 1971; Dimitrieva, 1975; Pieri and Jurberg, 1981). This characteristic is shown by several physiological and behavioral adaptations exhibited by these animals. Such adaptations represent efficient solutions for the problems related to environmental conditions.

The substrate on which a pulmonate lives provides it humidity, food, protection, camouflage and oviposition sites and, therefore, it influences procreation, growth and survival on these animals. Under desiccation conditions, the substrate constitutes a source of humidity for mollusks rehydration (Cook, 2001). *Subulina octona* shows a close association with the substrate (Dutra, 1980; D`ávila et al., 2004). This influences on the growth and the procreation of these mollusks (D`ávila et al., 2004).

The aim of this study was to verify the influence of substrate humidity on desiccation resistance of

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S. octona, continuously exposed for 48 h, to the temperature of 35 °C.

MATERIAL AND METHODS

Forty individuals were obtained from the matrix of mollusk Laboratory of Biological Sciences Post-Graduation Course (Animal Biology and Behavior) of Universidade Federal de Juiz de Fora, Minas Gerais, Brazil. The animals were conditioned in two plastic boxes (12cm diameter and 9cm depth, 20 individuals/box). The first box contained black earth humidified with 40 ml water and the other one contained dry black earth. Both boxes were kept in a chamber acclimatized to the temperature of 35 °C and 80% relative humidity, for 48 h. Cephalopodal mass retraction inside the shell, perceptible due to its transparence, was measured through a pachymeter at intervals of 12 h. After 48 h of exposure, the number of dead individuals was verified. Statistical treatment of the data was by ANOVA analysis.

RESULTS AND DISCUSSION

Individuals from dry and humid substrate boxes showed cephalopodal mass retraction of 9.9 cm ± 2.88 and 2.78 cm ± 3.17, respectively after 12 h of exposure; 8.55 cm ± 1.3 and 6.33 cm ± 2.91 after 24 h; 11.07 cm ± 4.19 and 7.27 cm ± 2.7 after 36 h; and 9.12 cm ± 2.15 and 6.47 cm ± 2.11 after 48 h. ANOVA analysis ($p < 0.005$) showed that the difference between these averages was significant. After 48 h, every individual of dry substrate box died, whereas every individual of humid substrate box survived. Epiphragm formation was not observed.

The results showed the role of substrate humidity in mollusk survival during adverse conditions of temperature. Terrestrial gastropods loose water by the tegument and, in the same way, they rehydrate by the tegument, through the so-called rehydration by contact (Cook, 2001). In this context, the amount of water retained by substrate in which mollusks live influences the maintenance of homeostasis by these organisms. These animals are not able to absorb the humidity of saturated air (Cook, 2001), and because of this although relative humidity was kept in favorable conditions during the study, the animals kept in dry substrate died after 48 h of exposure.

Cephalopodal mass retraction is a generalized behavioral response among terrestrial mollusks during adverse conditions of temperature and humidity and it takes part in the series of biochemical, physiological, and behavioral changes that occurs with aestivation (Richardot, 1977a,b; Stiglingh and Van Eeden, 1977; Storey, 2002). Among the critical survival elements during aestivation period, there is the mollusk capacity of retaining water. Protected places selection, submersion in substrate, cephalopodal mass retraction inside the shell and immobilization corporeal water maintenance in levels that are compatible with mollusk survival. Submersion constitutes a behavioral response exhibited by several mollusk species during adverse conditions of humidity and temperature. Slugs resist to desiccation by submerging in the ground and by covering up their retracted bodies with mucus (Hyman, 1967; Wiktor, 1987). Individuals of species *Derosceras caucasicum* and *Parmacella rutellum* have their activity inhibited and use to submerge in the ground, to hide in the plants' basis or under lumps of soil, when relative humidity is under 18% (Dimitrieva, 1975). Some species of genus *Biomphalaria* (Preston, 1910) submerge in the mud when habitat desiccation occurs (Pieri and Jurberg, 1981). This behavior, very frequent in *S. octona* even under favorable conditions, reduces desiccation risk since substrate provides the humidity that is necessary to mollusks survival and since it may work as an obstacle to corporal water evaporation. D`ávila et al. (2004) observed in *S. octona*, which were kept in boxes without substrate, an average cephalopodal mass retraction of 14.37cm after 48 h of exposure to the temperature of 35 °C. The retraction observed was superior to the one verified in the current study for individuals kept in humid substrate (6.47 cm) and in dry substrate (9.12 cm), which reinforced the role of substrate as an obstacle to corporal water evaporation and as a source of water to mollusks rehydration.

The capacity of desiccation resistance in terrestrial mollusks may be correlated to the preferential habitat and to the species lifestyle (Arad, 1993; Emberton, 1994). According to Luchel and Deyrup-Olsen (2001), shell and epiphragm density, as well as the diameter of shell's aperture related to body size, may indicate a better or worse adaptation to dry habitats. *S. octona* rarely forms

epiphragms (when they do so, epiphragm are constituted by thin and transparent pellicles) and it is frequently found in the substrate, most of the time submerged. This species is probably adapted to humid and shaded environments and is sensitive to light and heat exposure (Dutra, 1980; D`ávila et al., 2004).

Results in the current study demonstrated that substrate humidity was an influent factor on desiccation resistance of *S. octona* since humid substrate provided survival chances to mollusks.

RESUMO

O objetivo deste trabalho foi verificar a influência da umidade do substrato sobre a resistência à dessecação em indivíduos da espécie *S. octona*, submetidos a uma exposição contínua, por 48 horas, à temperatura de 35 ºC. Foram utilizados 40 indivíduos, acondicionados em dois potes plásticos, um pote contendo terra vegetal® umedecida com 40ml de água e outro contendo terra vegetal seca, mantidos em câmara climatizada a 35±1 ºC. Foram verificados, a retração da massa cefalopodal no interior da concha e o número de indivíduos mortos. Os moluscos do pote com substrato seco e do pote com substrato úmido apresentaram retração da massa cefalopodal de 9,9cm±2,88 e 2,78cm±3,17 respectivamente, após 12 horas de exposição; 8,55cm±1,3 e 6,33cm±2,91, após 24 horas; 11,7cm±4,19 e 7,27cm±2,7, após 36 horas e 9,12cm±2,15 e 6,47cm±2,11, após 48 horas. Todos os indivíduos do pote com substrato seco morreram, enquanto todos os indivíduos do pote com substrato úmido sobreviveram. Esses resultados demonstram que a umidade do substrato é um fator que influencia a resistência à dessecação em *S. octona*.

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