Calcium granules in the mucus trails of three littorinid species

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The feet of terrestrial and freshwater snails has been shown to be important in calcium regulation, often secreting granules of $CaCO_3$. This phenomenon has not, until now, been observed in marine snails. Here I report the presence of $CaCO_3$ granules in the trail mucus of *Littorina littorea, L. saxatilis* (both collected from Rhosneigr, Anglesey, Wales) and *L. obtusata* (collected from Derbyhaven, Isle of Man). Snails were allowed to crawl over "thermonox" (Bio-Rad) plastic coverslips in an aerial environment. The trail mucus produced was immediately fixed by immersing the coverslip in liquid nitrogen and then lyophilising the coverslip overnight. Coverslips were then cut into small pieces, carbon-coated and the mucus trails analysed for elemental composition by X-ray microanalysis in a Cambridge 360 SEM.

Of the single-metal granules observed in the mucus trails the most abundant were of Ca (means : *L. littorea*, 440 mm^{-2} ; *L. saxatilis*, 401 mm^{-2} ; *L. obtusata* 348 mm^{-2}) followed for each species by Si (maximum mean density : *L. saxatilis*, 120 mm^{-2}) and Fe (maximum mean density : *L. saxatilis*, 65 mm^{-2}) granules. Single-metal granules of Al, Ti, Mg and P were also found but only in the mucus trails of *L. obtusata*, perhaps reflecting its different collection site from the other two species. The mean size of the Ca granules varied significantly interspecifically (Kruskall-Wallis test : H = 66.3, p = 0.000) : *L. littorea*, 1.32 µm diameter ± 0.08 µm, n = 143 ; *L. saxatilis*, 1.80 µm ± 0.12, n = 113 ; *L. obtusata*, 2.14 µm + 0.09, n = 167. Granule diameter was taken as the mean of the longest and shortest visible axes. Most Ca granules (*L. littorea*, 80 %, n = 35 ; *L. saxatilis* 57 %, n = 113 ; *L. obtusata*. 69 %, n = 167) were attached to or were embedded within microthreads of mucus (up to 1 µm diameter) which tended to run parallel to the direction of locomotion. The significance of this is unknown although it may imply that the $CaCO_3$ granules are secreted with the mucus. The density of granules was constant across the width of the mucus trail of each species.

Assuming a mucus trail width of 10 mm, that the $CaCO_3$ granules are of calcite with a density of 2.71 g cm^{-3} and that snails move 2 m day^{-1}, the loss of Ca in mucus trails is 11.51 µg day^{-1} for *L. littorea*, 26.33 µg day^{-1} for *L. saxatilis* and 39.18 µg day^{-1} for *L. obtusata*. These losses appear too small for pedal mucus to be a significant ionoregulatory route for Ca. The Ca in the trail may therefore perform other functions, for example indicating trail polarity.

Histological examination of the foot sole of *L. littorea* revealed an unidentified granular secretion from "cell type L4" (Shirbhate & Cook, 1987). This secretion alone also stained positively for Ca. It is therefore likely that this cell type is the source of the Ca granules, although granule function remains unclear.

Reference

Shirbhate, R. & A. Cook, 1987. *J. molluscan Stud.*, 53 : 79-96.

Population genetics of *Littorina striata* at a microgeographical scale

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