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Little is known about ionic and osmotic stress tolerance in tardigrades. Here, we examine salt stress tolerance in Ramazzottius oberhaeuseri and Echiniscus testudo from Nivå (Denmark) and address whether limno-terrestrial tardigrades can enter a state of quiescence (osmobiosis) in the face of high external osmolyte concentrations. Direct transfers into NaCl solutions showed an upper tolerance level of around 600 mOsm kg−1 in R. oberhaeuseri and 200 mOsm kg−1 in E. testudo. During salt exposures, R. oberhaeuseri contracted into a 'tun', whereas E. testudo remained active leaving it more susceptible to acute effects of the ions. Further experiments focused on the more resilient R. oberhaeuseri, which entered a tun and readily regained activity when directly exposed to polyethylene glycol and sucrose of up to 872 ± 0 and 813 ± 3 mOsm kg−1, respectively, revealing a higher tolerance towards non-ionic osmolytes as compared to NaCl. Ramazzottius oberhaeuseri furthermore readily regained activity following gradual increases in non-ionic osmolytes and NaCl of up to 2434 ± 28 and 1905 ± 3 mOsm kg−1, respectively, showing that short-term acclimation promoted salt stress tolerance. Our results suggest that the limno-terrestrial R. oberhaeuseri enters a state of quiescence in the face of high external osmotic pressure and that it, in this state, is highly tolerant of ionic and osmotic stress.

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