Testing the metabolic cold adaptation hypothesis: an intraspecific latitudinal comparison in the common woodlouse

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ABSTRACT

The metabolic cold adaptation (MCA) hypothesis predicts an increase in the metabolic rate of ectotherms from cold environments compared with their more temperate counterparts. This adaptive hypothesis is one of the most controversial in physiological ecology, for which the evidence comes principally from the meta-analysis of data sets of arthropods. Important for the study of metabolic cold adaptation are comparisons at a geographic level, especially on a latitudinal scale, because mean annual temperature decreases towards high latitudes. Furthermore, few studies have conducted intraspecific comparisons of metabolic rates along a latitudinal gradient. We tested the MCA hypothesis in the common woodlouse, *Porcellio laevis*, using different populations along a distributional range with a wide range of mean ambient temperatures (5°C, 12°C, 18°C and 25°C) in Chile. Our results demonstrated that metabolic rate increased towards low latitudes – that is, woodlice from the warmer (i.e. northern) part of the distribution range had markedly higher metabolic rates than those from the cooler (i.e. southern) region, for almost all experimental temperatures. Thus, our results provide direct evidence of intraspecific latitudinal differences in metabolism, rejecting the MCA hypothesis, which is more difficult to resolve with interspecific level comparisons.

Keywords: latitudinal cline, local adaptation, metabolism, *Porcellio laevis*, temperature.

INTRODUCTION

Much controversy and speculation has surrounded the metabolic cold adaptation (MCA) hypothesis and the latitudinal compensation hypothesis (e.g. Krogh, 1916; Chown and Gaston, 1999; Steffensen, 2002; Hodkinson, 2003). The MCA hypothesis refers to the observation that at the same ambient temperature the metabolic rate of ectotherms from cold climates is higher than that of their counterparts from warm climates (i.e. temperate or tropical). The increase in metabolic rate is considered to be an adaptation to compensate for the short period of favourable environmental conditions for development, growth and...
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