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Article

Day/night variations of feeding and immune activities in larvae of the European grapevine moth, *Lobesia botrana*

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With 5 figures

Abstract: Daily varying intensities of exposure to infectious enemies should select for the evolution of a daily structure of host immunity with a marked peak and trough (i.e. a daily rhythm). Such nychthemeral variations have been documented for insect inducible immunity (responsiveness to microbial challenge), while the existence of similar daily patterns in basal immunity remains unexplored. Basal immunity is defined as the background, readily available protection aimed at preventing infection at any time. Daily rhythmic elevation of basal immunity should bear substantial costs and be performed only when facing highly predictable changes in threat of infection. This could be the case for risk of food-borne infection, presumably fluctuating with daily patterns of host feeding activity. This study investigated the existence of day/night variations in feeding activity and basal immunity, using larvae of the moth *Lobesia botrana* (Lepidoptera: Tortricidae) raised under a realistic daily cycle of light and temperature conditions. At night, larvae (i) spent a greater amount of time feeding, (ii) displayed a higher total phenoloxidase activity and (iii) underwent subtle changes in the balance of some haemocyte types newly described for this species (increase in the relative abundances of prohaemocytes and plasmatocytes, decrease in the one of oenocytoids). These data provide the first evidence of nychthemeral variations of basal immunity in an insect model, with peaks in some immune effectors co-occurring with maximal feeding activity (during nighttime). The ecological implications and the contribution of this work to improve the general understanding of the temporal structure of immunity are discussed.

Keywords: basal immunity, ecological and evolutionary immunology, nychthemeral variations, haemocyte types, Tortricidae

1 Introduction

The fundamental observation that organisms do not constitutively maintain immunity at its maximum levels has given rise to the field of evolutionary and ecological immunology (Schmid-Hempel 2003; Schulenburg et al. 2009; Siva-Jothy et al. 2005). Its underlying theory predicts that the expression of immune traits can be adjusted in a dynamic way, depending on environmental factors like population density (Barnes & Siva-Jothy 2000), food availability and quality (Ponton et al. 2013; Vogelweith et al. 2011), temperature (Raffel et al. 2006) or parasitism threat (Schmid-Hempel & Ebert 2003; Sheldon & Verhulst 1996). Indeed, resource allocation to immunity is predominantly shaped by the intensity of exposure to pathogens and parasitic faunas (parasites, parasitoids), which is spatially and temporally dynamic (Lindström et al. 2004; Martinez-Bakker & Helm 2015). Accordingly, spatial variations in levels of immunity have been found between distinct host populations experiencing geographically heterogeneous pressures exerted by these natural enemies (Corby-Harris & Promislow 2008; Lindström et al. 2004; Vogelweith et al. 2013). Temporal

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