Differences in the amino acid content of four green algae and their impact on the reproductive mode of Daphnia pulex

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Abstract: The enormous success of the genus Daphnia in freshwater ecosystems is at least partially due to their cyclical parthenogenetic life cycle and their ability to produce resting eggs. Recently it has been shown that resting egg production in Daphnia can be influenced by specific dietary amino acids: at high population densities (crowding), Daphnia produce resting eggs when feeding on the green alga Scenedesmus obliquus, but produce subitaneous eggs when feeding on S. obliquus supplemented with specific amino acids, or with the amino acid rich phytoflagellate Cryptomonas sp. The present study was conducted to evaluate how differences in the availability of amino acids in edible green algae affect life history and resting egg production of Daphnia pulex. In standardized growth experiments, we raised D. pulex under crowding conditions either on Ankistrodesmus falcatus, Chlamydomonas klinobasis, Chlorella vulgaris or Scenedesmus obliquus and determined juvenile somatic growth rates, production of subitaneous and resting eggs and population growth rates in order to relate them to the amount of essential amino acids in the diet. Our results show that D. pulex produces ephippia under crowding conditions with all four green algal species offered as food. However, the specific amino acid content of the green algae seems to influence the number of ephippia, respectively the number of neonates, produced. Hence, our study suggests that the availability of algae species, even though belonging to the same taxonomic group, in Daphnia’s food can change the amino acid supply and thus potentially the reproductive mode of Daphnia in experimental and natural environments.

Key words: Daphnia, resting egg, amino acid, reproduction, food quality.

Introduction

Cladocerans of the genus Daphnia feed primarily on phytoplankton, a food source which is subject to high seasonal changes in quantity and quality (e.g. Ahlgren et al. 1990, Ahlgren et al. 1992, Von Elert 2002, Martin-Creuzburg et al. 2008) due to succession of algal species (Sommer 1985). Daphnids are non-selective filter-feeders and thus particularly sensitive to changes in the biochemical composition of their food. Differences in food quality of single algae or lake seston for Daphnia have been related to C:P and C:N ratios (e.g. Sterner & Elser 2002), polyunsaturated fatty acids (e.g. Wacker & Von Elert 2001, Müller-Navarra et al. 2000, Von Elert 2002) and sterols (Martin-Creuzburg et al. 2005, Martin-Creuzburg et al. 2008). However, potential effects of amino acids on the performance of Daphnia were up to now largely neglected. Moreover, food quality research has almost exclusively focused on parthenogenetic reproduction of Daphnia, there-