JARQ 49 (3), 293 - 299 (2015) http://www.jircas.affrc.go.jp

Occurrence of Cellulose Activities in Planktonic Crustaceans Inhabiting Mangrove Areas in Malaysia

Wen LIU[1], Aya TANIMURA[1], Kyohei YAMADA[1], Haruhiko TOYOHARA[1]*, Lilee CHEW[2], Yukio HANAMURA[3, 4], Tomoyuki OKUTSU[3] and Katsuhisa TANAKA[3, 5]

[1] Division of Applied Biosciences, Graduate School of Agriculture, Kyoto University (Kyoto, Kyoto 606-8502, Japan)
[2] Institute of Ocean and Earth Sciences, University of Malaya (Lembah Pantai, Kuala Lumpur 50603, Malaysia)
[3] Japan International Research Center for Agricultural Sciences (Tsukuba, Ibaraki 305-8686, Japan)
[4] National Research Institute of Fisheries Science, Fisheries Research Agency (Yokohama, Kanagawa 236-8648, Japan)
[5] National Research Institute of Far Seas Fisheries, Fisheries Research Agency (Shizuoka, Shizuoka 424-0902, Japan)

Abstract

We assessed cellulase activity in several crustaceans of different taxonomic groups inhabiting the mangrove areas of Malaysia to clarify whether these animals could digest cellulose derived from mangrove trees. We investigated four Copepod species, two Mysida species, and ten Decapoda species. Three copepod species demonstrated multiple cellulase active bands that differed among species in a zymographic assay, suggesting that these animals were equipped with distinct cellulases. Interestingly, the way the cellulase were expressed in the zymographic assay differed, even among members of the same species collected at different locations, suggesting that cellulase expression patterns of copepod species are regulated by environmental factors. Although no significant cellulase activity was detected in two of the Mysida species, widespread distribution of cellulases was also detected in decapod species. Multiple common active bands in the various organs of decapod species were detected by the zymographic assay, while remarkable activity was detected in the hepatopancreas in the reducing sugar assay. The above findings suggested that cellulases are synthesized in the hepatopancreas and then secreted into digestive tracts such as the stomach and intestine. The present study shows that various crustaceans comprising most of the biotic resources in mangrove areas may be there because of their ability to digest cellulose.

Discipline: Aquaculture
Additional key words: Cellulase, Copepod, Decapoda, Digestion, Mysida

Introduction

All zooplanktons are heterotrophic, although the individual species differ in how they obtain organic energy; classified as herbivores, carnivores, detritivores and omnivores (Lalli & Parson 1997a). In temperate areas, zooplankton mainly feed on phytoplankton and are classified as carnivores (Bouillon et al. 2000). In tropical mangrove areas, however, the amount of phytoplankton is assumed to decrease due to the low transparency of water caused by the suspended clay particles (Okamura et al. 2010, Robertson et al. 1992). Conversely, a remarkable number of zooplankton inhabit mangrove areas, including small crustaceans such as mysid crustaceans, despite the turbid water (Hanamura et al. 2008). Therefore, it seems likely that small crustaceans in the mangrove areas feed on alternative carbon sources and not solely on phytoplankton.

Recently, our studies showed that various aquatic invertebrates in temperate zones could break down cellulose using cellulases (Niiyama & Toyohara 2011). In addition,

The present study was funded by the Japan International Research Center for Agricultural Sciences (JIRCAS) and partly by Grants-in-Aid for Scientific Research from the Japan Society for the Promotion of Science (nos. 22405030 and 25292113)
* Corresponding author: e-mail toyohara@kais.kyoto-u.ac.jp
Received 13 May 2014;accepted 3 September 2014.