

Introduction to Special Issue

Pattern Recognition Receptors and their Roles in Immunity in Invertebrates

Jin-Xing Wang¹ and Gerardo R. Vasta²

¹ Shandong Provincial Key Laboratory of Animal Cells and Developmental Biology, School of Life Sciences, Shandong University, Qingdao, Shandong, China

² Department of Microbiology and Immunology, School of Medicine, University of Maryland Baltimore, and Institute of Marine and Environmental Technology, Baltimore, Maryland, USA

The concept of “pattern recognition receptors” (PRRs) as key components of innate immunity for the recognition of infectious challenges was proposed during the late 80’s (1), upon the cloning of the IL-1 receptor (IL1-R1) in the previous year (2). The identification of Toll as a receptor in innate immune responses against fungal infection of the fruit fly *Drosophila melanogaster* (initially characterized as key to dorso-ventral polarization in early development), and the elucidation of inflammatory signaling pathways that led to the expression of immune genes (3,4) merited the Nobel Prize in Physiology or Medicine awarded to Jules Hoffmann in 2011.

Since the early 90’s the growth of the research field of Toll-like receptors (TLRs) was particularly explosive in mammalian experimental model systems and man, as it enabled a detailed understanding of the links between innate and adaptive immune responses. Invertebrates lack the adaptive immunity typical of vertebrates mediated by immunoglobulins, and T- and B-cell receptors, and rely on innate immune responses for defense against infection. Thus, the study of Toll and TLRs, as well as many other PRRs, either intra- and extracellular, or soluble or cell membrane-associated, has emerged as most relevant to our understanding of how invertebrates detect potentially pathogenic microbes and initiate an inflammatory defense response. In addition to TLRs, among the various PRRs described in invertebrates, and although described in the early 60’s in terrestrial snails under the term “protectins”, the role(s) of lectins in the recognition of carbohydrate moieties on the surface of potentially pathogenic bacteria, viruses, yeasts and eukaryotic parasites have generated increasing interest since then. Furthermore, although members of the immunoglobulin superfamily have been identified in invertebrates and participate in functions unrelated to immunity (fasciclin and amalgam), hemolin and the Down syndrome cell adhesion molecule (Dscam), initially described in insects, have been shown to participate in innate immune responses against microbial or parasitic challenge.

In this Special Issue of DCI titled "Pattern recognition receptors and their roles in immunity in invertebrates", we have attempted to offer a collection of review articles that illustrate recent studies focused on PRRs from invertebrate taxa, including insects, crustaceans, mollusks, and annelids. Although the list of topics is by no means comprehensive, we hope that this collection of reviews will serve as a useful overview of recent achievements in the field, highlight the multiple questions that remain unanswered in the structural and functional aspects of invertebrate PRRs, and provide a selection of the diverse experimental approaches that several research groups are currently implementing to address these questions.

We thank Professor Kenneth Söderhäll, Editor-in-Chief, for his kind invitation to produce and edit this special issue, and all the contributors who made this initiative possible. We are also grateful to Drs. Gowri Vasanthkumar and Jenny Henzen for their assistance in this project.

References

1. Janeway, C. A. Jr. Approaching the asymptote? Evolution and revolution in immunology. Cold Spring Harb. Symp. Quant. Biol. 54, 1–13 (1989).
2. Sims, J. E. et al. cDNA expression cloning of the IL-1 receptor, a member of the immunoglobulin superfamily. Science 241, 585–589 (1988).
3. Lemaitre B, Meister M, Govind S, Georgel P, Steward R, Reichhart JM, Hoffmann JA. Functional analysis and regulation of nuclear import of dorsal during the immune response in *Drosophila*. EMBO J. 1995 Feb 1;14(3):536-45.
4. Lemaitre B, Nicolas E, Michaut L, Reichhart JM, Hoffmann JA. The dorsoventral regulatory gene cassette *spätzle*/Toll/cactus controls the potent antifungal response in *Drosophila* adults. Cell. 1996 Sep 20;86(6):973-83.