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Innate immunity in the Purple Sea Urchin; diversity of the Sp185/333 system

The innate immune system of the Purple Sea Urchin, *Strongylocentrotus purpuratus*, is complex and sophisticated, functioning with several large gene families that encode pathogen detection and immune response proteins. One example is the Sp185/333 gene family, composed of ~50 small genes that are tightly linked in clusters. The genes share blocks of sequence called elements that are present in mosaic patterns, include a variety of repeats, and each gene is surrounded by microsatellites. The genomic regions harboring Sp185/333 genes are predicted to be unstable based on the repeats and shared sequence, and diversity may be driven by gene recombination, conversion, duplications, deletions, and meiotic misspairing. A single Sp185/333 gene is expressed in single phagocytes, which suggests that each cell expresses and secretes a single version of the Sp185/333 proteins that may function synergistically in response to pathogen challenge.

The Sp185/333 proteins are highly diverse in sequence, which is expanded by RNA editing, yet are structurally similar with a leader, a glycine rich region, an RGD motif, and a histidine rich region. Sp185/333 proteins opsonize bacteria, induce phagocytosis, and retard the growth of most bacteria. One Sp185/333 recombinant protein (rSp0032) binds specifically to *Vibrio* and yeast, but not to *Bacillus*. It also binds LPS, 1-3, glucan, and flagellin with specificity and high affinity, but does not bind peptidoglycan. rSp0032 binds phosphatidic acid (PA) and can deform liposomes composed of 10% PA. rSp0032 is intrinsically disordered until bound to LPS or PA, which induces a switch to helical structure, suggesting “shapeshifter” capabilities for binding lipids, sugars and proteins. Each of the Sp185/333 isoforms may have a range of overlapping binding activities resulting in highly effective host protection against a wide range of pathogens.

Biography

Courtney Smith has been investigating invertebrate immune systems since 1980, during which time she has worked on allograft rejection in marine sponges and initiated a research program on the innate immune system of sea urchins. She is author of 60 publications on invertebrate immunity. She serves on the editorial board for *Developmental and Comparative Immunology* and is currently a special editor for that journal. Smith is a member of the International Society of Developmental and Comparative Immunology and was a member of the Executive Board from 2003-2012. She has participated in numerous review panels for the US National Science Foundation since 2000.

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