



## Mapping Immunity; Vertebrates Versus Invertebrates

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Humans evolved with a unique immune system consist of innate and adaptive immunity. Both innate and adaptive immunity comprised of different types of cells, immune players, and associated with different functions. In higher animals, including humans, innate immunity derived from birth hence called inbuilt immunity. On the contrary, adaptive immunity called acquired immunity is gain due to the environment. Vertebrates are ranked as superior over in-vertebrates on the classification table due to many reasons, including the presence of vertebra and spinal cord. In-vertebrates often considered as lower animals due to poorly developed organs, lack of vertebra and spinal cord. Similarly, the immune system and set of immune organs in a lower organism are entirely different and primitive on the basis of the organization. Like humans and other vertebrates, the in-vertebrates do not have a distinct classification/setup of innate and adaptive immunity. In human and higher vertebrates, innate and adaptive immune systems are consisting of different cells; immune players such as cytokines, antibodies, and chemokines, etc. enable crosstalk between innate and adaptive immune systems. On the contrary, invertebrates' immune system is consists of unique cells and potent biomolecules; enzyme, peptides, and proteins. These molecules provide a complete defense to the animal via several mechanisms. The question we raise here does the classification superiority of humans, and other vertebrates over in vertebrates are justified in terms of immunity. How a complex and evolved immunity system mostly in human often fail to fight against infections while lower animals with the primitive immune set can survive even in hearse conditions.

Apart from organization setup in humans and higher vertebrate's immunity can be further classified based on function such as cell-mediated and Humoral immunity. Cell-mediated immunity provides protection using different cells such as white blood cells (WBC), Macrophage, Phagocytes, Dendritic cells and T cell (CD4 and CD8), etc. Humoral immunity is a function of B cells, memory cells and antibodies. The immune response in human and other higher vertebrates consist of activity of different cells and immune

players for identification of the foreign substance, presentation to immune system followed by killing/removal. The effective identification and clearance of foreign objects depend on synchronization between immune cells and players of both innate and adaptive immunity. On the contrary, lower animals, i.e. invertebrates, do have a more straightforward mechanism of identification and clearance of foreign objects that ultimately depends on endogenous short peptides, proteins, and enzymes. The more straightforward sets often provide ease in synchronization of immune players in lower animals reported more effective and robust. There is growing evidence that enzyme and protein as part of the immune system in the lower animal are highly dynamic and do possess promiscuity at the substrate and catalytic level. Enzyme promiscuity is capacity often describe for broad substrate affinity and catalytic diversity. The short peptides, proteins, and enzymes present in lower animals; invertebrates are highly promiscuous and capable of catalyzing multiple biochemical reactions.

Earthworm, a classic invertebrate model for immune comparison, studied tremendously in the last couple of decades. The animal habitat is an environment rich in infections and invading elements. The presence of promiscuous and potent biomolecules including enzyme; serine protease provides a complete defense to the animal. The coelomic cavity of animals is rich in many short peptides, and other bioactive molecules offer extended protection to a wide range of infections. The key molecules are Fetidin 1, Fetidin 2, Lysenin, Eiseniapore, Coelomic Cytolytic Factor (CCF), and Lumbricin I. These molecules exist in isoforms and vary in size among different species of earthworm. The isoforms of these molecules provide extended support in defense mechanisms. There are growing research findings suggested protease present in coelome of earthworm are generally exist in isoforms. Each isoforms possesses a broad substrate affinity and catalytic diversity. This can be compared with VDJ recombination in B cell for the diversity of antibodies. There is another advantage in having promiscuous and isoforms of series protease in coelome of animal, i.e. a large number

of infection often arises from feed and hence this enzyme help in encountering such invading elements. The enzymes are small and easily get reassembled based on need. On the other hand though human and higher vertebrates though evolved with complex and developed immune systems but often get fail to deliver complete protection to a wide range of invading elements.

There is growing research evidence demonstrating that the animal-based bioactive molecules are being tested and used clinically for various purposes such as antimicrobial, anti-inflammatory, clot buster and antiviral etc. The clot-dissolving enzyme, antimicrobial peptides, and proteolytic enzyme are classic examples studied tremendously in past from various sources. There is enormous literature in folk medicine as well about the potential of lower animal and their products. However, these studies need a revisit in the modern prospect and validation as well. Indeed, human and other vertebrates are evolved with a unique and robust immune system; however, the complex nature on a structural and functional level often restricts its efficacy. On the contrary, higher animal do have a robust and effective immune setting such as humoral immunity that provides a memory for various infections that is absolutely absent in lower animals. The comparison between the immune system of Vertebrates versus in-vertebrates should be on the structural level but must be on its functionality. For example, our immune system is a complete collapse in the case of novel SARS-CoV-2 infections that raise a question immediately do we are really superior over lower animal invertebrates encounter daily such infections [1-6].

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