Immunity in social amoeba suggests ancient beginnings

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Finding an immune system in the social amoeba (Dictyostelium discoideum) is not only surprising but it also may prove a clue as to what is necessary for an organism to become multicellular, said the Baylor College of Medicine researcher who led the research that appears today in the journal *Science*.

Dictyostelium discoideum usually exists as a single-celled organism. However, when stressed by starvation, the single cells band together to form a slug that can move. Eventually the slug changes to produce cells that perform specific functions – spores and stalks. In this new report, Dr. Adam Kuspa, chair of biochemistry and molecular biology at BCM, and his colleagues describe a new kind of cell they dubbed a "sentinel" cell.

Sentinel cells circulate within the slug, engulfing invading bacteria and sequestering poisons or toxins, eventually eliminating these from the slug. These cells often operate through a particular mechanism in the cells controlled by a Toll/Interleukin-1 Receptor domain protein (TirA), Kuspa and his team found.

This signaling pathway or a very similar one is present in plants and animals, he said. Now it has been identified in amoeba. It has not been found in fungi.

"Amoeba have, in the last 10 years, become appreciated as one of the four main forms of life in the crown group of eukaryotic (multicellular)

organisms – plants, animals, fungi and amoeba," said Kuspa. "What allowed them to become multicellular""

One way to estimate the characteristics of the organism that went before those that were multicellular is to look for characteristics that are present in two, three or all four of these main groups, he said.

"Those were likely present in the progenitor organism," said Kuspa. Because three of the four major groups of organisms have this pathway, "I argue that means that the progenitor of all multicellular organisms had this pathway. Since that organism was not likely multicellular, it must have used it as some kind of signaling to respond to bacteria in the environment."

Looking at it from another point of view, "it's possible that one of the properties of those (crown) organisms that allowed them to become multicellular was the ability to distinguish self from non-self – the hallmark of an immune system," said Kuspa. "The speculation is that a requirement of multicellularity is that you develop systems to recognize pathogens and other non-self cells from yourself."

Kuspa sees two paths for future research in the area. One is to look for evidence of the same immune mechanism and protein in other kinds of amoeba. The other is to look at unicellular organisms to determine if they have this same kind of immune signaling pathway.

"If none of the early diverging organisms that never became multicellular developed this kind of signaling system, it would subtly strengthen our argument," he said.

Source: Baylor College of Medicine