

[S9-1]

Bactsphere; New Concept on Bacterial Surface

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It has been widely recognized that bacteria play fundamental roles in material cycles in marine environments. Their metabolic versatilities make them possible to metabolite or degrade various organic and inorganic compounds that are not utilizable by other organisms. A part of the reasons of this huge potential activity is that their wide distribution and high numbers. They are present in almost any environments including extreme environments such as deep sea or hydrothermal vent. Even below 5,000 m depth, usually 1,000 cells/ml or more are usually present. Although each cell is small, the total number and total surface area of the cells are enormous, i.e., approx. 10^{28} cells and 6×10^{10} km², respectively. The latter corresponds to roughly two orders of magnitudes more than that of the earth surface area. The initial step of any bacterial metabolism starts from the contact of the material to the bacterial surface. Therefore, the understanding of this process and new concept will greatly enhance the research on bacterial functions in the sea.

Bacterial cells are composed of membrane fraction and intracellular materials. As for Gram-negative bacteria, the O-specific side chains of lipopolysaccharide extend outside of the cells. Some bacteria have pili or lateral flagella, and some produce extracellular polysaccharides around the cells. We assume that the environmental condition of the zone within those polymers or fibrous materials is different from outside of those structures. We also assume that the understanding of the chemical nature, fine structure and functional implication of the zone is a key to understand the bacterial function. Here, I will propose a concept of "Bactsphere" which is defined as the zone surrounding a bacterial cell and having specific environmental conditions.

So, how can we confirm the presence of the bactsphere? What kind of specific function does it possess? What are their possible physiological and ecological roles? Some fine structure images of natural cells taken by Atomic Force Microscopy will be shown and discussed. The bactsphere seems to have specific function when bacterial cells are attaching to the surface and also when the cells have specific interaction with nano-size particles. For the latter, I will also propose a concept of "Particle Capturing" that means the bacterial ability to capture fine particles. The ecological and physiological implications of this ability will be discussed together with the concept of the bactsphere.