Misconceptions and facts about the bacterial population growth, revealed by the study of cyanobacteria

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Bacterial population growth has traditionally been described as a dynamic process characterized by continuous reproduction and cell death. However, what we found is in sharp contrast the general consideration. We studied the bacterial population growth under nutrient-rich conditions. We demonstrated that in a well-fed population, the stationary phase inevitably occurs. We excluded the starvation and the accumulation of toxic compounds to enter the stationary phase. In the late stationary phase there is no mass death of cells only the colony-forming units (CFUs) declines, being produced the so called VBNC cells, meanwhile the total cell concentration remains stable. What we found with proteomic analysis is a perpetual differentiation of cells. From our perspective, a bacterial population can be regarded as a virtual tissue resulting from a specific process of cellular differentiation. Interestingly, nutrient richness appears to have no effect on either the growth rate or the final stationary-phase cell density. Serial dilution experiments from stationary-phase populations revealed the existence of a so-called minimal stationary cell concentration (MSCC). This represents a threshold cell concentration above which a stationary-phase population remains in stationary state despite dilution. The existence of MSCC is characteristic of unicellular organisms.

The tubulin homologue FtsZ protein is considered to play a central role in bacterial cell division. We have successfully generated a mutant strain of *Synechococcus elongatus* PCC7942, in which we introduced FtsZ-GFP, deleted endogenous FtsZ, and segregated it to a homozygous state. Employing this mutant a cortical, cellular network built by the FtsZ was revealed. We found that FtsZ is essential for cells, but appears to be less important for bacterial cell division.