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Role of urease and carbonic anhydrase in the calcium carbonate biomineralization

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The application of bacteria for ecological engineering purposes is becoming increasingly popular. Microbial carbonate precipitation has gained interest in the last 20 years in civil engineering, because of the selective cementation due to formation of deposits commonly called calcite crystals. These $CaCO_3$ crystals have advantages in special structures and excellent material properties through biomimetic synthesis. Microbial calcite precipitation comprises of a series of complex biochemical reactions. Certain bacterial species produce urease enzyme which is responsible for raising the pH of the system and production of carbonate crystals. However, studies related to carbonic anhydrase on calcite precipitation by these bacteria have not been studied in detail. In the present study we have studied the role of urease (UA) and carbonic anhydrase (CA) in the calcium carbonate biomineralization by Bacillus megaterium (SS3) isolated from calcareous soils of Anantapur district of Andhra Pradesh, India. Two types of experimental systems with and without B. megaterium which could produce extracellular UA and CA were studied to determine the effect of bacteria and bacterial produced UA and CA in calcite precipitation. The results showed that precipitation of Ca^{2+} was significantly faster in the experimental system with bacteria than that without bacteria. The effect of UA inhibitor acetahydroxamic acid and CA inhibitor acetazolamide was also studied to find the role of these enzymes in calcite precipitation. The results showed that calcite precipitation significantly reduced when both inhibitors are present in the system compared to the individual inhibitors. SEM and XRD analyses also confirmed the precipitation of calcite crystals by this bacterium. These results suggest that bacteria themselves could serve as nucleation sites for calcite precipitation and both UA and CA are involved in precipitation of Ca^{2+}.

Biography

M. Sudhakara Reddy has completed his PhD from University of Madras and postdoctoral studies from University of Lyon, France. He is the Professor and Head, Department of Biotechnology, Thapar University, Patiala. He has supervised 12 Ph.D. theses and published more than 70 papers in reputed journals. He also handled many research projects as Principal Investigator sponsored by different funding agencies such as DBT, DST, CSIR, UGC, AERB, and CEFIPRA. He is also honoured as Fellow of Mycological society of India and Fellow of Association of Biotechnology and Pharmacy.

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Optimization of medium for pullulan production using a novel strain of Exiguo bacterium sp. SH3

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The aim of this work was to study the effects of cultural parameters on Pullulanase production of Exiguobacterium sp. SH3. This bacterium produces an interesting cold-adapted Pullulanase with high catalytic activity at temperatures approaching freezing condition. To this aim, the combinatorial effects of seven cultural parameters including: time (h), temperature(c), pH, shaking speed (rpm), yeast extract (g/l), tryptone (g/l), starch (%) were analyzed at two levels using Plackett–Burman and Central composed design. The results indicated that the effects of 3 factors including temperature (25 and 40oC), yeast extract (1 and 3 g/l), and shaking speed (100 and 180 rpm) were statistically significant resulting in improved amylase productions. Temperature at lower level while yeast extract and shaking speed at higher levels were more suitable for Pullulanase production and secretion by this bacterium. The results revealed that cold condition is more suitable for Pullulanase production by this psychrotrophic bacterium. Yeast as a general growth-improving factor and shaking as an important factor for aerobic organisms at higher levels were effective. The newly psychrophilic PullulanaseSH3 seems to be suitable biocatalyst for practical use in liquefaction of starch at low temperature, detergent and textile industries.

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