Halophilic Bacteria as a Source of Extracellular Enzymes

Antonio Ventosa and Cristina Sánchez-Porro

Department of Microbiology and Parasitology, University of Sevilla, Spain

Two groups of prokaryotes are adapted to live under extreme hypersaline conditions: halophilic archaea (haloarchaea) and halophilic bacteria. The halophilic bacteria are represented by the moderate halophiles (showing optimal growth at 3 to 15% NaCl) and the extreme halophiles (with optimal growth at 15 to 15% NaCl). Although haloarchaea have been considered as the most interesting models for basic research in halophiles and several important biotechnological applications have been developed, halophilic bacteria have a great biotechnological potential as a source of new compounds (compatible solutes, polymers) or for biodegradation processes. Since these bacteria are able to grow at changing environmental conditions they can be important sources of extracellular enzymes that could be used as biocatalysts under extreme conditions of salinity as well as of temperature and pH values.

The pioneering studies in this field were carried out by Onishi and Kamekura in 1970's; they described the biochemical features of several extracellular enzymes (amylase, protease, nuclease). In 2000 our group carried out the first molecular characterization of an alpha-amylase produced by the moderately halophilic bacterium *Halomonas meridiana.* This amylase hydrolysed starch producing maltose and maltotriose, showing optimal activity at 10% NaCl (with a high activity even at 30% NaCl). Other amylases produced by the halophilic species *Halothermothrix orenii* and *Halobacillus karajensis* have been latterly studied. More recently we have studied a protease, designated as haloprotease CPI produced by the moderately halophilic bacterium *Pseudoalteromonas ruthenica* CP76. This metaloprotease showed optimal activity at 55ºC, pH 8.5 and 0-10% NaCl. The gene encoding this extracellular protease, designated as *cpo* gene, encodes a 733-residue protein showing sequence similarity to metalloproteases of the M4 family. Our results show that the haloprotease CPI is secreted by the type II secretion apparatus. Other extracellular enzymes produced by halophilic bacteria will be reviewed. Our present studies are focused on the analyses of metagenomes obtained from several hypersaline environments.