Frugal microbes reduce the cost of proteins

September 1 2010

Bacteria tend to be more frugal when constructing proteins for use outside of the cell versus internally, saving their energy for synthesizing compounds that can be recycled, according to research published in the current issue of the online journal *mBio*.

"Because extracellular proteins are lost to the environment and not recycled like other cellular proteins, they present a greater burden on the cell, as their amino acids cannot be reutilized during translation. We hypothesize that evolution has optimized extracellular proteins to reduce their synthetic burden on the cell," says Matthew Chapman of the University of Michigan, an author on the study.

Microbes secrete proteins to perform essential interactions with their environment. Because microbes generally lack a system to import proteins, secretion is often a one-way street and the secreted proteins are less likely to be recycled by the organism due to environmental loss. It would therefore make sense that these secreted proteins would evolve to require less energy in their construction.

Chapman, along with his colleague Daniel Smith, calculated the amount of energy required to produce the amino acids, also known as the average synthetic cost (ASC), of each protein produced by the bacterium Escherichia coli K-12. They then compared them by their location, whether they were used internally (cellular) or externally (extracellular).

"Strikingly, 11 of the 100 most economical proteins (those with the lowest ASCs) were extracellular, even though extracellular proteins

comprise only 0.37% of total proteins," says Chapman.

They also conducted computer analyses of Pseudomonas syringae, Mycobacterium tuberculosis, Saccharomyces cerevisiae and over 25 other microbes and found a similar broad bias towards more economical amino acids in extracellular proteins.

"We found that the synthetic costs of extracellular proteins are significantly reduced in E. coli, P. syringae, M. tuberculosis, S. cerevisiae and many other organisms. It appears that economy may address the compositional bias seen in many extracellular proteins and deliver further insight into the forces driving their evolution," says Chapman.

More information: mbio.asm.org/

Provided by American Society for Microbiology