DNA: Bacteria's survival ration

May 26 2006

The ubiquitous bacteria E. coli rank among nature's most successful species for lots of reasons, to which biologists at the University of Southern California have added another: in a pinch, E. coli can feast on the DNA of their dead competitors. A research team led by Steven Finkel, assistant professor of molecular and computational biology in the USC College of Letters, Arts and Sciences, had already shown that DNA is an acceptable source of nutrients for bacteria.

The team's latest study, presented in the June 1 issue of the *Journal of Bacteriology*, finds that DNA is a critical food source in the battle of the fittest. Bacteria that stay alive just a little longer than their counterparts get a double reward: the competition for food lessens, and the supply of nutrients increases.

"The bacteria actually eat the DNA, and not only that, they can use the DNA as their sole source of nutrition," Finkel said.

In hindsight, it should come as no surprise that DNA can serve as a meal for microbes.

"You're surrounded by living things, and living things die," Finkel said. "Where does all that stuff go? Why aren't we up to our ears in DNA, in ribosomes, in plant protein?

"A lot of decay is microbial, and nobody ever thinks about it."

Finkel calls this phenomenon "nutritional competence" to distinguish it

from natural competence, defined as the ability of cells to assimilate waste DNA in order to mutate or repair their genomes.

Natural competence is potentially risky, Finkel said, since bad mutations can result, "but there should be no genetic cost to eating [the DNA]."

The study identified eight genes in E. coli that are necessary for nutritional competence. Without any one of these genes, the bacteria cannot consume DNA and lose their competitive advantage.

"The gene family is found in many other species," the authors reported, "suggesting that the use of DNA as a nutrient may be a widespread phenomenon."

The concept of nutritional competence could have applications to medical research, as the DNA from dead cells in the human body may be sustaining harmful bacteria.

One of the pathogens implicated in cystic fibrosis is suspected of feeding on DNA in lung tissue, Finkel said. Biofilms, which have been linked to chronic infections, also may harbor nutritionally competent germs.

If researchers succeeded in turning off nutritional competence in such pathogens, as Finkel did in E. coli, the advance might lay the groundwork for a new class of genetic antibiotics.

The study did not prove that all DNA decay is microbial. But Finkel discounted the significance of inorganic processes, citing the chemical stability of genetic material. If a thick layer of DNA were exposed to the sun, he said, only molecules at the top would break down chemically, while bacteria would eat the rest from the bottom up.

Nevertheless, Finkel said, DNA remains a backup nutrient for bacteria, being harder to digest than glucose and other simpler food sources.

Source: University of Southern California