Shuttle brings space-grown strep bacteria back for study

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When the space shuttle Endeavour touched down at the Kennedy Space Center August 21, University of Texas Medical Branch at Galveston microbiology and immunology department chairman David Niesel was waiting by the runway, looking forward to a reunion with some of its passengers.

The space travelers Niesel was meeting weren't astronauts. They were Streptococcus pneumoniae bacteria, members of a species commonly found in the human upper respiratory tract but in this case riding in sealed experimental containers in the shuttle's mid-deck.

Streptococcus pneumoniae is what's known as an "opportunistic bacterium," one that's normally harmless but always ready to exploit the right circumstances and cause full-blown disease. For infants, the elderly and others with weaker-than-normal immune systems — possibly including astronauts on long space flights — it can be quite dangerous.

"Strep pneumoniae is a very potent pathogen in people who are immunosuppressed — it's the number-one cause of community-acquired pneumonia, and a leading mediator of bacteremia [bacterial blood infections] and meningitis," Niesel said. "There's a decline in people's immune function the longer they're in the space environment, and it's been shown that other bacteria also alter their properties in microgravity — they grow faster, they tend to be more virulent and resistant to microbial treatment."

Niesel and other investigators want to know exactly how Streptococcus pneumoniae changes in microgravity and whether those changes could pose a threat to crew members on a mission with no chance of a quick return to Earth — for example, a months- or years-long journey to Mars and back. In 1999, they began work on SPEGIS (Streptococcus pneumoniae Expression of Genes in Space), a project to grow the bacteria in orbit and bring them back home frozen in "zero-g mode" for study.

Eight years later, six tightly sealed vials of the bugs were launched into orbit in a cold-storage experiment locker that kept them inactivated at about 39 degrees Fahrenheit. To make sure that the shuttle crew would not be exposed to a potential pathogen, the vials themselves were also packed into two sealed aluminum canisters.

On day five of the mission, with the shuttle docked to the International Space Station, the crew raised the canisters and their contents to just above human body temperature and incubated them there for 15 and a half hours. Then they transferred them to a super-cold freezer on the ISS, which dropped the temperature of the canisters to 139 degrees below zero Fahrenheit.

"That locked the bacteria at whatever stage they were at, whatever genes they were expressing and whatever proteins they had present were locked in, because no more metabolism was occurring," Niesel said. "So we get a picture of what they were like in space at that time, which is the cool part."

Control experiments conducted on Earth followed every step of the process as it was done in orbit, with canister transfers even timed to the minute. "Now we have two snapshots of the bacteria frozen in time, grown with the same parameters except the microgravity part, and we should be able to see the differences that result when the bacteria see

this unique space environment," Niesel continued.

The bacteria are expected to arrive in Galveston later this week or early next week, kept cold with dry ice all the way to maintain them just as they were in orbit. Once he gets the bacteria in his lab, Niesel plans to conduct complete protein and genetic analyses, as well as possible virulence studies in laboratory mice.

"Seeing the Endeavour land was the culmination of many years of preparation, persistence and uncertainty — we were originally scheduled to fly shortly after the Columbia accident — but it's been worth the wait to get the chance to make one of the first studies of an opportunistic pathogen in space," Niesel said. "We think it will provide important information for understanding the adaptation of bacteria to unique environments, and begin to answer the question of whether this species is a cause for concern for long-duration space travelers."

Source: University of Texas