Microscopic 'astronauts' to go back in orbit

March 10 2008

When space shuttle Endeavor blasts off on March 11, some tiny ‘astronauts’ will piggyback onboard an experimental payload from Arizona State University’s Biodesign Institute.

The new experiment, called “Microbial Drug Resistance Virulence” is part of the STS-123 space shuttle Endeavor mission. It will continue the research studies of Cheryl Nickerson, PhD, project leader and scientist in the institute’s Center for Infectious Diseases and Vaccinology. Nickerson has been at the forefront on studying the risks of germs associated with spaceflight to the health and well being of the crew.

“Wherever people go, germs will follow,” said Nickerson, who is also an associate professor at ASU’s School of Life Sciences. Last fall, she completed a multi-institutional study that showed for the first time that microbes could be affected by spaceflight, making them more infectious pathogens. The results were from a payload flown onboard space shuttle Atlantis in 2006.

Spaceflight not only altered bacterial gene expression but also increased the ability of these organisms to cause disease, or virulence, and did so in novel ways. Compared to identical bacteria that remained on earth, the space-traveling Salmonella, a leading cause of food-borne illness, had changed expression of 167 genes. In addition, bacteria that were flown in space were almost three times as likely to cause disease when compared with control bacteria grown on the ground.

Now, her research team, which includes James Wilson, PhD, Laura

Quick, Richard Davis, Emily Richter, Aurelie Crabbe and Shameema Sarker, will have an extraordinarily rare opportunity to fly a repeat experiment of their NASA payload to confirm their earlier results.

“We are very fortunate to get a follow up flight opportunity, because in spaceflight, you only get one shot for everything to go just right,” said Nickerson. “We saw unique bacterial responses in flight and these responses are giving us new information about how Salmonella causes disease. NASA is giving us the opportunity to independently replicate the virulence studies of Salmonella typhimurium from our last shuttle experiment and to do a follow-up experiment to test our hypothesis about new ways this bacteria causes disease in this unique environment.”

In the new experimental wrinkle, the team will test a hypothesis that may lead to decreasing or preventing the risk for infectious diseases to astronauts. The experiment will determine if the modulation of different ion (mineral) concentrations may be used as a novel way to counteract or block the spaceflight-associated increase in the disease-causing potential that was seen in Salmonella.

In addition, the project will support three other independent investigators to determine the effect of spaceflight on the gene expression and virulence potential of other model microorganisms, including: Dave Niesel, University of Texas Medical Branch at Galveston, Streptococcus pneumoniae; Mike McGinnis, University of Texas Medical Branch at Galveston Saccharomyces cerevisiae; and Barry Pyle, Montana State University, Pseudomonas aeruginosa.

These microorganisms were chosen because they are well studied organisms that have been, or have the potential to be, isolated from the space shuttle, Mir space station, International Space Station, or its crew, or have been shown to exhibit altered virulence in response to spaceflight. These organisms are all important human pathogens that cause a significant amount of human morbidity and mortality on Earth as well.

“We now have a wide variety of supportive evidence that the unique low fluid shear culture environment the bacteria encounter in space is relevant to what pathogens encounter in our body, including during Salmonella infection in the gut, and there may be a common regulatory theme governing the microbial responses,” said Nickerson. “But to prove that, we need to fly these common bugs together with the same hardware on the same flight so that everyone is tested under the same conditions.

The investigators believe that information gained from these studies will prove beneficial in assessing microbiological risks and options for reducing those risks during crew missions. When taken together, these studies will ultimately provide significant insights into the molecular basis of microbial virulence. Once specific molecular targets are identified, there is the potential for vaccine development and other novel strategies for prevention and treatment of disease caused by these microbes both on the ground and during spaceflight.

“We are learning new things about how Salmonella is causing disease,” said Nickerson. “There is compelling evidence that the unique environment of spaceflight provides important insight into a variety of fundamental human health issues with tremendous potential for the commercial development of novel enabling technologies to enhance human health here on Earth," said Nickerson.

For more information about the Nickerson team’s previous space shuttle Atlantis project, visit: [www.biodesign.asu.edu/news/spa … ria-to-cause-disease]

Source: Arizona State University