Bacteria can grow under extreme gravity: study

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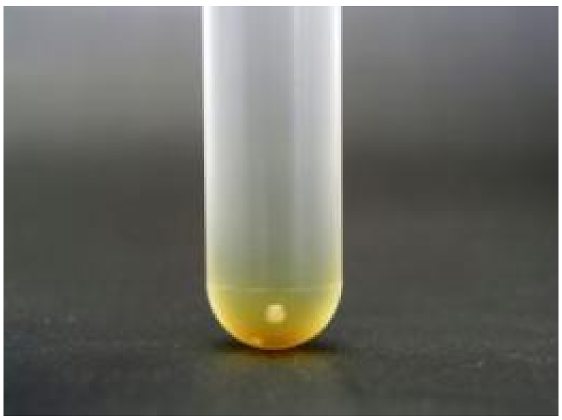

Photograph of pellet of E. coli cells formed after incubation at 403,367 × g and 37 °C for 60 h. The outer diameter of the tube is 18 mm. Image (c) PNAS, doi: 10.1073/pnas.1018027108

(PhysOrg.com) -- A new study in the *Proceedings of the National Academy of Sciences* shows that bacteria is capable of growing under gravity more than 400,000 times that of Earth and gives evidence that the theory of panspermia could be possible.

Biologist Shigeru Deguchi of the Japan Agency for Marine-Earth Science and Technology led the research. With his team, he set out to test the growth capability of bacteria under intense gravity conditions. With the use of a machine called an ultracentrifuge, they spun four different species of bacteria in a way to replicate hyper-gravity.

While the bacteria clumped together in pellet form when the gravity increased, their growth rate was not affected. Two of the species, *Paracoccus dentrificans* (soil bacteria) and Escherichia coli were able to continue growth within a gravity rate of 403,627 g.

Researchers believe that the reason the microbes are not affected is due to their size and structure. The smaller an organism is the less sensitive it is to gravitational forces. Bacteria, a prokaryotic cell, do not have organelles. Organelles, such as cell nuclei, tend to compact and are subject to sedimentation effect and shutting down. Bacteria, by contrast, do not suffer with this problem. Researchers are still unclear as to why some bacteria are more resistant than others and say further study is needed.

The theory of panspermia believes that life on Earth could have begun when comets or asteroids carrying microbes collided with Earth. While there is no proof that microbes here are descendants from alien life, it is now a possible theory. This research however does allow for expansion into areas where we previously thought life would not be possible. For example, the gravity on a brown dwarf has been estimated at around 10 to 100 g. While it wasn't believed that life could grow under those conditions, this study shows that is not the case.

More information: Microbial growth at hyperaccelerations up to 403,627 × g, *PNAS*, Published online before print April 25, 2011, doi:10.1073/pnas.1018027108

Abstract
It is well known that prokaryotic life can withstand extremes of temperature, pH, pressure, and radiation. Little is known about the proliferation of prokaryotic life under conditions of hyperacceleration attributable to extreme gravity, however. We found that living organisms can be surprisingly proliferative during hyperacceleration. In tests

reported here, a variety of microorganisms, including Gram-negative Escherichia coli, Paracoccus denitrificans, and Shewanella amazonensis; Gram-positive Lactobacillus delbrueckii; and eukaryotic Saccharomyces cerevisiae, were cultured while being subjected to hyperaccelerative conditions. We observed and quantified robust cellular growth in these cultures across a wide range of hyperacceleration values. Most notably, the organisms P. denitrificans and E. coli were able to proliferate even at 403,627 × g. Analysis shows that the small size of prokaryotic cells is essential for their proliferation under conditions of hyperacceleration. Our results indicate that microorganisms cannot only survive during hyperacceleration but can display such robust proliferative behavior that the habitability of extraterrestrial environments must not be limited by gravity.