Nano particles for healthy tissue

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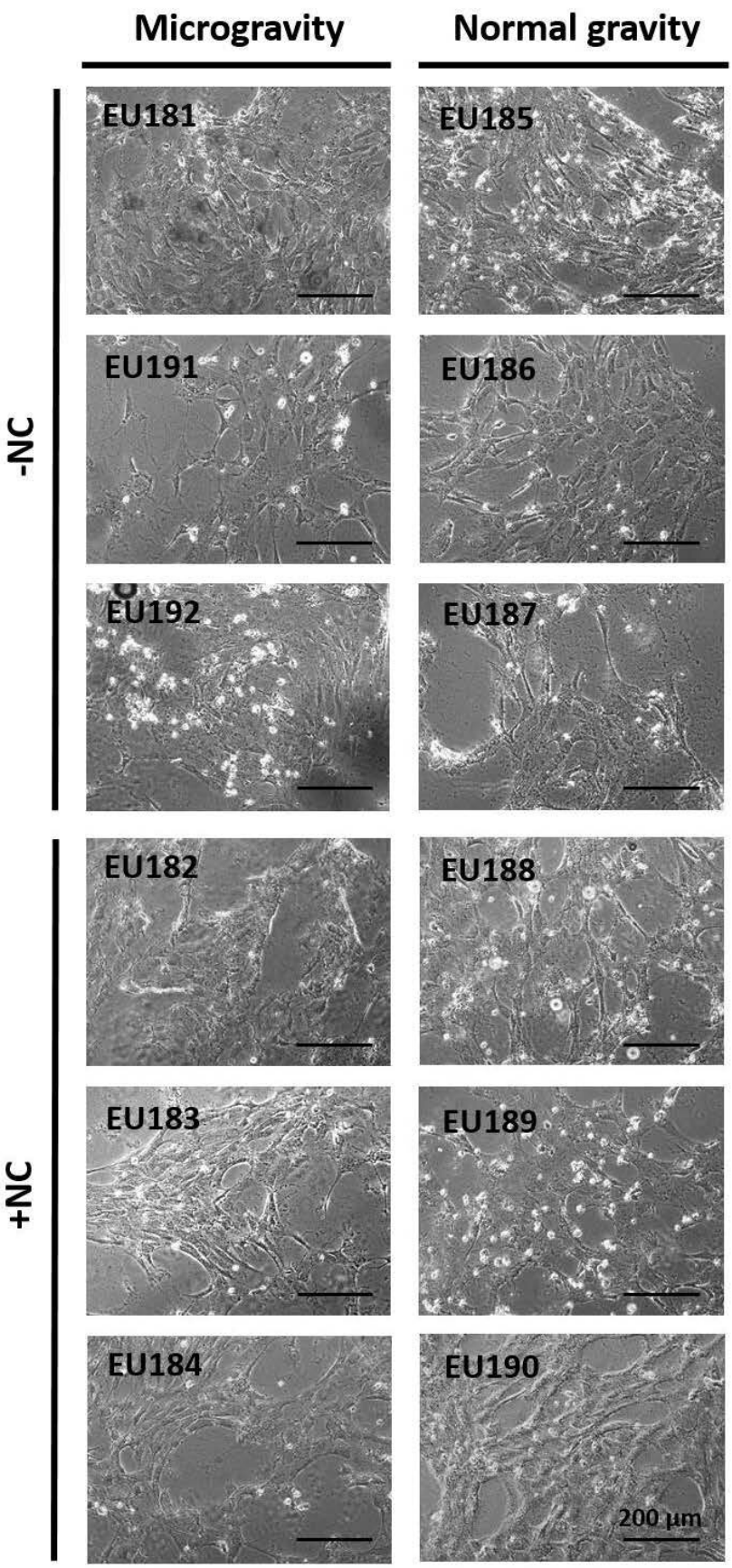
Microgravity
Normal gravity
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200 µm

Phase contrast optical microscopy images of Nano Antioxidants samples after at normal gravity and weightlessness. Credit: European Space Agency

"Eat your vitamins" might be replaced with "ingest your ceramic nano-particles" in the future as space research is giving more weight to the idea that nanoscopic particles could help protect cells from common causes of damage.

Oxidative stress occurs in our bodies when cells lose the natural balance of electrons in the molecules that we are made of. This is a common and constant occurrence that is part of our metabolism but also plays a role in the aging process and several pathological conditions, such as heart failure, muscle atrophy and Parkinson's disease.

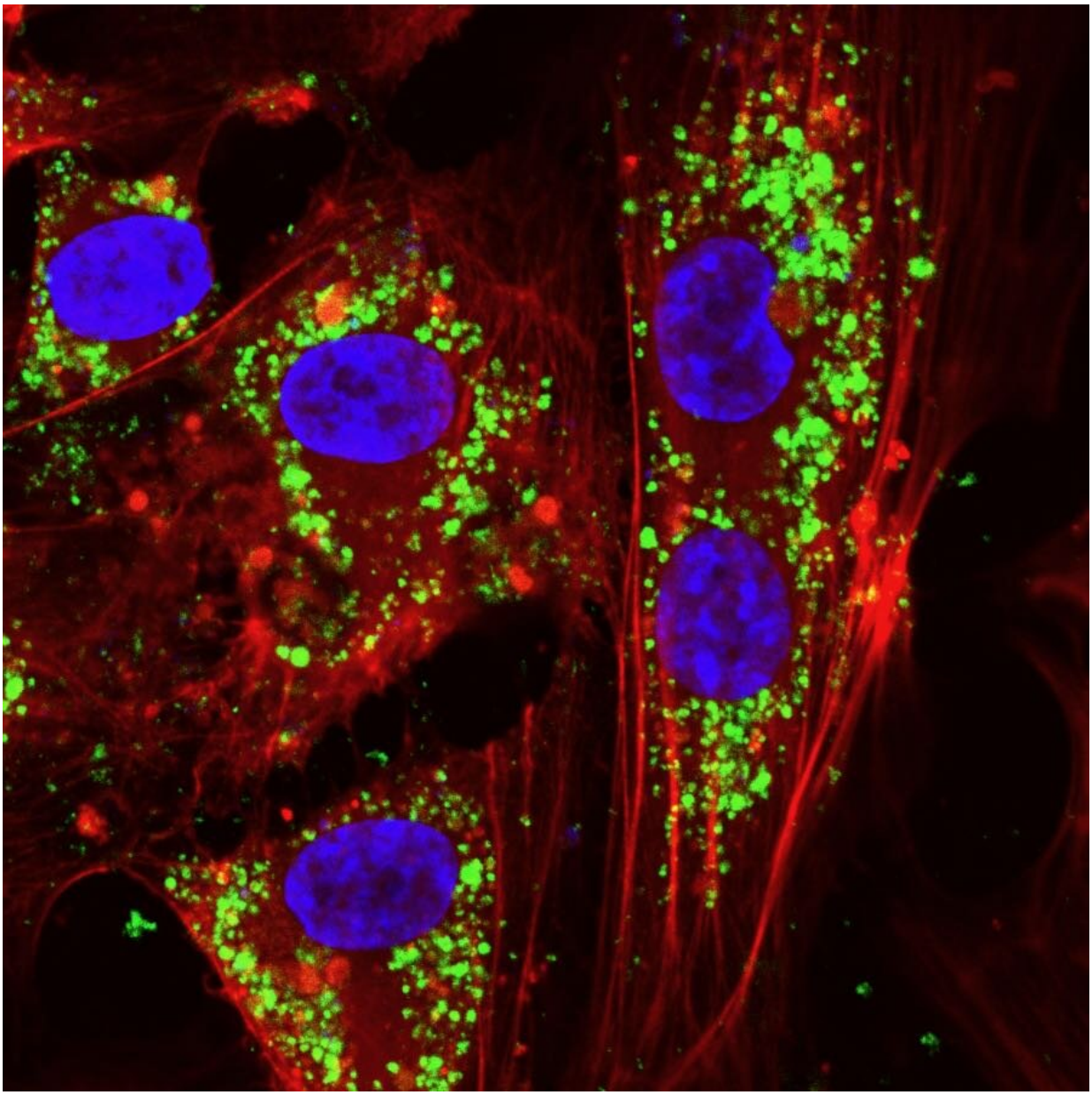
The best advice for keeping your body in balance and avoiding oxidative stress is still to have a healthy diet and eat enough vitamins, but nanoparticles are showing promising results in keeping cells in shape.

When in space, astronauts have been shown to suffer from more oxidative stress due to the extra radiation they receive and as a by-product of floating in weightlessness, so researchers in Italy were keen to see if nanoparticles would have the same protective effect on cells on the International Space Station as on Earth.

They prepared muscle cells that flew to the International Space Station and were cultured in ESA's Kubik incubator before being frozen for storage.

"A year ago our frozen samples splashed down in the Pacific Ocean on

the Dragon spacecraft, and after comparing the samples we saw a marked effect in the cells treated with ceramic nanoparticles," says Gianni Ciofani from the Istituto Italiano di Tecnologia in Italy. "The effect we observed seems to imply that nanoparticles work better and longer than traditional antioxidants such as vitamins."



Down to the microscopic level, nanoparticles show promising properties. A team

of experts in Italy has spent years tailoring tiny inorganic materials and analysing their behaviour. Some have magnetic properties, others are able to give electrical stimuli. In this picture, a peculiar type of nanoparticle is mimicking the biological activity of enzymes in living organisms. Credit: Gianni Ciofani

"The experiment setup resulted in excellent samples to analyze using state-of-the art RNA sequencing," continues Gianni. "Conducting space research is nothing like traditional lab work, as we have less samples, we cannot do the work ourselves and we have to work around deadlines such as launch days, landing and storing the samples, it is challenging but thrilling research!" The team even found ways to improve and simplify the process for future studies.

Baby astronauts hypothesis

The research adds weight to the baby-astronaut hypothesis of weightlessness. The changes in muscle tissue observed are similar to how babies' tissues develop in the womb.

"Some researchers see similarities to how human bodies adapt to living in space with pre-natal conditions: there are similarities with floating in a warm environment with different oxygen intake and we consider it a possibility of return to the state," says Giada Genchi, also of the Istituto Italiano di Tecnologia's Smart Bio-Interfaces department.

The team's high-quality muscle tissue samples are being further analyzed and compared to samples from similar experiments that flew earlier. There is still much more to learn, such as what is the best way to administer nano-ceramics and how long do their protective effects last as well as possible unwanted side effects.

More information: Giada Graziana Genchi et al. Modulation of gene expression in rat muscle cells following treatment with nanoceria in different gravity regimes, *Nanomedicine* (2018). DOI: 10.2217/nnm-2018-0316

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