New Scientist

WEEKLY 26 August 2023

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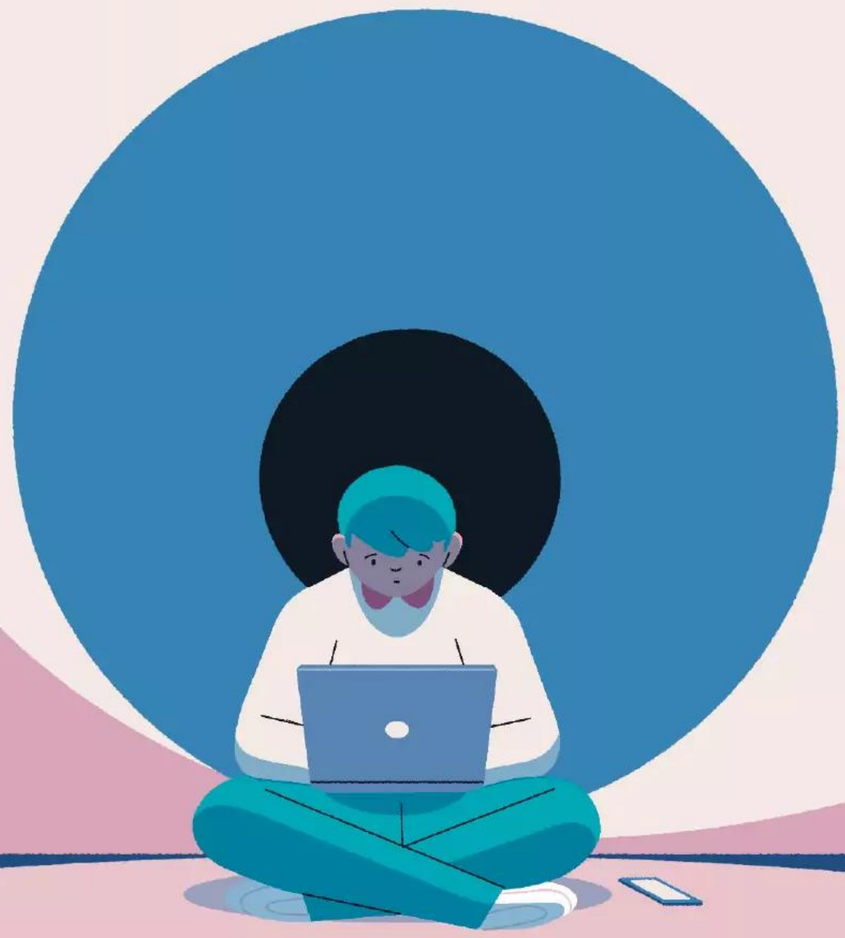

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Food science

Gene-edited yeast makes rice wine taste like bananas

Karmela Padavic-Callaghan

BY EDITING yeast genomes, we can make bread that rises higher, potato crisps that contain fewer potential carcinogens and rice wine that tastes like bananas.

The fermentation process caused by yeasts has been used in baking and brewing for millennia and there are yeast strains that work better in specific applications.

Yong-Su Jin at the University of Illinois Urbana-Champaign and his colleagues have now used CRISPR gene editing to modify the *Saccharomyces cerevisiae* yeast, which is commonly used in the food industry. The team edited the yeast's genome so that it turned more sugar into carbon dioxide rather than alcohol, Jin told attendees of the American Chemical Society meeting in San Francisco on 14 August. Bread made with this gene-edited yeast had an 18 per cent larger volume than bread made with conventional yeast.

Jin and his colleagues also altered a gene in another yeast strain used to make crisps from fermented potato dough. Crisps made with this yeast had up to 78 per times lower levels of a potentially carcinogenic chemical called acrylamide.

SHUTTERSTOCK/ART-UR

Illustration of yeast, which can be genetically modified to transform foods

The team also manipulated yeast to alter the flavour of a Korean rice wine called makgeolli. Engineering yeast to produce more amino acids during fermentation led to makgeolli with a stronger savoury, umami flavour. And another yeast engineered to make more molecules called esters produced a wine that had a banana-like flavour. ▮

Space

Aliens on low-oxygen worlds may never discover fire

Alex Wilkins

YURIY MAZUR/SHUTTERSTOCK

Some planets could host complex life, but nothing will burn there

LIFE on a planet with low levels of oxygen might never be able to develop technology because combustion would be impossible. This bottleneck for creating advanced civilisations may also help explain why we have yet to observe life elsewhere in the universe.

The development of more sophisticated technology on Earth hinged on fire, also known as combustion, a chemical reaction that uses oxygen to generate large amounts of heat.

This is crucial for extracting metals from ore, say, which almost all advanced human technology relies on. Lab experiments have found that combustion can't fully occur in atmospheres with oxygen levels below about 18 per cent.

Now, Adam Frank at the University of Rochester in New York and Amedeo Balbi at the University of Rome in Italy suggest that this might be a bottleneck for whether alien species can develop technology.

"You may have enough oxygen in the atmosphere of an exoplanet to have complex multicellular life, but you may not have enough oxygen to start combustion," says Balbi.

We don't know the exact balance of geological and biological processes that lead to an atmosphere with this level of oxygen because we only have Earth as an example. "Oxygen in the atmosphere is also produced by photosynthetic activity, so that's why it gets complicated, because it's not just geology, it's also biology," says Balbi.

18%

Amount of oxygen needed in atmosphere for full combustion

There is also an upper limit to a useful amount of oxygen. At about 30 per cent and above, depending on the air's moisture content, the chance of widespread fire killing life forms would become high as combustion becomes so easy, says Frank. Astronomers are looking for any type of life in the universe, but the search for advanced aliens might be guided by seeking planets with atmospheres that are between 18.5 and 21 per cent oxygen, the optimum for useful combustion (arXiv, doi.org/kptb).

For now, though, detecting atmospheric oxygen is beyond the abilities of our telescopes for almost all known exoplanets. "We're just getting started looking for the atmospheres of terrestrial planets," says Frank. "This is the exciting thing – we're at the frontier now."

Combustion as a bottleneck for technology makes sense if life emerges how it did on Earth, but might not apply if life elsewhere evolved differently, says Ingo Waldmann at Imperial College London. "That was the evolutionary path we took, but I'm not necessarily sure whether that can be generalised across the universe."

For instance, it is possible that an alien species in a low-oxygen environment could harness heat from geothermal activity, such as volcanoes, to do their smelting, says Waldmann.

Such alternatives aren't portable like wood and fossil fuels, says Balbi, which may mean any civilisations would need to stay close to the heat.

If the oxygen bottleneck is a limiting factor, say Frank and Balbi, it might help solve the Fermi paradox, which questions why there are no signs of advanced intelligent alien life if it is apparently likely, given the size of the universe.

"The Fermi paradox is telling us something about the nature of life in the universe that we don't understand," says Ian Crawford at Birkbeck, University of London. "In that context, all potential solutions to the Fermi Paradox are of interest." ▮