Bread mould avoids infection by mutating its own DNA

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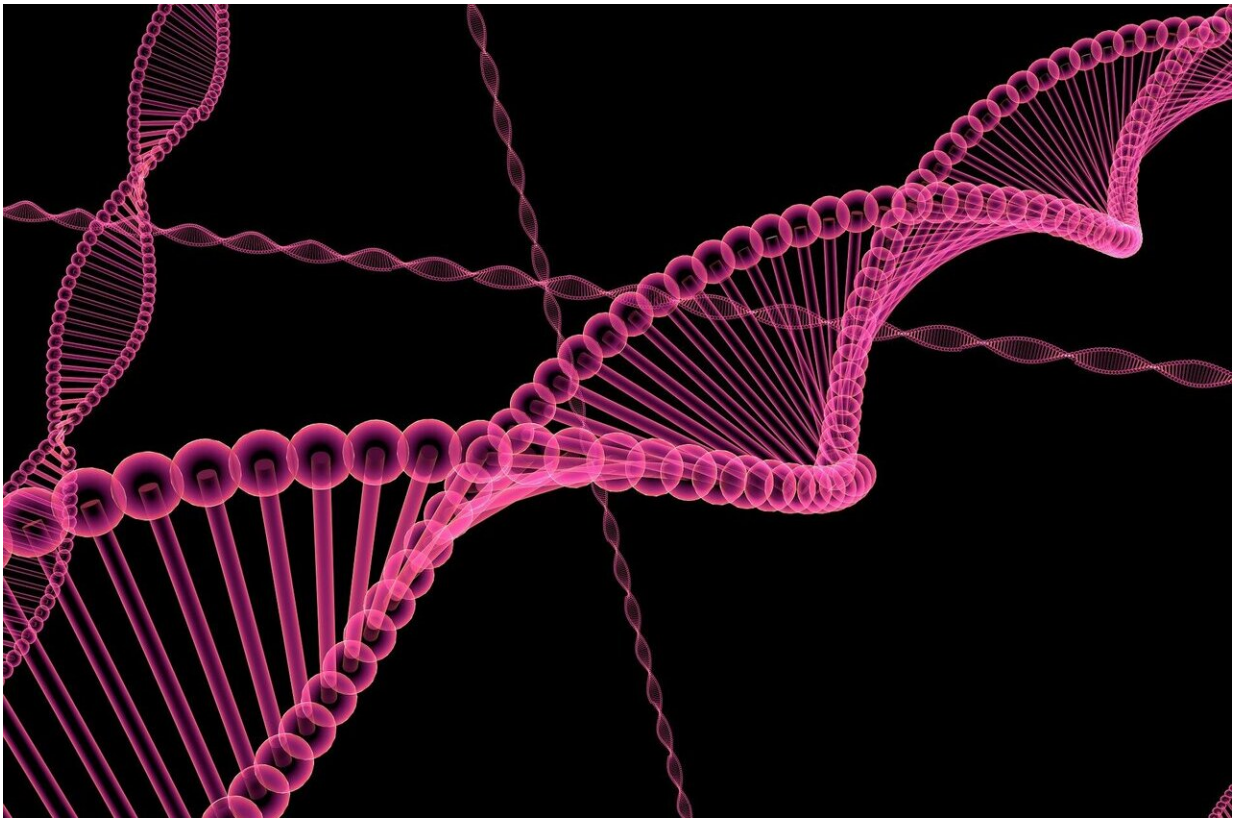

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Whilst most organisms try to stop their DNA from mutating, scientists from the UK and China have discovered that a common fungus found on bread actively mutates its own DNA as a way of fighting virus-like

infections.

All organisms mutate all of the time. You were born with between ten and a hundred new mutations, for example. Many do little harm but, if they hit one of your genes, mutations are much more likely to be harmful than beneficial. If harmful enough they contribute to genetic diseases.

Whilst mutations can enable species to adapt, most mutations are harmful, and so evolutionary biologists have postulated that natural selection will always act to reduce the mutation rate.

While prior data has supported this view, recent work by Professor Laurence Hurst of the Milner Centre for Evolution at the University of Bath (UK) and Sihai Yang, Long Wang and colleagues at Nanjing University (China) have found that Neurospora crassa, a type of bread mould, is a remarkable exception to the rule.

Professor Hurst, Director of the Milner Centre for Evolution at the University of Bath, said: "Many organisms have a problem with transposable elements, otherwise called jumping genes.

"These are virus-like bits of DNA that insert themselves into their host's DNA, copy themselves and keep on inserting—hence the name jumping genes.

"Organisms have found different ways of combatting this nuisance, many of which try to prevent the transposable elements from expressing their own genes. Neurospora has evolved a different solution: it hits them exceptionally hard with mutations to rapidly degrade them."

The study, published in *Genome Biology*, found that Neurospora distinguishes jumping genes from its own DNA by detecting two or

more copies of the same bit of DNA. The fungus then attacks the jumping genes by mutating them in a process called Repeat-Induced Point mutation (RIP).

To understand how RIP affects the fungus's own DNA, the team sequenced the whole genome from both parents and offspring for many strains of Neurospora to see how many mutations could be found and where they were in the DNA.

Overall, they found that each base pair in the Neurospora genome has about a one in a million chance of mutating every generation; over a hundred times higher than any non-viral life on the planet.

Professor Hurst said: "This was a real surprise to us—any organism that hits its own genes with that many mutations is likely one that will not persist for very long. It would be like opening up the back of a watch, stabbing at all the cog wheels that look a bit similar and expecting the watch to still function!

"Our findings show that Neurospora has not only a high mutation rate but is also a massive outlier. It appears to use RIP to destroy transposable elements but at a cost, with considerable collateral damage.

"This organism thus goes against the standard theory for mutation rate evolution which proposes that selection should always act to reduce the mutational burden.

"It is the exception that proves the rule."

More information: Long Wang et al, Repeat-induced point mutation in Neurospora crassa causes the highest known mutation rate and mutational burden of any cellular life, *Genome Biology* (2020). DOI: 10.1186/s13059-020-02060-w

Provided by University of Bath

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