New-to-nature yeast chromosome could be game changer for industry

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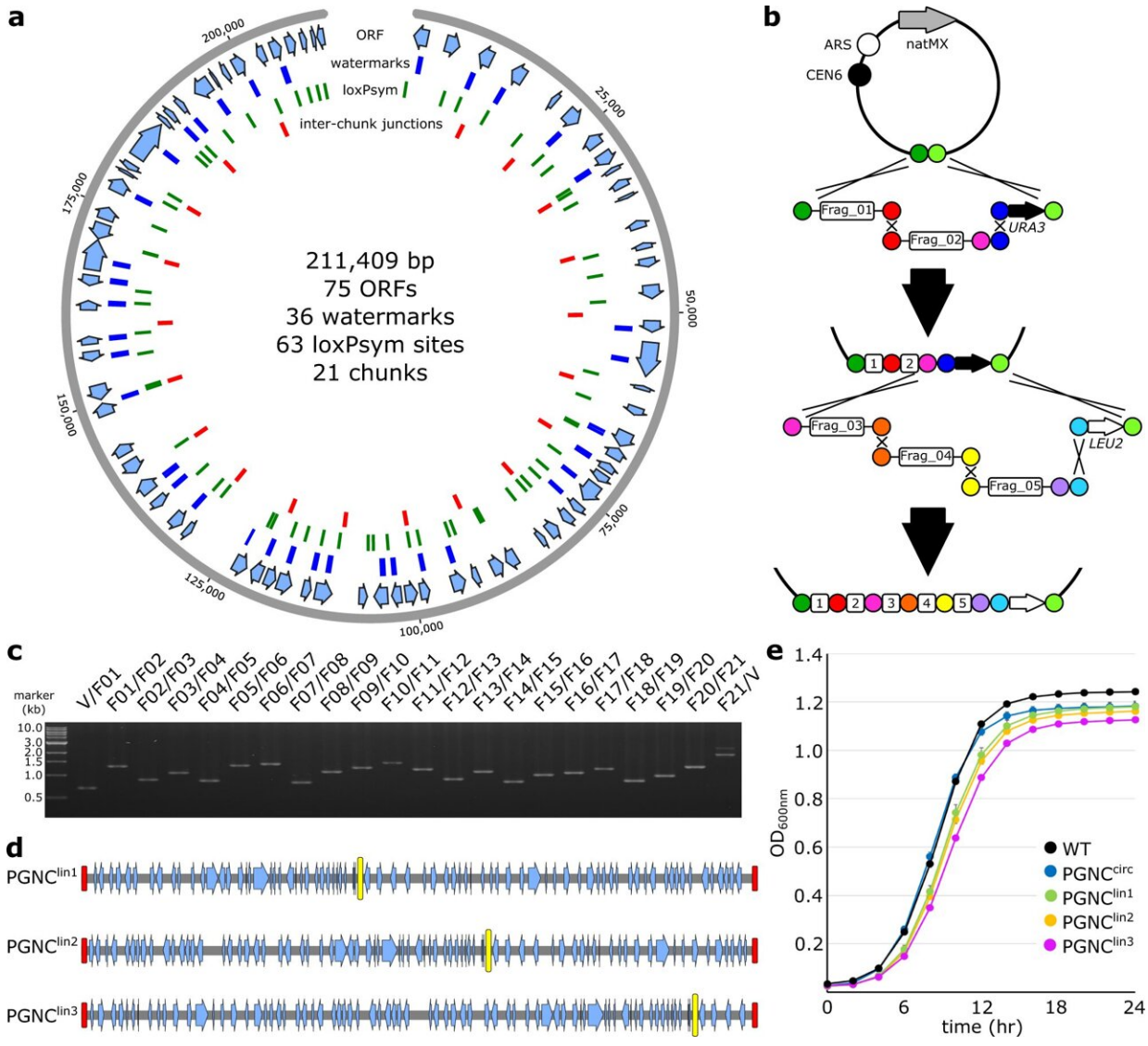

Construction of a yeast pan-genome neo-chromosome. a Schematic representation of the circular PGNC construct (PGNCcirc). b Iterative assembly

of the PGNC via homologous recombination and using alternating selectable markers. c Confirmation of the PGNC assembly using PCR reactions that span each inter-chunk junction. Identical PCR results were obtained across at least two repetitions and during sub-assembly d Production of three linear PGNC variants using the telomerator (PGNClin1, PGNClin2 and PGNClin3). Yellow boxes define the position of the centromeric-plasmid backbone. Red boxes denote positions of synthetic telomeric repeat sequences added by the telomerator process. e Microplate growth kinetics of the four PGNC variants (PGNCcirc, PGNClin1, PGNClin2 and PGNClin3) compared to the BY4742 (WT) strain. Data are presented as mean values +/− SD, based upon values obtained from three independent biological replicates. Credit: *Nature Communications* (2022). DOI: 10.1038/s41467-022-31305-4

A completely new-to-nature yeast chromosome has been developed, paving the way for engineered yeast to be applied to an array of industrial applications.

Scientists from the ARC Center of Excellence in Synthetic Biology, Macquarie University and the Australian Wine Research Institute (AWRI) have made a major breakthrough in yeast genome engineering, outlined in a recent issue of the journal *Nature Communications*.

"It's a proof of concept that we can build entire new chromosomes for specific industrial purposes," says AWRI Research Manager Dr. Anthony Borneman, lead author of the study. "Unique genomic sequences from a range of yeast strains—including those used in wine, sake and biofuel production—were assembled into a completely new chromosome in the laboratory strain. This additional genetic material imparted new characteristics, such as allowing the laboratory strain to ferment sugars it normally can't use, widening the feedstocks available for industrial purposes."

Saccharomyces cerevisiae, the yeast strain used in this research, is an industrial workhorse. It has been used in brewing, distilling, winemaking and baking for thousands of years. More recently, it has been important for producing ethanol for E10 petrol and for a wide variety of industrial biochemicals.

"This is a groundbreaking new study that opens up the possibility of designing new chromosomes. For instance, making yeast producing oils or making it better at producing other industrially useful compounds," says co-author, Distinguished Professor Ian Paulsen, Center Director of the Australian Center of Excellence in Synthetic Biology at Macquarie University.

This body of work is an extension of a global engineered yeast project, Sc2.0, which is attempting to synthesize the entire genome of the yeast Saccharomyces cerevisiae. The project aims to help researchers understand how a yeast genome is organized and how genomes might be improved to create more robust organisms. It also provides a foundation for future specific purposes, such as creating new medications or biofuels. Macquarie University, the ARC Center of Excellence in Synthetic Biology and the AWRI are partners in the Sc2.0 collaboration.

The overall goal of this work was to address the lack of genetic variation in the Sc2.0 strain that could limit future industrial application.

More information: Dariusz R. Kutyna et al, Construction of a synthetic Saccharomyces cerevisiae pan-genome neo-chromosome, *Nature Communications* (2022). DOI: 10.1038/s41467-022-31305-4

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