PRESS RELEASE

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Bioengineered yeast microbes as targeted drug delivery systems

Singapore, 16 December 2024 – Researchers from the Yong Loo Lin School of Medicine (NUS Medicine) have developed a groundbreaking way to engineer yeast (*Saccharomyces cerevisiae*) to create microbial communities that can perform complex tasks and self-regulate their composition in response to external signals.

By reprogramming how yeast cells switch types, the team enabled these micro-organisms to form cooperative groups that can perform complex tasks and self-regulate their composition based on external signals. These engineered yeast cells have the potential to help transform personalised healthcare by delivering tailored treatments that adapt to a patient's condition in real time. This approach could lead to more effective therapies with fewer side effects, paving the way for significant advancements in medical treatment while also significantly enhancing the efficiency, sustainability, and scalability of biotech applications.

Traditional microbial biotechnology has focused on single-cell organisms, limiting their ability to handle complex tasks. The NUS Medicine team re-engineered yeast cells to mimic natural ecosystems, enabling them to divide into two specialised types that work together synergistically. These synthetic microbial communities can autonomously adjust their population composition in response to environmental stimuli, making them ideal for tasks undertaken in precision medicine or therapeutic applications in the human gut.

The yeast cells act as microscopic factories, capable of producing therapeutic compounds or breaking down complex substances into simpler, usable forms. By responding dynamically to disease markers—small molecules that accumulate in the body during illness—the yeast adjusts its structure and activity to deliver just the right amount of therapeutic compounds. This smart programming ensures the yeast only produces what is needed, reducing waste and increasing precision.

"This artificially engineered smart yeast could revolutionise how microbial communities are controlled for health purposes. As the communities can independently split into different types of cells that work together, it allows them to divide tasks and share the workload, alleviating the burden it places on the cells," said research team leader A/Prof Matthew Chang, Director of the Synthetic Biology Translational Research Programme at NUS Medicine and NUS Synthetic Biology for Clinical and Technological Innovation.

"For example, in the gut these yeast cells can adjust their balance and activity based on health signals, like disease markers, without needing any manual adjustments. This approach reduces stress on the cells and allows for precise production of helpful compounds, making it

useful for flexible, targeted therapies in treatments and thus potentially reducing any side effects and improving treatment efficacy."

After their paper was published in the journal, *Nature Communications*, the research team is now fine-tuning their results, with a focus on optimising how the yeast communities adapt their actions in response to various disease markers. They will then explore the efficacy of using this autonomous system to produce health-conferring molecules for treatment of specific diseases.

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About National University of Singapore (NUS)

The National University of Singapore (NUS) is Singapore's flagship university, which offers a global approach to education, research, and entrepreneurship, with a focus on Asian perspectives and expertise. We have 16 colleges, faculties, and schools across three campuses in Singapore, with more than 40,000 students from 100 countries enriching our vibrant and diverse campus community. We have also established more than 20 NUS Overseas Colleges entrepreneurial hubs around the world.

Our multidisciplinary and real-world approach to education, research and entrepreneurship enables us to work closely with industry, governments, and academia to address crucial and complex issues relevant to Asia and the world. Researchers in our faculties, research centres of excellence, corporate labs and more than 30 university-level research institutes focus on themes that include energy; environmental and urban sustainability; treatment and prevention of diseases; active ageing; advanced materials; risk management and resilience of financial systems; Asian studies; and Smart Nation capabilities such as artificial intelligence, data science, operations research, and cybersecurity.

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About the NUS Yong Loo Lin School of Medicine (NUS Medicine)

The NUS Yong Loo Lin School of Medicine is Singapore's first and largest medical school. Our enduring mission centres on nurturing highly competent, values-driven, and inspired healthcare professionals to transform the practice of medicine and improve health around the world.

Through a dynamic and future-oriented five-year curriculum that is inter-disciplinary and inter-professional in nature, our students undergo a holistic learning experience that exposes them to multiple facets of healthcare and prepares them to become visionary leaders and compassionate doctors and nurses of tomorrow. Since the School's founding in 1905, more than 12,000 graduates have passed through our doors.

In our pursuit of health for all, our strategic research programmes focus on innovative, cutting-edge biomedical research with collaborators around the world to deliver high impact solutions to benefit human lives.

The School is the oldest institution of higher learning in the National University of Singapore and a founding institutional member of the National University Health System. It is one of the leading medical schools in Asia and ranks among the best in the world (Times Higher Education World University Rankings 2024 by subject and the Quacquarelli Symonds (QS) World University Rankings by subject 2023).

For more information about NUS Medicine, please visit https://medicine.nus.edu.sg/