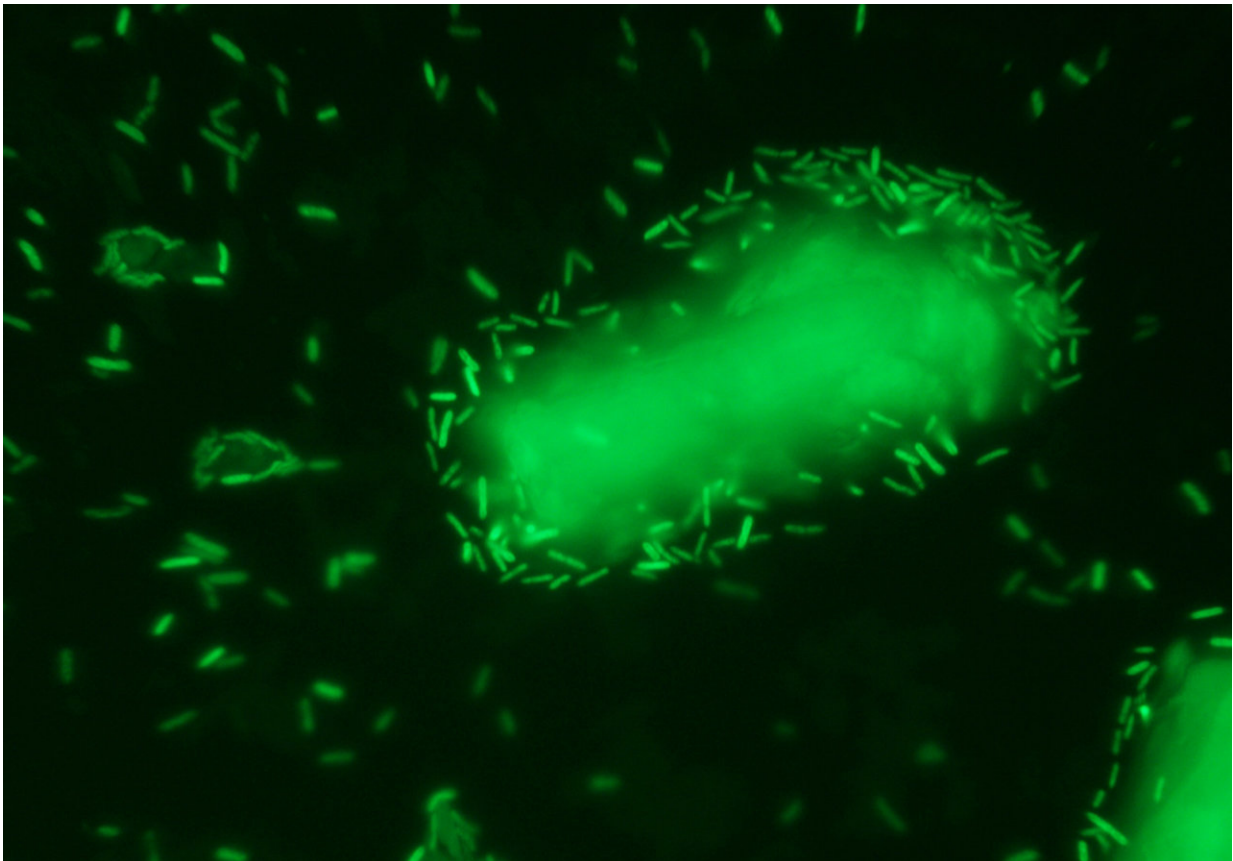


Engineers pioneer greener and cheaper technique for biofuel production

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The adhesion of *Thermoanaerobacterium thermosaccharolyticum* TG57 cells to cellulose particles -- a fundamental stress adaption for such microorganisms -- facilitates the efficient utilisation of cellulose for biobutanol production. The unique genome of the TG57 strain enables the bacterium to produce enzymes that enhances the synthesis of biobutanol. Credit: National University of Singapore

A team of engineers from the National University of Singapore (NUS) recently discovered that a naturally occurring bacterium, *Thermoanaerobacterium thermosaccharolyticum* TG57, isolated from waste generated after harvesting mushrooms, is capable of directly converting cellulose, a plant-based material, to biobutanol.

A research team led by Associate Professor He Jianzhong from the Department of Civil and Environmental Engineering at NUS Faculty of Engineering first discovered the novel TG57 strain in 2015. They went on to culture the strain to examine its properties.

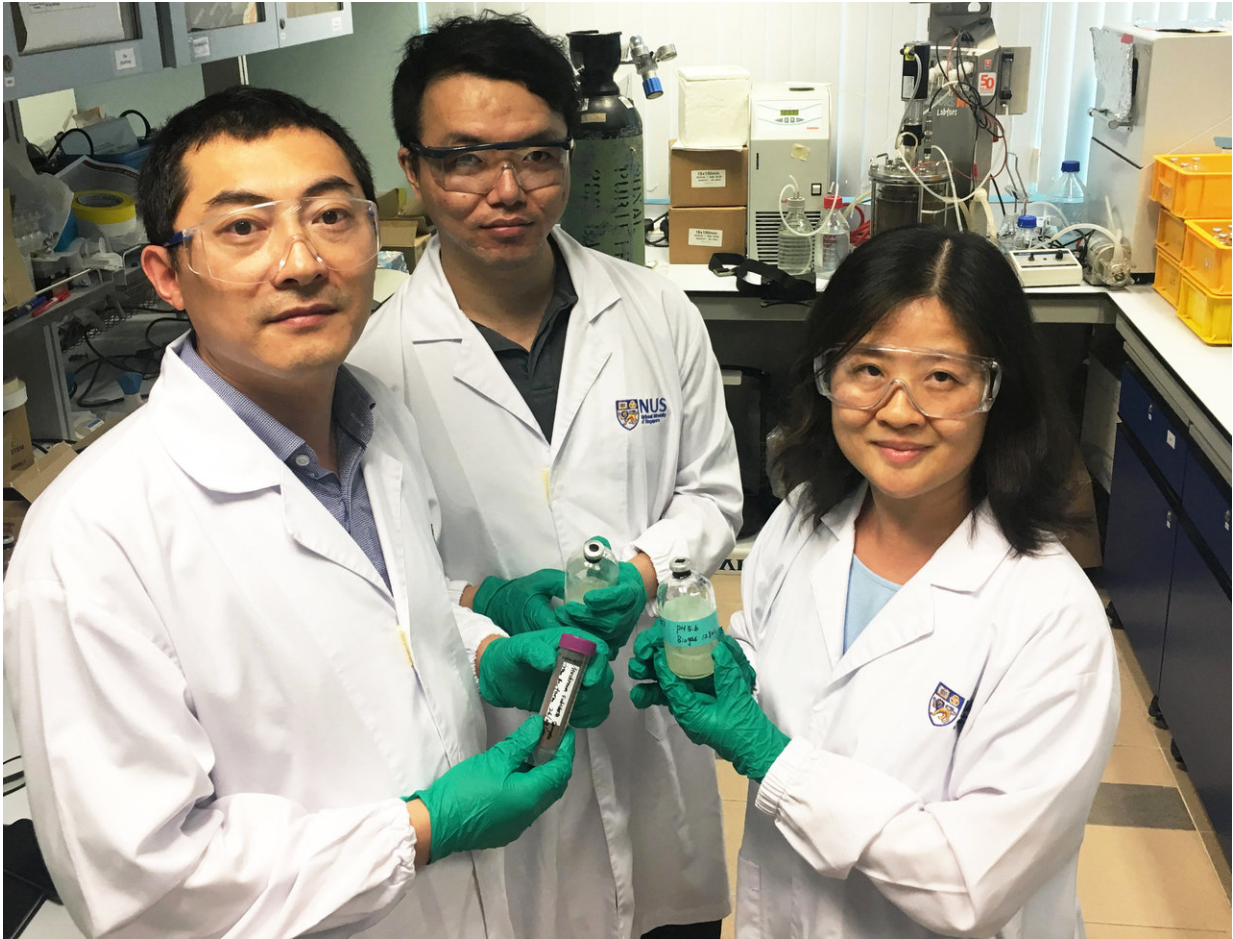
Assoc Prof He explained, "The production of biofuels using non-food feedstocks can improve sustainability and reduce costs greatly. In our study, we demonstrated a novel method of directly converting cellulose to biobutanol using the novel TG57 strain. This is a major breakthrough in metabolic engineering and exhibits a foundational milestone in sustainable and cost-effective production of [renewable biofuels](#) and chemicals."

Traditional biofuels are produced from food crops. This approach is highly costly and competes with food production in the use of land, water, energy and other environmental resources.

Biofuels produced from unprocessed cellulosic materials such as plant biomass, as well as agriculture, horticultural and organic waste, are expected to meet growing energy demands without increasing [greenhouse gas emissions](#) resulting from the burning of fossil fuels. These cellulosic materials are in great abundance, environmentally friendly, and economically sustainable.

Among various types of biofuels, biobutanol offers a great promise as petrol substitute because of its high energy density and superior properties. It can directly replace gasoline in car engines without any

modification. However, commercial production of biobutanol has been hampered by the lack of potent microbes capable of converting cellulosic biomass into biofuels. The current technique is costly and also requires complicated chemical pre-treatment.



A research team led by Associate Professor He Jianzhong (right) from the Department of Civil and Environmental Engineering at NUS Faculty of Engineering has found that a natural bacterium isolated from mushroom crop residue can directly convert cellulose to biobutanol, a biofuel. Credit: National University of Singapore

Green biofuel production

The novel technique developed by the NUS team could potentially be a game-changing technology for cost effective and sustainable [biofuel](#) production. Spent mushroom compost, typically composed of wheat straw and saw dust, is the residual compost waste generated by mushroom farming. The microorganisms in the waste are left to evolve naturally for more than two years to obtain the unique TG57 strain.

The fermentation process is simple, and no complicated pre-treatment or genetic modification of the microorganisms is required. When cellulose is added, the bacterium simply digests it to produce butanol as the main product.

Moving forward, the research team will continue to optimise the performance of the TG57 strain, and further engineer it to enhance biobutanol ratio and yield using [molecular genetic tools](#).

More information: Tinggang Li et al, Unique genetic cassettes in a Thermoanaerobacterium contribute to simultaneous conversion of cellulose and monosugars into butanol, *Science Advances* (2018). [DOI: 10.1126/sciadv.1701475](https://doi.org/10.1126/sciadv.1701475)

Provided by National University of Singapore

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