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NTU scientists find way to produce microalgae oil in bulk, may replace palm oil in food products

Powdered microalgae (left) and a vial of oil produced from the microalgae. PHOTO: NTU

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SINGAPORE - Scientists from Nanyang Technological University (NTU) have found a way to sustainably produce oil from microalgae that could replace the use of palm oil in food production.

Palm oil is the world's most popular vegetable oil and is present in around half of all consumer products, with around 77 million tonnes produced for the global market in 2018. This is set to grow to 107.6 million tonnes by 2024.

However, the rapid expansion of oil palm plantations has led to massive deforestation in several countries.

For example, in Indonesia, the world's biggest producer of palm oil, large swathes of carbon-rich rainforests and peatlands are destroyed to make way for palm oil plantations, releasing huge amounts of greenhouse gases into the atmosphere and destroying the habitats of endangered native wildlife.

Aside from being a greener alternative to palm oil, the microalgae-derived oil is also more nutritious than palm oil, Professor William Chen, director of NTU's Food Science and Technology Programme, told reporters on Monday (March 21).

For one, the oil derived from algae contains more polyunsaturated fatty acids compared with palm oil - which can help reduce cholesterol levels in the blood and lower a person's risk of heart disease and stroke, said Prof Chen, who led the project.

The algae-produced oil, developed in collaboration with scientists from the University of Malaya in Malaysia, also contains fewer saturated fatty acids, which have been linked to stroke and related conditions.

To produce the oil, pyruvic acid, an organic acid that occurs in all living cells, is added to a culture medium solution with the algae Chromochloris zofingiensis and exposed to ultraviolet (UV) light to stimulate photosynthesis.

After 14 days, the microalgae is washed, dried and treated with methanol to break down the bonds between the oil and the algae protein, so that the oil can be extracted.

The team has also developed green processing technology to efficiently separate the lipids, carbohydrates and proteins from the microalgae to ensure that the entire process has little to no waste, said Prof Chen.

The extracted lipids would be the plant-based oil while the proteins and carbohydrates could be extracted for other uses.

To produce enough plant-based oil to manufacture a store-bought chocolate bar that weighs 100g, 160g of algae would be required.

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Prof Chen noted that, while microalgae oil currently exists in the market, there are no options for food applications. On top of this, a check online found that microalgae oil costs around US$2.40 (S$3.30) per litre, compared with US$0.60 to US$0.80 per litre for vegetable oils. This is a result of factors such as high downstream processing costs and low biomass yield - which are areas the NTU team has sought to address.

When scaling up the production of microalgae, the scientists are looking to replace UV light with natural sunlight so the plants can remove carbon dioxide from the atmosphere through photosynthesis, converting it into biomass and oxygen at relatively fast rates. Biomass refers to the organic materials and nutrients that are stored by the plant.

Director of NTU's Food Science and Technology Programme William Chen and research fellow Ng Kuan Rei. PHOTO: NTU

Prof Chen added that microalgae can also be grown in a vertical farm, which requires less farmland.

The scientists have also developed a method to produce pyruvic acid, by fermenting fruit peels. The culture medium for the microalgae, on the other hand, can be made by fermenting soya bean residues.

This can help cut down on food waste and reduce production costs, while ensuring the microalgae oil remains price-competitive, noted Prof Chen.

He added that the acid made from fermented fruit peels is also able to enhance the yield of microalgae biomass by three times compared with generic pyruvic acid.

The team is now working on optimising their extraction methods to improve yield and quantity, and they have received interest from several food and beverage partners to scale up their operations within two years.

Said Prof Chen: "We are also exploring the possibility of adding the oil to plant-based meats to improve their texture and nutritional properties. The oil can also be used for pharmaceuticals and cosmetics, such as topical creams and lipsticks."

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