

Soya • Making good use of food waste | B9



(From foreground) Dr Jasmin Lim, Dr Susmita Bandyopadhyay, Dr Chiradip Chatterjee and Mr Yilong Ng from Republic Polytechnic have developed a cheaper and nutritious food for abalone, made from a soya and tofu by-product, called okara, or soya pulp. Compared with juvenile abalone fed with commercial feed, the abalone fed with soya pulp weighed more and had shells with a more vibrant colour. ST PHOTO: KHALID BABA



Juvenile abalone (right) from Republic Polytechnic's Aquaria lab were fed with the okara-based feed (above). They weighed about 25 per cent heavier than those on commercial feed. PHOTOS: REPUBLIC POLYTECHNIC



Using soya waste in new ways for food production

Two separate projects are under way to use okara for cell-cultured meat and abalone

Shabana Begum

The white, mushy and unpleasant-smelling waste that remains after making tofu and soya milk may revolutionise the novel food space and aquaculture.

Researchers from Nanyang Technological University (NTU) and Republic Polytechnic (RP) are working on separate projects to maximise the potential of the by-product called okara, or soya pulp, which is high in fibre and protein.

From fermenting the okara, NTU scientists have been able to derive a liquid extract that contains plant growth hormones that can spur animal cells to grow and multiply into tissue, to form cell-cultured meat.

Cell-cultured protein allows meat products to be manufactured without slaughtering animals.

Currently, when producing cell-cultured meat, the chicken or cow cells are usually immersed in a pink nutrient broth containing a bit of serum that helps the cells grow and multiply.

But the serum comes from the blood of unborn calves of pregnant cows that are later killed.

The serum can cost up to \$2,000 per litre. Its use in cultivated meat that aims to be cruelty-free may also seem ironic, said Professor William Chen, director of NTU's food science and technology programme, who is leading the okara research. "The process of harvesting the bovine serum causes pain and distress to the foetal calves."

The team used a week-long process that involved fermenting the okara with micro-organisms, heating and adding water, to extract a yellow liquid containing the hormones.

About 200g of okara can produce 300ml to 400ml of the liquid, said the NTU programme's PhD student Teng Ting Shien. The okara fermentation research is part of his food science and technology thesis.

In the lab, Mr Teng found that the cultured mice muscle cells multiplied 70 per cent as much as another batch of cells that were treated with the bovine serum.

Prof Chen said: "To find a bovine serum replacement, other labs have come up with growth media that are generally expensive and non food-grade. But okara is available in large quantities from the food industry, is edible and safe, and is low cost."

The team's fermented okara extract can cost \$2 per litre. The main cost driver for this novel food is the growth serum.

The research team is now reaching out to local cultivated meat start-ups to test the liquid extract. Singapore became the first country to approve the sale of a cell-cultured product last December.

Over at RP, researchers have concocted a cheaper feed for abalone, using okara as the main ingredient. Juvenile abalone fed on the okara-based food weighed about 25 per cent heavier than those sustained on commercial feed, and the abalone shells were a more vibrant purple.

Dr Chiradip Chatterjee, senior lecturer at the polytechnic's School of Applied Science, and his team developed the food pellets using a technology that included pre-treating the okara under high temperature and mixing it with key nutrients. "Abalone fed by commercial feed is less striking in their colour, more greyish... Their vibrant shell colour can increase their selling potential."

Although soya pulp is used as food for livestock, the team believes this is the first abalone feed that uses okara.

Dr Chatterjee said the protein-rich pellets cost up to 30 per cent less than commercial feed, with okara replacing fishmeal, the costliest ingredient in fish feed.

In the market, feed costs between \$1.80 and \$2 per kg. Fishmeal is usually made from wild-caught small fishes, and their numbers are depleting, he said.

"There is potential for our okara-based feed to be used with commercially available feed to reduce the cost of aquaculture."

The research team sourced okara from a local soya beverage maker. A 2017 report by The Straits Times said 30,000kg of okara is discarded in Singapore each day.

The RP team is reaching out to local and South-east Asian abalone farms to trial the okara feed in the industry.

Although the high amount of fibre in okara is most suitable for herbivores like abalone, the pellets can be customised for omnivorous and carnivorous marine species such as shrimp, seabass and tuna, with more research.

"For the carnivorous species, the indigestible fibres in okara should be reduced before developing the feed," said Dr Chatterjee.

nshab@sph.com.sg



Soya pulp, also known as okara, is a by-product derived after tofu and soya milk is made. The NTU team used a week-long process that involved fermenting the okara with micro-organisms, heating and adding water, to extract a yellow liquid containing the hormones. PHOTOS: NANYANG TECHNOLOGICAL UNIVERSITY



A bottle of the fermented okara extract that contains plant growth hormones, which help the cell grow and multiply to form tissue.



Mice muscle cells multiplying in a pink nutrient broth that includes the fermented okara extract.



(From far left) Professor William Chen, director of the food science and technology programme at Nanyang Technological University (NTU); Dr Jaslyn Lee, senior research fellow; Mr Teng Ting Shien, PhD student researcher; and Dr Rita Mark, former researcher with the NTU programme.