Saving the world with fish fingers

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Credit: Pixabay

Smothered in ketchup or squished into a sandwich, there's one tasty convenience food that's hard to resist. With over 1.5 million of them eaten every day in Britain, fish fingers are one of the nation's favorite foods. Now two Cambridge researchers believe that a twist on this 1950's creation might help address the challenge of sustainably feeding our global population.

David Willer and Dr. David Aldridge are on a mission to work out how to look after our planet and people's health at the same time. Zoologists in the University of Cambridge Conservation Research Institute, they want to demonstrate that bivalve shellfish—oysters, scallops, mussels and clams—can be a source of affordable, sustainable and nutritious food.

"In the developed world, over two billion people eat too many calories but not enough nutrients to stay healthy," says Willer, "and a billion people in the developing world don't have access to enough food. We believe bivalves are the answer!"

Better for the planet

"This is about providing people with food that is environmentally sustainable but also nutrient dense," says Willer. "We know that meat and fish have a greater environmental impact than plant-based foods. But the environmental footprint of bivalve aquaculture is even lower than many arable crops in terms of greenhouse gas emissions, land and freshwater use."

Bivalves sit right at the bottom of the food chain. They are filter feeders, and eat whatever is suspended in the water, which is usually either decaying organic matter or algae. This is in stark contrast to salmon farming, which takes five kilos of wild fish for every kilo of salmon produced. Willer says that if just 25% of this 'carnivorous fish' aquaculture was replaced with an equivalent quantity of protein from bivalve aquaculture, 16.3 million tonnes of CO_2 emissions could be saved annually—equivalent to half the annual emissions of New Zealand.

Bivalves offer other environmental benefits too. Farming them has many benefits on marine ecosystems including the provision of nursery habitats for fish, coastal protection, and helping to clean up waterways

by filtering out nuisance algae and suspended sediments.

Room to grow

Across the world there is a huge area of coastline suitable for growing bivalve shellfish—an estimated 1,500,000 square kilometres, equivalent to over six times the total area of the United Kingdom. Willer says that developing just one percent of this could produce enough bivalves to fulfil the protein requirements of over one billion people.

"The regions of the world where there's a lot of available coastline include places where people need extra sources of protein in their diets, such as the west coast of Africa, and Asia," says Willer. In developing countries like these, where populations are growing, there are high levels of malnutrition because people are not getting the key nutrients and the energy they need from traditional diets.

Bivalves have a higher protein content (per kcal) than beef. They are high in many key nutrients that humans need, including vitamin A, iodine and zinc, and omega-3 fatty acids. A small quantity eaten regularly is a far more efficient way of getting required levels of these nutrients compared with eating a large variety of plant crops, all of which require land and resources to produce.

The safety issue

The challenge for the researchers is to increase the productivity of bivalve farming, while at the same time raising safety standards. Their work focuses on oysters and other bivalves at the hatchery stage, where they are grown for a year before being put into open sea—on ropes or in cages—to grow to full size.

"At the moment, bivalve hatcheries are very small scale and pretty basic," says Willer. "Farmers grow algae to feed the oysters in big tanks using lots of light and energy. The tanks get contaminated all the time, so a lot of the feed is bad quality or gets wasted. This is the main cause of bacterial disease in shellfish. For a farmer working alone, it's a difficult venture."

One of the reasons why some people won't eat mussels, oysters and other bivalves is fear of food poisoning—of which there have been some high profile cases, including a recent gastroenteritis epidemic in Brittany. Oysters in particular tend to be eaten raw, so anything harmful within them—most commonly norovirus—is not killed before they're consumed by humans.

Taking control

Willer and Aldridge's solution is to change the bivalve feed. They have developed a specially formulated diet for the shellfish that enables farmers to take better control of their hatcheries.

"We call it a 'microencapsulated BioBullet,'" says Aldridge. "It contains algae, just like the algae being used in the hatcheries now, except ours is grown on a commercial scale and then powdered down and sterilized. As well as preventing the introduction of diseases into hatcheries, our new method is about 100 times more efficient than the current one in terms of energy use, carbon emissions and cost."

The fact that the algae is sourced from the waste streams of other aquaculture systems gives this method an additional environmentally friendly credential. The approach has attracted funding from European Institute of Innovation and Technology's Food program (EIT Food) – an initiative working to make the food system more sustainable, healthy and trusted.

Microencapsulation involves putting the powdered algae inside a type of miniature eggshell made from vegetable oil, and adding a coating to make it buoyant and palatable. Other nutrients can be added as required, to alter the nutritional value or even palatability to the shellfish and ultimately the dietary benefits to human consumers.

This creates the potential to address particular nutrient deficiencies in a consumer population. Any nutrient or vitamin is far more easily absorbed by the body when it is integrated into a protein and fat source, rather than being in supplement form.

When bivalves are harvested they are held in tanks for a week before being sent to market. Clean water is run through the tanks to flush out the contents of their guts. At this stage, anything fed to the shellfish will remain in their gut cavity and be eaten by the consumer.

"The additives are where things get really interesting," says Willer. "One of the unique things about shellfish is that when you eat one, you eat the entire organism—including the gut. The microencapsulated diet allows either a flavoring or nutrient to be delivered at the final stage of shellfish production so it stays within the bivalve when it's harvested."

Commercial development

Willer and Aldridge have been collaborating closely with a shellfish company in Whitstable, Kent—a town defined by the oysters it has produced since Roman times—to develop their microencapsulated diet into a saleable product. In addition, Aldridge and another team member, Dr. Camilla Campanati, have tested products in commercial settings in Spain, achieving remarkable results.

"Mediterranean mussel spat reared on our BioBullets grew just as fast and survived just as well as mussels fed with the leading commercial

alternative, an algal concentrate," says Aldridge, "but our products cost ten times less than this alternative and are much easier to handle and store." The results of an independent consumer panel are very encouraging too: mussels fed on BioBullets were deemed just as tasty and attractive as mussels produced by conventional methods.

"It's surprising how little research has been done on this," says Willer. "A few people tried to make a type of microencapsulated feed in the 1980s but it didn't work, partly because the technology wasn't available. We hope that with the recent successful trials of our new forms of microencapsulated diets, and continued refinement, it won't be long before the concept goes mainstream and drives the expansion of the bivalve industry on a huge scale."

The final hurdle

There is just one last challenge to overcome before bivalves could help to feed the world. "They're not actually a food many people tend to like," admits Willer, "and I think that's probably one of the biggest challenges. We can increase the production of a very sustainable food, but if no-one eats it, it's pointless."

Diets have changed a lot since the 19th century when oysters in Britain were cheap and eaten in large quantities, mostly by the poorest in society. Today, oysters and other bivalve shellfish are perceived as luxury foods in the Western world—but only by those who relish the salty, slippery sensation of slurping them down.

Rather than trying to convince the rest of us to change our dietary preferences, Willer and Aldridge are looking at novel ways to make bivalves more palatable—essentially by disguising them. One idea is to swap out fish—which is often sourced unsustainably—for processed clam meat in a new form of "bivalve fishfinger."

"Climate change is an impending pressure, and this pressure extends to our food supply," says Aldridge. "We need to make fairly rapid changes to people's diets, and trying to encourage huge cultural shifts just isn't going to work. I think modifying things people are familiar with is the best way to make bivalves into a more acceptable product." Microencapsulated diets really could be the start of a revolution.

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