

Would you eat lab-created fish? This startup is carving new path in 'alt-meat' industry

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It's official: alternative meat has gone mainstream.

Vegetarian creations like the Impossible Burger—which look and taste like real meat—are the big headliners, with companies like Beyond Meat and Impossible Foods leading the pack. Just this month, these startups scored multi-billion dollar valuations and mega-deals with [fast food chains](#), igniting the plant-based "foodtech" industry.

But there's another area of food science fast on their heels: lab-grown meat. And San Diego is home to the newest player.

In a small laboratory in Sorrento Valley, scientists at BlueNalu are growing fish parts—just the muscle and fat—from cells. The tissue will one day be stacked into familiar shapes like freshly caught Mahi-mahi fillets, red snapper or flaked tuna using something akin to a 3-D printer. Instead of printing plastic, the scientists are using ink made of cells.

The startup's experimental food is a far cry from the plant-based meat products that keep popping up in headlines and are designed to look like something they're not. BlueNalu's "alternative seafood" will be made of real fish cells—they're just grown outside the fish's body.

"The only difference from a BlueNalu fillet and a regular fish fillet is that we don't have the bones," said BlueNalu's CEO Lou Cooperhouse. "We also don't have the mercury, the parasites, the micro-plastics, nor the bacteria these things are usually covered in."

These fillets would also be missing the animal's nerves, lymph system and blood vessels.

This is why food scientists, along with BlueNalu's executives, are calling it "clean meat." Some researchers prefer the moniker "cultured" or "cell-based" meat. Media and consumers have come up with other, perhaps less flattering names for it: "lab-grown" fish and—and in the case of beef—test tube steak."

It's a knee-jerk reaction to something unfamiliar. But bizarre or not, BlueNalu has stepped into an emerging industry that's teeming with activity for good reason. And the local startup is arguably one of the most exciting new players.

BlueNalu has an ambitious goal to build massive manufacturing facilities in cities around the world, creating enough cell-based seafood to meet the consumption demands of more than 10 million nearby residents. It's a mission that would help cut down on overfishing, improve sustainability and deliver fresh seafood to landlocked areas of the world.

But is the science there yet?

BlueNalu is not the first to make cell-based animal products. A Dutch company called Mosa Meat debuted a lab-made beef burger in 2013, an endeavor that cost them roughly \$280,000 to make the first patty. They've since improved the technology and production to cut that cost down to \$10.30 per patty.

That seems pricey now, but lab-made meat is appealing to the food industry for numerous reasons, including the potential for cheaper production down the road. Growing (and buying) only the valuable parts of the animal would reduce waste.

Cell-based meat production could also open up previously rare animal or seafood proteins, or allow scientists to design artisan products.

"There is the opportunity for each producer to create their own versions of the product (much like craft brewers, farmhouse cheesemakers and charcuterie producers now), therefore giving them diversity and competitiveness in the market," wrote the authors of a 2018 journal article in *Trends in Food Science & Technology* on the topic of cell-based meat.

Sarah Lucas, Mosa Meat's head of operations, said the science is getting more sophisticated, and new players such as BlueNalu are jumping in to develop different kinds of animal products. While Mosa Meat doesn't work with fish cells, Lucas said it could be a smart target. That's because fish cells can grow at room temperature, unlike mammalian cells.

"This could mean that the production process uses less energy, which would be fantastic," Lucas said.

Creating the perfect fish fillet is an exacting science. A live fish is first put under anesthesia so scientists can collect a sample of muscle stem cells. The fish isn't harmed during this process, scientists said, and can go on living a happy fish life. One sample can produce billions of cells.

The muscle stem cells are then placed in a plant-based broth full of nutrients, which stews in a bioreactor while the cells grow and multiply. Essentially, the cells are "tricked" into thinking they're still inside a body and therefore continue doing their work to create tissue.

From here, the cells are concentrated down and mixed with a nutritious liquid called "bio-ink," which is then 3-D printed into the desired shape, such as a fish fillet, a scallop or any other seafood creation. By the end of this year, the startup expects to make scallop-sized pieces of fish, like the kinds found in Poke bowls. One day, BlueNalu plans to make a variety of fish, crustaceans and mollusks.

We don't know yet how the fish will taste, as the startup is too early in production. But Cooperhouse said he's confident they can produce a fillet whose taste and texture will meet consumer expectations. In fact, he thinks leaving out the undesirable bits like bones and blood will result in a superior alternative to "real fish" caught in oceans.

Besides BlueNalu, there's only one other seafood competitor on the

foodtech industry's radar: a Bay Area company called Finless Foods. This company raised \$3.5 million from investors in a seed round last summer, and they're still early in the science.

BlueNalu executives think their own team may be the most advanced in cell-based seafood. And they also have a marketing edge. While most cell-based meats require animal serums (made of blood) to grow, BlueNalu has created a plant-based alternative. This will appease most consumers concerned about animal cruelty.

While alternative [meat products](#) have been around for decades in the form of bean burgers and tofurky dogs, it was only with the advent of shockingly convincing fake beef that set the industry on fire. Impossible Foods and Beyond Meat designed plant-based burgers that look and taste like the real thing. They even bleed.

Consumers have flocked to try the products, and investors are tripping over themselves to grab a stake. Beyond Meat burst onto the stock market earlier this month in one of the best-performing initial public offerings in decades. The company's stock price soared over 200% in a fortnight, giving the company a market cap of \$4.8 billion and igniting investor interest in alternative meat.

Two weeks after Beyond Meat's debut on Nasdaq, Impossible Foods raised \$300 million from tech investors and celebrities. They were valued at \$2 billion during the deal.

And perhaps the biggest news of all—the Impossible Whopper is now available at select Burger King locations across the nation, cementing alternative meat's place in American culture.

"As demand increases, we expect a flood of new entrants chasing an expanding market opportunity," said PitchBook Emerging Tech analyst

Alex Frederick. In his recently published foodtech report, Frederick noted venture capitalists have poured \$7.5 billion into foodtech startups in 2018, an all-time high.

The big promise of alternative meat is obvious: less animal cruelty, less impact on the environment, and a good option for vegans and vegetarians who prefer their burgers with fewer beans.

But Beyond Meat and Impossible Foods are both playing in the plant-based arena, creating products from things like wheat and potato protein. Although their products were certainly designed in food laboratories, they are ultimately not animal products. They're excellent imitations of animal products.

Is the market for cell-based meat similarly promising? It's hard to say. The science is young, and startups working on this technology are a bit behind companies like Impossible Foods. But Pitchbook's report says cell-based meats is an "emerging area" in which venture investors have invested more than \$42 million.

BlueNalu's leadership team is chock-full of notable executives, which should aid in maturing the startup (and its science). Cooperhouse, the CEO, is a 35-year veteran of the food industry who's held senior roles at Nestle, The Campbell Soup Co., and ConAgra. The opportunity to lead BlueNalu was so attractive that it pulled him away from a gig as the executive director of the Rutgers Food Innovation Center, where he assisted many other startups, including Impossible Foods in its early days.

In 2017, Cooperhouse formed a partnership with entrepreneurs Chris Somogyi and Chris Dammann, and together the team raised \$4.5 million in seed funding to get started. They also packed in an impressive advisory board, including research and development, and regulatory

executives from Campbell's, PepsiCo and Nestle. They also have Susie Fogelson, who led marketing and brand strategy for the Food Network and Cooking Channel, to help them with marketing.

And marketing will indeed be a challenge.

While cell-based meat is intriguing to industry, startups in the field have their work cut out when it comes to presenting the concept to the public. Many consumers will reject something they perceive as "unnatural." It's a serious concern outlined in the previously mentioned journal article in Trends in Food Science & Technology. The authors point to existing studies on the perceptions of cultured meat, which they say vary from "the very supportive to the very negative, with many shades of uncertainty in between."

Language matters immensely to this industry. The BlueNalu executive team was quick to reject the idea that lab-designed and factory-made fish muscle was any less unnatural than, say, Greek yogurt, which also requires the culturing of cells.

"We are not any more 'lab-made' than ketchup or Oreos," said Dammann, BlueNalu's chief technology officer. "They're all started in a lab."

Lucas at Mosa Meat is quite familiar with this narrative, as her company blazed the trail for cell-based meat.

"From my personal experience, I think the most common first reaction when I tell people about cultured meat (especially when it's called 'lab-grown') is that it's unnatural, or disgusting," Lucas said. "But if you talk to them about it, usually it doesn't take long for people to realize that livestock meat production is very unnatural. For example, using artificial growth hormones or selectively breeding animals that don't resemble

animals in the wild."

The fact that there's so much discourse over the language is telling.

"This contestation over what it is called reflects both the ambiguity over what it is, and the political sensitivities of how different groups want it to be positioned," the research paper reads.

There are also regulators to win over, as this new food type will need to be approved before selling. BlueNalu has hired a former executive with the U.S. Food and Drug Administration (FDA) to help them with communication and strategy with regulators.

"As we are not employing any genetic modifications, nor are we using trans-differentiation, we do not anticipate any extraordinary challenges from FDA," the executives wrote in an email.

They also plan to lobby in Washington, giving federal and state legislators educational material about cell-based products.

Besides marketing and regulatory challenges, cell-based meat has other—more immediate—obstacles ahead.

Ricardo San Martin, who runs the Alternative Food Program at University of California, Berkeley, has been tasked with leading entrepreneurial pursuits around the new field of science. He says the industry is "full of challenges," the most concerning of which has to do with production. It's tough to produce cell-based [meat](#) in large quantities, and he doesn't know of any company or research team that's achieved it on a big scale.

"There are some limitations to how many cells you can put into a liquid chamber if you want them to survive," San Martin said. "The cells

become stressed and they turn suicidal. They stop growing and do all kinds of things you don't want them to do."

This science is still very early and many startups are keeping their research private, so it's possible San Martin isn't privy to new methods. But he said he's interviewed several companies in the space and has never received an answer on how large-scale production could be accomplished.

When asked how BlueNalu would master it, the executives were mum on the specifics but did say they've modeled large-scale production "in extraordinary detail," using a team of bioprocess engineers, food processing engineers and an architectural firm. They believe there are no scientific barriers to getting it done—once they have the resources and facilities they need.

"We confidently believe that we have designed the most comprehensive and holistic plan for the commercial production of cell-based protein products of any company worldwide," the executive team wrote in an email.

For now, the startup is still small. The company employs 13 people and is currently raising more startup capital to push growth forward.

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