

WELCOME TO THE EAST BAY'S BIOTECH BANQUET

The East Bay is ground zero for a food revolution of plant-based burgers, clean meat, and slaughter-free fish. Are we ready for test-tube foods?

By Anneli Star Josselin Rufus



What happens when assertively avant-garde attitudes about eating and the environment emerge during — and on the same square-mileage as — a tech boom? Artists, entrepreneurs, investors, scientists, and microbes meet, fueling a food revolution whose products thrill futurists as much as they petrify purists.

The East Bay is one of that revolution's hubs. Right here, well-funded startups are making faux meats that “bleed,” real meat lab-grown from cells, and other edible innovations.

The best-known — and by far the best-funded — among these companies is **Impossible Foods**, whose 68,000-square-foot East Oakland plant opened last year and now produces a half-million pounds per month of the plant-based burgers that attract worldwide buzz for their ability to “bleed.”

Having committed himself to eliminating factory farming, celebrated Stanford biochemistry professor Patrick O. Brown founded Impossible Foods in 2011. Based on molecules found in soy-plant roots, the company uses its labs to grow a compound called soy leghemoglobin, which

contains heme: That's the iron-containing protein molecule that gives real meat its distinctive color, faintly metallic flavor, and vivid red blood.

A gas chromatography mass spectrometry system helps Impossible Foods' scientists identify the countless elements configuring the taste,



texture, and aroma of real beef — and then how to replicate those elements as closely as possible with such plant-based ingredients as wheat protein, potato protein, and de-flavored coconut.

They're sold at the Oakland Coliseum and well over 3,000 restaurants, including all 377 locations of the fast-food empire White Castle, which this summer became the first such chain to serve Impossible Sliders.

Impossible Foods raised \$114 million in the first half of 2018 alone, bringing the company's accumulated value close to \$400 million.

In Berkeley, **Memphis Meats**, co-founded by Mayo Clinic-trained cardiologist Uma Valeti and two other scientists, is developing what is now known as "clean meat:" real beef, chicken, and duck that's been lab-cultured from the real cells of real animals that remain unharmed throughout this process.

Memphis Meats' "test-tube" meat production requires no livestock husbandry or feeding, no heavy farm machinery, no slaughter — and

comparatively minuscule greenhouse-gas emissions.

Although its labs have produced "clean" chicken strips, duck a l'orange, and a meatball, with future plans announced to try making clean-meat Thanksgiving turkeys, company insiders predict that Memphis Meats products won't reach stores until 2021.

Following a \$17 million funding round last year, the company has attracted high-profile investors such as Bill Gates, Richard Branson, and its own ostensible arch-rival, poultry mega-producer Tyson Foods.

This summer, Memphis Meats made headlines by teaming up with the North American Meat Institute in formally asking President Donald Trump to establish regulatory procedures — through the USDA and FDA — which could mainstream the new clean-meat category onto the market. Laws and labeling — what can and can't be called, considered, and/or sold as "meat" — are potential red-tape maelstroms awaiting

such startups down the road.

Using genetically engineered yeast to create animal-free, lactose-free dairy proteins, Berkeley's **Perfect Day Foods** — named after the Lou Reed song — is a pioneer in what is now known as the cellular-agriculture sector. Planning to sell the products not directly to consumers but to food and beverage brands, vegan biotechnologist co-founders Ryan Pandya and Perumal Gandhi raised \$24.7 million in Series A funding this year.

Perfect Day's patented procedure entails adding DNA sequences from cows to food-grade yeast, "programming" this yeast to yield full-fat vegan versions of the same proteins found in real dairy milk. Grown in fermentation tanks along with added nutrients, fats, and plant-based sugars, the proteins are then mechanically harvested.

Cellular agriculture makes the dairy-production process kinder, cleaner, and more sustainable than traditional farming, assert the co-founders — who, before launching Perfect Day four years ago, were initially inspired by the relative dearth of delicious vegan cheese, yogurt, and ice cream.

Spicy, fruity, fizzy, high-fiber, low-sugar **OLIPOP** soda is named after oligosaccharides — those complex carbohydrates that double as prebiotic fibers. While *probiotics* are gut-dwelling bacteria, *prebiotics* are dietary fibers that fertilize those bugs. They're all part of the microbiome, that trillion-strong micro-population inhabiting our bodies — and which Oakland's OLIPOP, sold at Berkeley Bowl and other stores, aims to fuel.

"The microbiome has a leveraged effect on nearly every body part; there's a synergistic link between the microbiome and brain function," said OLIPOP's co-founder Ben Goodwin, who maintains a microbiome lab and developed a kombucha brand before joining fellow food innovator David Lester to oversee extensive clinical studies in this booming research-field — in hopes of disrupting the wildly lucrative soft-drink industry.

Containing chicory, cassava, kudzu root, marshmallow root, sunchokes, nopales, calendula, and other prebiotic, anti-inflammatory plant-based ingredients, it's sumptuously flavored, "so it's fun and super-accessible to soda fans," Goodwin said. But given its role as a high-tech digestive-health beverage, "it's also a Trojan horse."

Heading OLIPOP's advisory board is microbiologist Joseph Petrosino, director of Baylor College's metagenomics and microbiome research center.

"We're poised at the very intersection of food and health, where — rigorously, with access to some of the leaders in the field — we can be very serious about the impact that food has on us not just naturopathically but scientifically," Lester said.

Cellular agriculture isn't just for humans. Berkeley-based **Wild Earth** makes "clean-protein"

vegan pet food such as dog treats, launched this year in limited release, from koji (*Aspergillus oryzae*) — a fungus that ferments soybeans in soy sauce and miso-paste manufacture and is also used in sake-brewing.

“I really like people. I really like animals, too, and I think we can exist in a world that’s good for both,” said Wild Earth CEO Ryan Bethencourt, a biohacking entrepreneur who co-founded the Berkeley Biolabs biotech accelerator and Oakland’s Sudo Room hackerspace. He’s also an adviser at Berkeley’s Good Food Institute and a vegan.

“I’m a scientist, so 10 years ago, I started thinking maybe it was possible to start using biotech to remove a lot of the suffering that goes on around us.”

Wild Earth’s chief science officer, Ron Shigeta, familiarized Bethencourt with koji, which can be grown rapidly and cost-effectively.

“It’s Japan’s national fungus. It’s been used for 9,000 years and now has so much human-based data detailing how good it is,” Bethencourt said. “And it was right in front of our eyes: this prebiotic, sitting in plain sight.”

Wild Earth’s head of operations and fellow co-founder Abril Estrada “tested over 50 iterations of our dog treats” on hundreds of actual pets “whose enthusiastic reactions resulted in our working theory that animals love koji,” said Bethencourt, who sees creating cruelty-free alternatives as his lifetime mission.

“We want to be the Impossible Foods of pet food. If I don’t eat animals, kill animals, or use

products made from animals in the industrial-agriculture system, then what will I feed my pets sustainably?”

Conventional pet food is typically made from animals or plants deemed unfit for human consumption.

“They might have been diseased or euthanized. These are not pigs and cows. These are something else. I’ve been led to speculate that dogs and cats might be thrown into the mix. Are America’s pets eating the animal version of Soylent Green?”

We’ve all heard that overfishing, trawling, and rampant pollution are ravaging the seas. **Finless Foods** wants to fix that — by producing, in its state-of-the-art Emeryville facility, tuna cultured from what CEO Mike Selden calls “precious cellular material” and what you call stem cells, extracted from actual fish.

Still in development and not yet supermarket-ready, Finless Foods’ slaughter-free seafood looks, tastes, and feels like its ocean-caught cousins — but lacks the toxic chemicals now afflicting many ocean-caught creatures.

“If consumers tell me they’d rather have natural fish than lab-grown fish,” said Ryan Bethencourt, who was involved in Finless Foods’ beginnings, “I say: OK, have you seen the state of the oceans? It’s not just mercury and heavy metals getting into fish. These days, it’s also microplastic particles. Those big predator fish,” including tuna, “are full of microplastics that get stuck in their kidneys and livers” — and then in ours, if we eat them.

Selden and his co-founder Brian Wyrwas met

while studying biochemistry at college. They brought on cellular biologist Jihyun Kim as the company’s senior scientist soon after establishing the company, which — after just one year in business — raised \$3.5 million in funding this spring.

“I think microplastics in fish are going to be our generation’s asbestos,” Bethencourt said.

Science meets supertime, and investors seem excited. But amid all this talk about sustainability, can the biotech-food sector sustain itself — or, in a blaze of bright startuppy promises, might it burn out?

“I am optimistic that this support will last,” said Dan Blaustein-Rejto, senior analyst at Oakland-based environmental think tank **The Breakthrough Institute**.

“Yet I also urge people to be cautious and avoid unbridled optimism. ... Support for high-tech food companies, though it may be strong today, is highly vulnerable to changes in public opinion.” And word travels fast, as social-media companies now know.

Nor is this current East Bay food-tech boom unprecedented.

UC Berkeley professors were among the first to develop genetically modified organisms during the 1980s, then later helped to produce the first commercial GMO food, the Flavr Savr tomato, Blaustein-Rejto said.

“Surprisingly, from today’s perspective, public opinion polls in the 1990s showed very strong support for GMOs.”

In other words, things change.

