FOOD SCIENCE

Over Easy, Hold the Eggs

A West Coast start-up wants to make the staple ingredient obsolete

Josh Klein used to work on vaccine development for HIV, but these days he focuses on a different biochemical conundrum: making cakes moist and fluffy. He insists he's still making a difference. As director of biochemistry research at Hampton Creek Foods in San Francisco, Klein is on a mission to systematically identify and replicate every single culinary function of chicken eggs—using plant proteins.

Although Hampton Creek's founder, Josh Tetrick, is a vegan, his goal is not to convert others. Instead Tetrick hopes that Hampton Creek's products will outcompete eggs on price and thereby "sneak sustainability" into a variety of diets. The company, which is backed by tech-centric

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venture capital firms, recently launched a mayonnaise alternative, Just Mayo, and an egg substitute, Beyond Eggs, for making cookies.

As targets for ecological overhaul go, the egg industry is a good one. The world's hens lay more than one trillion eggs a year, and they do so with startling inefficiency. Egg farming requires 39 kilocalories of energy to produce one kilocalorie of protein—on par with raising cattle for beef according to a 2003 study in the *American Journal of Clinical Nutrition*. The energyto-protein ratio for plants is 2.2 to one.

Whereas there are other egg substitutes on the market for allergy sufferers and conscientious objectors alike, Klein



says he is taking a more scientific approach. His team has scanned more than 1,500 plants, identifying 11 as strong candidates for egg stand-ins. "The egg is more than just a nutrient," he says. "It reacts to things like temperature, pH and salt content." By identifying proteins that perform specific functions—emulsion, coagulation, aeration, and so on—Klein and Tetrick say that Hampton Creek's products, taken as a whole, will be the first to totally replace eggs without sacrificing taste.

TECHNOLOGY

Big Data, Big Energy

Electricity-hogging data centers could soon power themselves

The data centers of the future might do more than crunch and store information. In addition to serving Web pages, streaming Netflix videos and hosting social networks, they might soon produce their own power.

Data centers consume a tremendous amount of energy—they account for roughly 2 percent of total electricity use in the U.S., by one estimate. But Microsoft researchers may have found a way for tech companies to reduce their energy usage without sacrificing the dependability of their infrastructure. The solution, they say, lies in fuel cells, devices that convert chemical energy from fuel into electricity. By integrating fuel cells directly into server racks, data centers could double their efficiency, the researchers predict.

Fuel cells work by stripping electrons from a fuel molecule (often hydrogen). The electrons are routed through an external circuit, producing electricity.

Placing fuel cells as close to data servers as possible would curb many of the efficiency losses that come from transmitting electricity over long distances. And underground gas lines supplying fuel cells would be more resilient during storms than overhead power lines.

In one scenario, fuel-cell assemblies would dot the data center, each powering a few racks of servers. The challenge is finding the optimal balance among reliability, cost and efficiency. "It's the classic Goldilocks issue: not too hot, not too cold," says Sean James, senior research program manager for Microsoft's Global Foundation Services. Hooking up too many servers to one fuel cell means more problems if that cell malfunctions, but hooking up too few servers increases the number and cost of the fuel cells needed. Another hurdle: data move fast, and fuel cells react rather slowly. Demand on a given server can spike in milliseconds, but fuel cells take several seconds to adjust to the increased load.

A full-scale data center powered by fuel cells is still several years out. In the meantime, as more information and services move into the cloud, it does not appear that data centers—or their huge energy footprint—are going away. —David Wogan

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