

AMAI FOODS: DESIGNING A PROTEIN THAT'S SWEETER THAN SUGAR



In the last 50 years, obesity rates have tripled worldwide, and sugar overconsumption is often identified as the main culprit. According to statistics published by the WHO, in 2016, 13% of the world's adult population was obese. Researchers at the John Hopkins Institute of Medicine suggest that sugar may be a mediator of this obesity epidemic in several ways. For one, most sugary foods are high in calories, which, if not spent through movement, can add up to significant weight gain. More recent studies also suggest that the type of sugar consumed can influence how much body fat stores around the belly, a known risk factor for heart disease. In addition to a heightened risk of cardiovascular disease, consequences of obesity can include diabetes, metabolic syndrome, musculoskeletal disorders, teeth decay, several forms of cancer, and an array of mental illnesses.

In 2016, an Israeli researcher in protein biochemistry, biophysics, and computational biology decided to wield his scientific savvy to tackle the sugar crisis. Dr. Ilan Samish, a long-time pioneer of the field of computational structural biology at the Weizmann Institute of Science, founded Rehovot-based startup Amai Proteins. In Japanese, amai means 'sweet', and this was precisely Samish's goal: to create a food ingredient that tastes like sugar, but is digested in the body as a protein.

FOR SAMISH, THE MEDICAL FIELD HAS FOCUSED MOST OF ITS EFFORTS ON ADDRESSING THE CONSEQUENCES OF UNHEALTHY SUGAR INTAKE.

“Huge amounts of funding are spent on curing diseases relating to sugar intake,”

HE SHARES IN AN INTERVIEW.

“I decided to devote my time into curing the food that causes these diseases.”

To this end, Samish recruited expert help, including Professor Michael Levitt, a Nobel laureate in structural computational biophysics, who now serves in the Scientific Advisory Board of Amai Proteins. From the other side of the science to the food market path, the Board of Directors is chaired by Richard Greubel, a long-time leader in the global food value chain. Not less impressive, the Amai team is composed of five PhDs, three engineers and a pharmacist-MBA with business development experience from Teva Pharmaceuticals who himself was a CEO for a decade.



SCALING NATURAL SWEET PROTEINS IN THE LAB

The first products in Amai's line are hyper-sweet proteins, which are intended to be used as a sugar substitute with no calories or glycemic index. The inspiration for the product came from nature itself, as sweet proteins can be found in the fruits of shrubs growing along the equatorial belt. Compared to sugar, these proteins are up to three thousand times sweeter by weight. However, in their naturally occurring form, they are highly unstable, scarce, and expensive, and exhibit a lingering taste. Collectively, these properties make them unusable as a main sweetening ingredient for the food and beverage industry.

To solve this problem, Amai's scientific team uses a technique called Agile-Integrative Computational Protein Design (AI-CPD). With the help of cloud-computing based AI-CPD, the startup's engineers can adapt sweet proteins to fit industrial conditions. Each protein contains a unique combination of 20 types of amino acids; the CPD cloud computing software analyzes the amino acid sequence of selected sweet proteins and helps to redesign a new, more useful sequence.

“The idea behind the technology is that most proteins live in their small piece of heaven, but food, for a protein, is a hell of an environment. Thus, one needs to redesign the amino-acid sequence of the protein to be more similar to proteins that sustain life in harsh environments such as hot springs, acidic swamps, or the Dead Sea,”

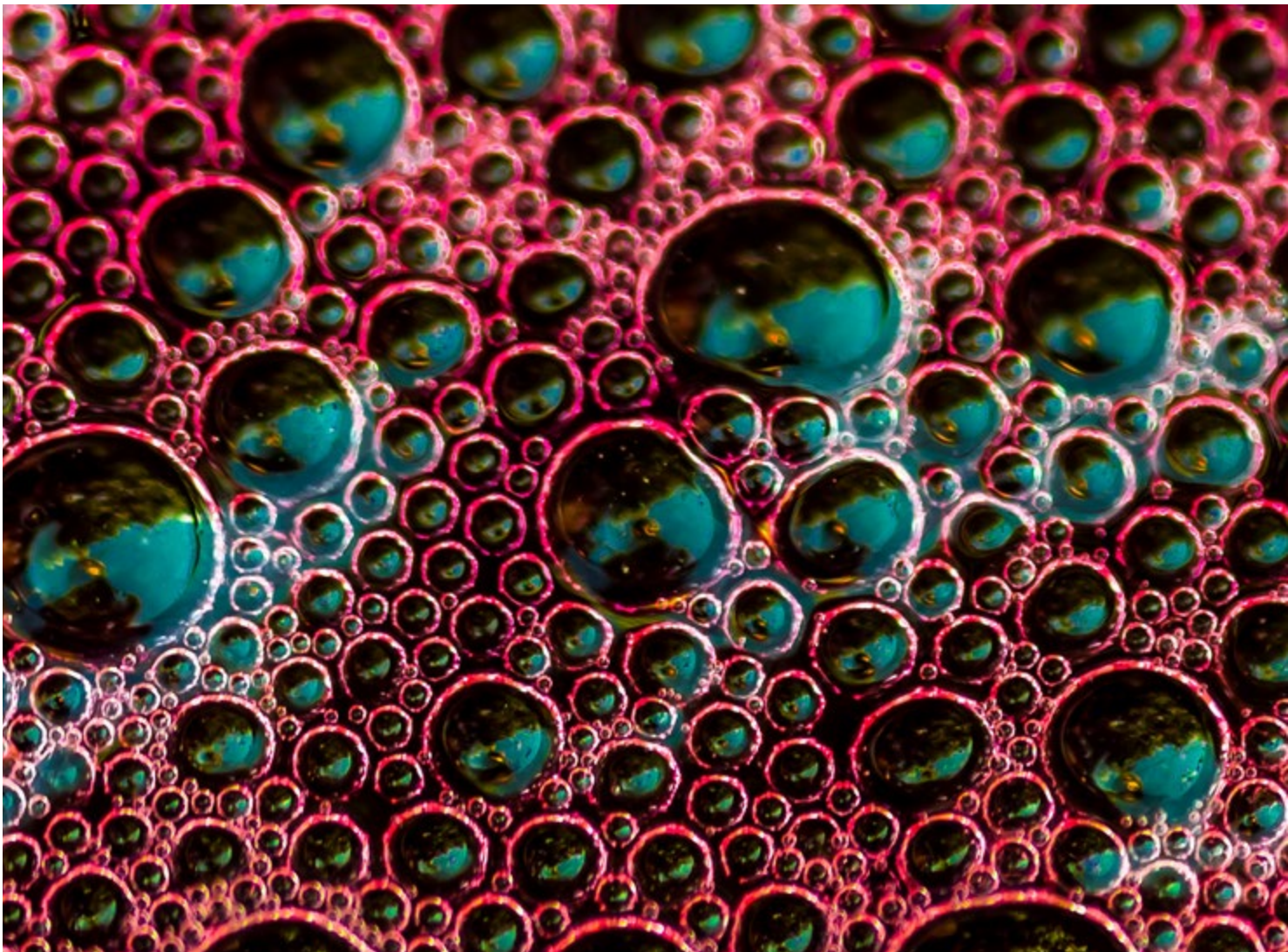
SHARES THE AMAI TEAM WITH VALUER.

Once this sequence is designed, the team produces the protein through a precision fermentation process, a staple method in biotechnology. More specifically, DNA for the newly designed protein is inserted into yeast cells, which are then brewed and produce the desired protein in large amounts. Then, the protein is harvested from the brewery, resulting in a pure sweet powder.

ACCORDING TO THE AMAI TEAM, THE RESULTING PROTEINS ARE 70-95% SIMILAR TO THE SWEET PROTEINS FOUND IN NATURE,

“yet confer beneficial properties such as taste, thermal-stability, acid-stability, shelf-life, and expression yield.”

Like Amai’s products, natural proteins promising to satisfy sweet teeth at a 0 calorie content have been on the market for some time now. However, for Samish, currently available proteins, such as thaumatin or brazzein, haven’t successfully grown in agriculture, and their production hasn’t reached a cost-effective scale. Furthermore, due to their cost and sensory profile, they may be used as sweet enhancers, but not as main sweetener ingredients. The value that Amai products will hold over the existing market is in their thermostability, potency, and sensory profile. Because of its high potency and precision fermentation production system, the startup can produce proteins at a cost that is 90% lower than that of sugar (in sweetness units). The team’s lab-designed proteins can preserve their structural integrity and sweetness under a wide range of conditions, including pasteurization, for an extended time. These properties make the products suitable for large-scale production.



AMAI PROTEINS RECEIVES IMPRESSIVE INDUSTRY SUPPORT

Amai Proteins has benefitted from a significant industry network in its effort towards scaling production and obtaining regulatory clearance. So far, the startup has cooperated with big biotech players Merck and Lonza and trialed its products with several companies from the food sector. With Ocean Spray, the Amai team is co-developing a sugar-reduced cranberry juice. Additionally, together with PepsiCo, Danone, and the Technion University in Israel, Amai Proteins received an EIT Food grant worth €1 million to support the formulation of the products for consumer packaged goods.

Notably, the startup has received financial support from both the public and the private sector. On top of the cloud computing grants from Google and Amazon, which total \$220,000, the company has received about \$1.45 million in seed funding from The Kitchen - FoodTech Hub, the Israel Innovation Authority. Other funding sources include fee-bearing agreements with several F&B multinationals and grants. In 2019,

the startup launched a Series A financing round with a target of \$5 million. With the round set to close soon, the Amai team predicts that it will reach commercialization within two years.

Given its current product, Amai Proteins is set to compete in the global market for sugar substitutes. According to a report by Grand View Research, the market size estimated at \$13.7 billion in 2016 will register a CAGR of 4.2% between 2016 and 2024. Analysts attribute this growth to soaring demand for sugar substitutes from the food and beverage industry in response to regulatory pressure and an increasingly health-conscious consumer base. Yet, in a broader sense, Amai is vying for the market for sugar and all other sweeteners, estimated at \$90 billion. Rather than conducting full sugar elimination, Amai is aiming at significant (30-80%) sugar reduction, while maintaining a sensory profile that is comparable with sugar.

As part of their future plans, Amai Proteins will continue to focus on its scale-up and commercialization efforts, as well as on expanding its product offering.



“Amai is optimizing the hyper sweet designer protein family, as well as expanding to other designer proteins - all with the overall mission of fitting proteins to the mass food and beverage market. Amai is currently conducting computational studies to prioritize the protein targets, which also include alternative proteins of meat, milk, and plants,”

CONCLUDES SAMISH.