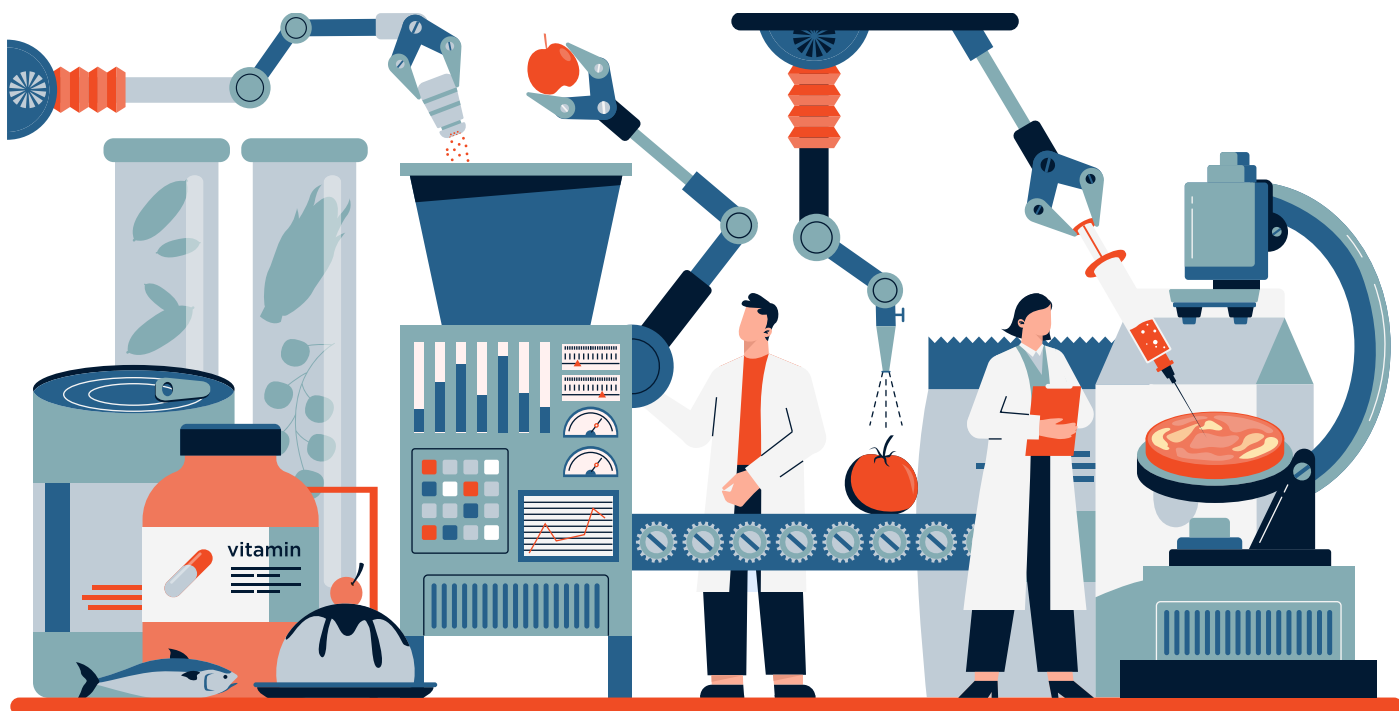


# FLAVOURFUL FOOD: A TASTE OF THINGS TO COME

How emerging  
technologies are  
changing our  
experience of food



## INTRODUCTION

### Making healthy eating appetising

Biomedical research has long established that a poor diet, such as those low in fruits and vegetables yet rich in fatty foods, contributes significantly to chronic diseases like diabetes. In turn, diabetes is a risk factor for other disorders like kidney failure, stroke and cardiovascular diseases, the latter being the world's leading killer that takes nearly 18 million lives annually.<sup>1</sup>

Singapore is no exception to this war on diabetes, with one in three expected to develop the condition in their lifetime. Not only is this a serious threat to health, but it also poses a significant strain on finances and quality of life. Given the large and growing burden of diabetes, costs from medical expenses to productivity losses are expected to reach as high as S\$1.8 billion by 2050.<sup>2</sup>

On the bright side, consumers are becoming more conscious about their food choices and demanding healthier alternatives. This has added fuel to a fast-growing 'functional food' industry, relating to food

products that have a potentially positive effect on health beyond basic nutrition. In February 2020, global functional food sales topped US\$267 billion.<sup>3</sup> During the height of COVID-19, vitamins and dietary supplements also saw a surge in sales as consumers looked to boost their immunity.<sup>4</sup> Even post-pandemic, about a third of global respondents indicated that they would continue to lean towards health and wellness products.

But can tasty and traditionally 'badly' perceived foods also have a place in a health-focused industry? Emerging technological advances are supercharging the future of food with novel ingredients that boost wellbeing and consumer appeal, making healthy meals accessible and desirable to the masses.

Read on as we provide an overview of the different tech-enabled functional foods being developed and highlight the most exciting opportunities in this space.

<sup>1</sup> World Health Organization, "Cardiovascular diseases", June 2021 [[https://www.who.int/en/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/en/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds))]

<sup>2</sup> Ministry of Health Singapore, "Diabetes: The war continues", August 2017 [<https://www.moh.gov.sg/news-highlights/details/diabetes-the-war-continues>]

<sup>3</sup> Institute of Food Technologies, "The top 10 functional food trends", April 2020 [<https://www.ift.org/news-and-publications/food-technology-magazine/issues/2020/april/features/the-top-10-functional-food-trends>]

<sup>4</sup> Euromonitor, "Consumer health in Southeast Asia: Strong growth beyond coronavirus", May 2020 [<https://blog.euromonitor.com/consumer-health-in-southeast-asia-strong-growth-beyond-coronavirus/>]

# OVERVIEW

## Transforming food for good

Earlier innovations in modifying food focused on removing undesirable ingredients and providing alternative options promoted as typically low-fat, reduced salt and zero-sugar versions of favourites like carbonated drinks and pastries.

Today, much of the focus has shifted to health-promoting components that have been *added* to base food products, such as vitamins and fibre. However, the concept of additives is not new. Commercial milk, whether cartons of fresh milk or powdered forms, is typically fortified with vitamin D. Meanwhile, wheat flour usually contains iron and B vitamins to prevent deficiencies, especially as the body does not store B vitamins for long and needs a regular supply of these compounds from dietary intake.<sup>5</sup>

Other benefits have also emerged, such as bioactive compounds usually found in plants with links to antioxidant properties. On the microbial end,

helpful gut bacteria called probiotics are gaining traction, not just for gut health but also for their links to improving cognitive function and immune health.<sup>6</sup> Alongside them are prebiotics, which are non-digestible fibres to foster the growth of gut bacteria, and synbiotics or mixtures of these two biotics.

While the goals of ingredient discovery and product reformulation have not changed, emerging technologies like artificial intelligence (AI) and genetic engineering are increasing the precision and speed at which new or improved food products are being developed. To take healthy food to the next level, food companies are exercising greater control over their product formulations, leveraging techniques that allow manipulation even at the single-molecule level. Moreover, many of these novel ingredients are also leaning towards being plant-based and organic, in alignment with the growing demand for 'natural' or clean label foods.

## Delivering healthier food options

*Today's innovations are taking diverse approaches to create healthy food, whether by removing unwanted compounds or by adding ingredients to neutralise unhealthy properties and enhance nutritional value.*

### ⊖ Subtractive Approach

- Provides nutritional value
- Removes normally present compounds
- Reduces harmful components and effects
- Substitution of ingredients possible
- May need to compensate for removed ingredient

### ⊕ Additive Approach

- Provides nutritional value plus health benefits
- Incorporates new compounds to the base product
- Increases beneficial, health-promoting effects
- Base product typically unchanged
- Several compounds can be added simultaneously

<sup>5</sup> Victoria State Government, "Vitamin B", May 2020 [<https://www.betterhealth.vic.gov.au/health/healthyliving/vitamin-b>]

<sup>6</sup> Harvard Medical School, "Probiotics may help boost mood and cognitive function", June 2019 [<https://www.health.harvard.edu/mind-and-mood/probiotics-may-help-boost-mood-and-cognitive-function>]

# STATE OF THE ART: DEEP TECH IN NOVEL FOOD DEVELOPMENT

For many, food preferences are primarily influenced by the flavours and experience of what they are eating. To make healthy foods more palatable and appealing, creating a specific sensory experience—whether through taste, texture or fragrance—requires determining the right combination of ingredients for any food items.

Each ingredient confers new, distinct qualities to a product. For instance, adding milk to coffee changes the taste and the texture or creaminess of the beverage. Emulsifiers are particularly key for stabilising products that contain clashing components, like fat and water phases that do not readily mix with one another.

Finding novel ingredients can involve direct replacements, but many cases of food development require reformulating entire recipes. The right combination of changes is necessary to achieve new, desired properties, such as boosting flavour or improving the nutritional profile, without compromising our experience of the dish.

Given the many factors to consider, the complexity of food development presents an exciting space for Deep Tech to disrupt through ingredient breakthroughs and integrated product reformulation. Innovative technologies could help companies from the food and beverage (F&B) industry maximise the nutritional content of their products at minimal resource cost, paving the way for achievable and scalable production of next-generation food to help us tackle public health issues.

Here, we look at three promising areas where trailblazing tech solutions are offering both creative sensory experiences and excellent health benefits by capturing palatable flavours, mimicking food textures and developing additives to serve market demands for nutritious yet enjoyable food.

## 1 FLAVOUR INNOVATIONS

When done right, food formulations resemble a harmonious symphony: compounds' synergistic and opposing relationships come together to achieve an intricate experience that meets consumer demands, from great taste to prolonged stability. Of the numerous factors to consider, flavour is front and centre, with 88 per cent of consumers surveyed by the International Food Information Council Foundation indicating taste as their primary reason for purchasing a product.<sup>7</sup> When substitute ingredients fail to recreate the flavours of the original food products, healthier alternatives may not fare well in the market.

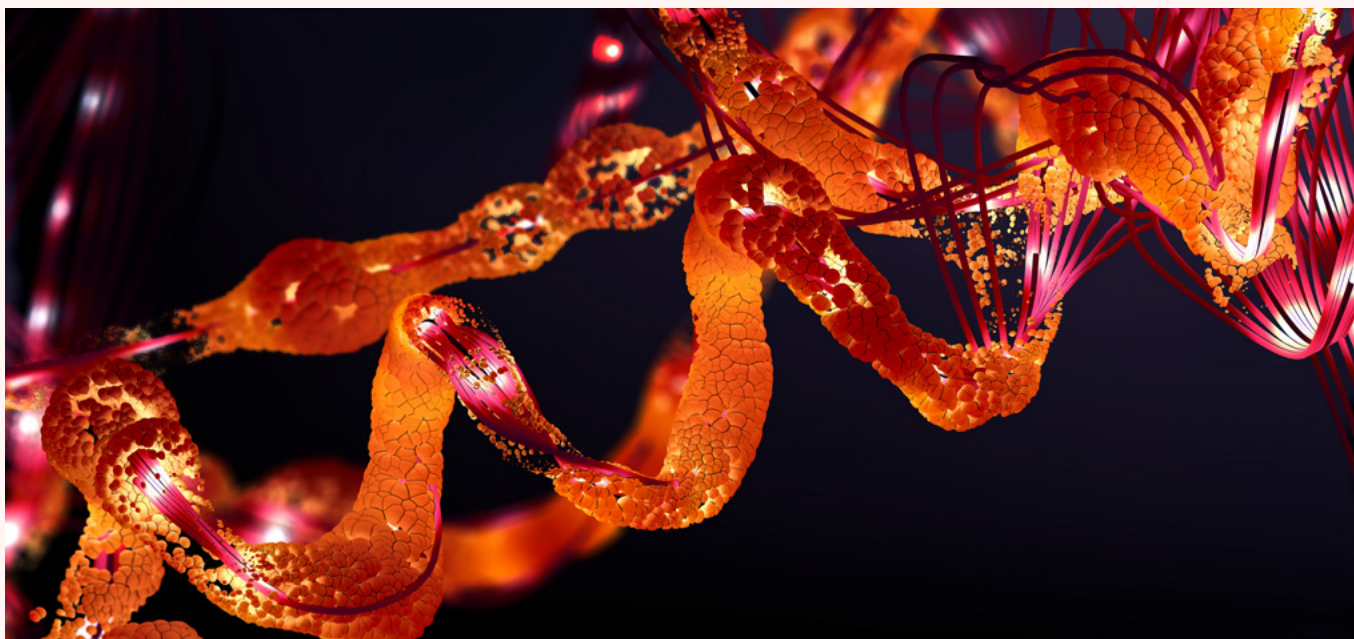
Flavour innovation relies on understanding the contribution of each component to the overall recipe and how their interactions with other ingredients might modify the end product's taste profile. For instance, bitter tastes can be repulsive to many people, ingrained as a biological defence mechanism against potential toxicity<sup>8</sup>, yet in truth many bitter compounds have health benefits. How can new technologies help us formulate introduce additional flavours that are able to mask such bitterness and allow us to enjoy these benefits without lowering the nutritional value of the food product?

To answer this problem and counteract any aftertastes in their products, flavour innovation company FlavorChem has a pilot testing plant where they develop flavour masking solutions in liquid and powdered form. These neutralise potentially undesirable flavours like strongly bitter or astringent tastes associated with pharmacologically active ingredients. Similarly, Symrise's taste balancing tool box creates taste tonalities to increase consumer appeal—from emulating chocolate flavours and rebalancing saltiness to delivering umami flavours and adding sensations like mouth-cooling effects.

That said, current screening processes typically require much time and resources, and success may not always be guaranteed. This costly endeavour is true even for well-established global companies like Firmenich that tests over 2,000 molecules yearly. Ultimately, only three or four of these compounds are deemed viable for the company's taste collections. The rest are discarded due to reasons such as unsuitable physicochemical properties for the desired taste or difficulties with extraction and production, showing just how complex a process flavour creation can be.

7 International Taste Institute, "The importance of taste in product development" [<https://www.taste-institute.com/en/resources/blog/importance-of-taste-in-product-development>]

8 Nissim, I., Dagan-Wiener, A., & Niv, M.Y. "The taste of toxicity: A quantitative analysis of bitter and toxic molecules", IUBMB Life, November 2017 [<https://doi.org/10.1002/iub.1694>]



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## Interview

# AMAI PROTEINS

As it turns out, sugars are not the only molecules that can deliver sweet-tasting properties. Israel-based Amai Proteins, a portfolio company of SGIInnovate, redesigns naturally sweet proteins into viable sugar alternatives, hoping to help reduce sugar consumption and combat the rising incidence of diabetes and other cardiometabolic conditions globally.

“For the mass market, you need something with a very long shelf life and can survive very harsh conditions. But proteins in the wild are intrinsically unstable,” said Dr Ilan Samish, founder and CEO of Amai Proteins. “If we can take a protein found in the wild and redesign it to fit harsh conditions, this can be of huge use in food innovations.”

With their computational protein design technology, the team examines amino acid sequences that would provide stabilising properties, inspired by microorganisms that survive in harsh conditions like extreme acidity or heat. To tweak the protein structure, they engineer the DNA sequences to code for the corresponding amino acids, then ‘print’ sweet proteins through precision fermentation. This approach harvests the proteins as either a highly concentrated

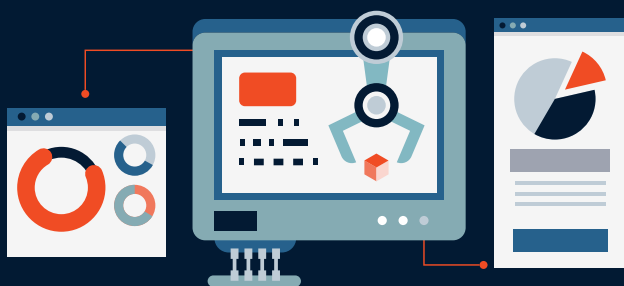
liquid or purified dried powder, with about a teaspoon of sweet protein enough to replace 100 pounds of sugar.

For Samish, the goal is not sugar elimination, which would drastically alter taste, but significant sugar reduction. In most cases, this enables sugar levels to drop drastically to about 30 to 40 per cent, while still preserving the sweet flavour that consumers will seek.

“Unlike sugar, sweeteners don’t have a linear-dose response. With higher concentrations, the potency drops and we need a much higher sweetener concentration,” he explained. “We place sugar only up to the point where people can distinguish between what we do and the full sugar product.”

After showing that producing these sweet proteins is possible—and cost-effective—Amai Proteins is looking ahead to commercialising the product by next year. The distribution plan will involve both direct to consumer selling and partnering with other F&B companies, the latter being important to reaching more consumers, changing key products and making a larger impact with their innovation.





## LEVERAGING AI FOR FLAVOUR DEVELOPMENT

AI systems can accelerate the discovery of the right ingredients and help to develop novel flavours and better-tasting food formulations.

At the Agency for Science, Technology and Research (A\*STAR), the Singapore Institute of Food and Biotechnology Innovation (SIFBI) uses bioinformatics to find plant or microbial ingredient sources with the target properties, enabling more efficient extraction and production of the desired flavours.

For F&B companies, AI models can readily identify the parts of a recipe needing modifications by analysing the physical and chemical properties of different compounds—effectively anticipating how substituting or removing specific compounds might affect overall food quality.

On the consumer-facing end, AI can also predict market trends to keep F&B companies ahead of the curve. Rather than conducting market research in a traditional way, companies are now taking a big data approach to co-create new food and flavours with customers dynamically and rapidly.

Global food corporation Cargill saw the benefits of AI for flavour development first-hand when it partnered up with analytics company AI Palette to conduct AI-powered market research. An SGInnovate portfolio company, AI Palette's Foresight Engine Platform uses natural language processing to analyse text like consumer statements, generate real-time insights and anticipate future trends. Armed with an understanding of emerging consumer needs, Cargill leveraged the platform to extract insights from over 250 million data points. This provided extensive evidence to support the company's product development strategy, contributing to the success of their plant-based dairy ingredients.

*By analysing ingredients and market trends, AI tools identify the best formulations to meet an appealing product profile, accelerating flavour innovation while reducing costs during development.*

### Input



Desired profile



Original recipe



Database of compounds



### Optimisation through AI analytics



#### Physiochemical properties

AI models analyse the physical and chemical properties of ingredients, anticipating how their interactions affect the final product's quality.



#### Sensory response

By simulating human perception of food and flavours, AI tools identify suitable formulations for creating a desired sensory experience.



#### Market trends

With big data on market trends, companies can more accurately predict changes in consumer preferences and develop flavours accordingly.



### Outcomes



#### Customised product lines

Data analytics aid creation of targeted product lines, catering to diverse consumer segments.



#### Improved formulations

By recommending ingredient ratios, AI tools help produce the right flavour profiles more efficiently.



#### Decreased time-to-market

AI tools minimise tedious trial-and-error steps in testing flavours, accelerating product development.



#### Improved market performance

With real-time market insights, F&B companies develop new flavours with high customer appeal.

## 2 MIMICKING TEXTURE

While taste is often top-of-mind for individuals' food preferences, it is texture that completes the sensory experience, adding a tactile dimension that influences perceptions of firmness, consistency and overall food quality. As such, texture plays a supporting, but nonetheless critical role when it comes to achieving consumer satisfaction.

Since food texture is highly dependent on its structure, the fat content is often a key element to achieving the perfect texture. Fat molecules' crystalline networks contribute to the viscous textures of certain foods like the crumbliness of pastries and the smooth richness of ice cream. As a way to lower the fat content in certain food products, innovations could potentially explore substitute ingredients with similar structural properties, enabling a similar sensory experience while reducing the negative health implications that come with saturated and trans fats.



The controlled addition of these fats or fat components can ensure that similar characteristics are achieved. For example, droplet aggregation techniques deliver nanosized emulsions of fatty acid molecules to precisely create a certain consistency in the mixture<sup>9</sup>, which could be useful for simulating a certain texture or maintaining stability.

One sector where texture innovation plays a significant role is the alternative meat segment, given the need to replicate the consistency, juiciness and tenderness of meat with such products. Due to the multi-sensory experience of consuming meat, texture has a big influence on how consumers perceive meat quality, in turn, the demand for meat-free substitutes.

To achieve that unique meaty texture, specific structural proteins are required for alternative options that may not be readily available in non-livestock sources. In Singapore's rapidly growing alternative protein scene, emerging solutions generally involve either cell culture methods or plant-based formulations, allowing companies to achieve the same texture with cleaner and healthier attributes.

### Cultured meat

Mosa Meat initially collects muscle cells from cows, then grows these cells in a lab to produce about 80 beef patties per half-gram sample. During culturing, the cells are placed in a growth medium that mimics the cow's natural tissue environment. By controlling temperature conditions and infusing compounds like vitamins, this lab-based process facilitates the multiplication of cells to form larger strands of muscle tissue. The growth environment is important to align the muscle fibres, replicating the tissue's structure.

However, the choice of growth factors and the need for antibiotics to prevent bacterial contamination can drive up costs. As much as 95 per cent of alternative meat production cost is attributed to the culture media used, packed with growth factors to nurture cells.<sup>10</sup> Opportunities abound in advancing tissue engineering to develop more efficient and safer methods and make cultured meat economically viable.

### Plant-based proteins

Another approach is to mimic animal fat, as demonstrated by companies like Firmenich that create meat from plant-based ingredients. Since using non-animal ingredients can affect the final product's texture, additional techniques like a sustained release flavour delivery system could emulate the missing or degraded properties, gradually delivering a mix of meat-like aroma and taste through fat emulsions. By combining various plant-derived fat molecules, the company developed a culinary paste that simulates the same mouth coating effect as animal fat.

Singapore-based food tech startup Karana, meanwhile, has looked to nature to achieve the same result by taking advantage of the already meat-like texture of the jackfruit, a large tropical fruit with naturally stringy flesh. By harvesting young jackfruits at a specific time during the ripening process, the company captures the fruit's more savoury profile while managing the latex-like sap that it produces. High in fibre and low in cholesterol, Karana's whole-plant based meat products currently include shredded or minced pork that are cost-effective to produce, since jackfruit is a high-yield crop.

9 McClements, D.J. "Advances in edible nanoemulsions: Digestion, bioavailability, and potential toxicity", *Progress in Lipid Research*, January 2021 [<https://doi.org/10.1016/j.plipres.2020.101081>]

10 Ben-Ayre, T., & Levenberg, S. "Tissue engineering for clean meat production", *Frontiers in Sustainable Food Systems*, June 2019 [<https://doi.org/10.3389/fsufs.2019.00046>]

## Interview

### GIVAUDAN

The alternative meat segment represents one per cent of the entire meat industry today, yet is predicted to surge to 10–30 per cent by 2030. No single company can deliver all the answers to keep up with this blistering pace. For multinational corporation Givaudan, whose offerings range from functional ingredients to technological tools, collaborations are key to driving this accelerated dietary shift towards alternative proteins.

“We have cast the net wide with the understanding that everyone has a part to play, and that co-creation will get us all further, faster,” said Dr Elisabetta Lubian, Category Technical Leader at Givaudan’s Science and Technology global team.

In the alternative protein space, the company’s focus areas include nutrition, taste and texture. The latter two, Dr Lubian explained, are often intertwined: for example, thickness affects the food’s taste by slowing the rate of flavour release.



Credit: Givaudan

Accordingly, Givaudan pays close attention to texture, using techniques like extrusion to create plant-based proteins around 10 millimetres (mm) thick. Working with experts, they analysed various protein profiles, examining how their behaviour during the extrusion process affects thickness and overall product texture.

Besides thickness, dryness is another critical aspect. Plant-based proteins typically replace meat fat with vegetable oils that melt at lower temperatures. Upon cooking, these oils seep out from the product and accumulate in the pan, leading to a dry eating experience.

Givaudan researchers have developed an encapsulation technology that traps the oil and flavouring agents in a matrix, effectively mimicking the function of animal fat cells. By retaining much of the vegetable oil in the product during cooking, this approach can improve juiciness and stability while reducing fat levels by 75 per cent and calories by 30 per cent.

As Dr Lubian highlighted, innovations spring from collaborations with academia, startups and even non-F&B companies like those in the manufacturing sector. For instance, their partner startup Redefine Meat 3D prints food layers that mimic the fibrous nature of meat. Meanwhile, Givaudan also works with Wageningen University researchers in the Netherlands to develop shear cell technology for texturising. The method uses heat and shear stress to create thicker plant-based meat products of up to 30 mm.

“We have created an efficient process to assess, nurture and enable startups in the early stages, helping them get to market successfully,” Dr Lubian shared. “Working with startups in the early stages helps us expand our innovation ability and approach innovation endeavours with more calculated risk.”

Through these partnerships, Givaudan ensures that their solutions are future-proof, better anticipating the needs of consumers for healthful and enjoyable food.



### ③ FORTIFYING FOOD FORMULATIONS

Beyond flavours and textures, a universe of additional components are being developed to infuse foods with desired properties. Innovative food formulations will need to look beyond nutritional standards and account for other factors like stability, so that the overall quality of the final product is not disrupted.

Aside from contributing taste, for example, salt also acts a preservative and water binder, the latter making it important for stabilising products made of various phases. Sugar is similarly used to extend shelf life by preventing bacterial contamination and maintaining viscosity.

As each ingredient can provide much more than just flavour, innovative food products maximise either integrated approaches that overhaul entire formulations or smaller tweaks with just one or two additional compounds to achieve an enhanced product. The secret lies in discovering and producing the proper additives.

#### An assortment of additives

Additives encompass a broad range of ingredients and functions, such as colouring agents, stabilisers and nutritional supplements. Opportunities abound to discover more compounds that can enhance food quality, whether by conferring additional health benefits or increasing consumer appeal. One exciting category to explore are nutraceuticals, compounds that reportedly provide pharmaceutical or medicinal benefits like protecting against or treating specific diseases.

A pioneer in this space is Givaudan, whose product portfolio covers various properties from taste and preservation to sugar reduction and enhancing immunity. In many of these cases, many of these solutions are natural extracts or single ingredients, identified through technology and research, and added to existing formulations. For instance, their patented quillaia bark extracts, harvested from a tree native to Chile, acts as a highly-effective emulsifiers, enabling food production companies create specific to achieve a particular consistencies in beverages, confectionery and ice cream.

Meanwhile, their turmeric extract is a nutraceutical with purported benefits for joint health and cardiovascular health. Compared to standard turmeric, Givaudan enhanced the bioavailability of their extract, delivering a higher concentration of bioactive compounds called curcuminoids in a lower dose.

Another possibility is to develop biotech applications to manipulate various additives' physical and chemical properties, essentially turning them into customised ingredients with novel and enhanced functions.

For instance, International Flavors & Fragrances (IFF) developed a drying method called Powderpure Infidri to transform fruits and vegetables into sustainable powdered ingredients, extending their freshness. Dehydration usually involves intense heat and vacuum pressure to create powdered forms, tending to damage bioactive compounds in the process. In contrast, IFF's technology uses wavelengths of infrared light to remove water, preserving their nutrients and colour compounds.



#### Mixing in modulators

When moving from additive ingredients to finished products, fortifying food becomes an increasingly complex process, often requiring a highly precise or individualised approach to adjust the formula for each type of product. Such was the case for Alchemy Foodtech, whose product lines of fibre blends were adapted according to different carbohydrates like rice and pastries to modulate their glycaemic index.

Getting the formulation and preparation method right can ultimately lead to a range of enticing new products that deliver the same satisfying consumer experience but at minimal cost to the environment and human health. Companies can reach a broader consumer base by expanding their product lines, catering to diverse preferences and specific health needs with a range of additives and modulators to choose from.

## Interview

# ALCHEMY FOODTECH

From rice to noodles, carbohydrates remain a staple in Asian cuisine. However, many of these products have a high glycaemic index (GI), releasing glucose quickly after consumption and causing a spike in blood sugar levels. While healthier alternatives, such as brown rice or wholegrain options, are available, the taste and texture of white, refined carbohydrates continues to appeal to many consumers here. Instead of attempting to modify the rice or noodle products, Singapore-based Alchemy Foodtech develops plant-based fibre blends that are added as part of the cooking process to lower the GI by modulating the rate of digestion of carbohydrate foods while maintaining a sensory experience similar to that of refined carbohydrates like white rice.

"We characterised plant fibres in terms of how they would affect properties like texture and digestibility to create fibre blends that would slow down the digestion of carbohydrate food without changing the taste and presentation," said Verleen Goh, Chief Food Fighter at Alchemy Foodtech.

Backed by five years of research and development (R&D) efforts, the team optimised their blends for

various food types, including noodles, bread and other confectionery products, and white rice. White rice, being a commodity grain with a very neutral taste profile, was particularly difficult to modify, as its taste can be easily affected by any flavoured ingredient, Goh shared. But after dedicated experiments, they developed the *Alchemy Fibre™* For Rice blend that increases the fibre content of white rice tenfold. The powdered blend also lowers the GI by forming a layer around the rice grains, delaying the body's digestion of rice and slowing down glucose release.

However, one key barrier to market entry the company faced was in the area of health and nutritional labelling regulations, which are sometimes not sufficiently inclusive or have not adapted fast enough to cover the diverse health benefits of these newer food innovations.

"In Singapore, there is no direct health claim related to glucose health. Also, there's one commonly used dietary fibre test, but it is restricted to pick up only high molecular-weight fibres, which are mostly insoluble. Other soluble fibres—or prebiotics—included in our product won't be detected, so this affects the fibre claims we can make and can dampen innovation pickup," Goh explained.

The team thus had to find alternative ways to educate companies and consumers alike about their blends. Fortunately, during their R&D stage, Alchemy Foodtech had already established their credibility and received various international awards, which helped them pursue B2B partnerships to add the fibre blends into other companies' existing consumer goods and meals.

"As you build up a reputation and launch with more partners, it also builds more trust and awareness that this healthy innovation can be affordable and very easy to implement," said Goh. Now, Alchemy Foodtech has partnered with over 50 food manufacturers, restaurants and caterers, including local pau manufacturer Lim Kee offering healthy, ready-to-eat rice meals, as well as heritage brands like Yum Cha, optimising GI-lowering blends for popular items such as dim sum and pastries. The company estimates that over 8 million meals have been made healthier with Alchemy Fibre to date.



Credit: Alchemy Foodtech

## BARRIERS TO UPTAKE

On the road to taking food innovations out of the lab and into the market, issues arise not just with getting the product formulation right but more so ensuring scalable production given the resources required. Local companies may be reliant on the global supply chain for sourcing certain ingredients, and disruptions or rising prices elsewhere can hike up production costs. Especially with emerging technologies, like cell cultures or nanoencapsulation systems, initial high costs for setting up and operating the facilities can also ramp up final selling prices to avoid losses.



**As consumers become more health conscious, the ability to comply with regulations and make veritable claims on the health benefits of food products will be key to capturing market interest.**

These costs can dissuade potential customers, making it difficult for smaller companies to establish themselves. For example, cell-based protein startups like Mosa Meat need an extensive foundation of facilities and resources to perfect their products. In comparison, traditional meat segments are at peak productivity, have lower overheads and are recognised brands with well-established distribution channels. Further complicating this challenge is the need to attract the right talent to help develop new products as the company scales, which can be especially difficult due to the multidisciplinary nature of Deep Tech.

As budding startups reach out to potential customers and partners, ecosystem builders like SGInnovate and other investors can make a difference in this space, directing funding and support for talent towards growing Singapore's food tech landscape. Such support can in turn help catalyse more partnerships between startups and larger companies, with the latter providing infrastructure and an established consumer base for the former to introduce emerging technologies and novel product concepts. These collaborations help create a thriving ecosystem that can keep on innovating to meet evolving market demands.

With the F&B industry continuing to develop, the uptake of next-generation food products will rely just as much on consumer acceptance as their healthful advantages.

Aside from attracting funding and support, AgriFoodTech companies need to invest heavily in consumer and stakeholder engagement. As consumers become more health conscious, the ability to comply with regulations and make veritable claims on the health benefits of food products will be key to capturing market interest. Moreover, companies and policymakers alike may have to initiate educational campaigns to overcome misconceptions that new product categories might encounter.

Many of these new classes of ingredients and completed products will inevitably face rigorous regulatory processes to ensure the quality and safety of food. Besides ensuring access to resources for support for the necessary testing and compliance procedures, AgriFoodTech startups will also need to allocate the resources needed to properly raise awareness and educate consumers and regulators alike. Ultimately such support and resources at every step ease the entry of these new products into the market and go a long way towards incentivising food innovation.



## CONCLUSION

Novel food product development, much like Deep Tech itself, is multi-disciplinary, given the complexities of food formulations, the process of commercialisation, as well as the need to understand consumer behaviour and preferences. With potential synergies between emerging technologies like AI and biotechnology, and existing fields like food chemistry, innovation can lead to the creation of more nutritious and tasty options for all. In time, this application of Deep Tech will make these processes more efficient, lowering costs and enabling companies to scale quickly with new products.

This is especially important as next-generation food products look towards new food manufacturing methods such as 3D printing or incorporate novel components to amplify health or sensory properties to address food insecurity and tackle a range of health issues.

As a country with an already rich food culture and heritage, new ways of adding flavour, refining texture and fortification will only serve to further enhance the way we experience our favourite foods and make such experiences available to an even wider audience. Furthermore, these emerging technologies also have a hand in helping Singapore achieve its 30 by 30 vision to produce 30 per cent of the nation's nutritional needs by 2030, by working alongside food producers to improve the quality of locally-produced food, from alternative proteins to reinterpreted classics.

With more next-generation foods gathering mainstream momentum, these novel innovations are fast proving that food can be simultaneously affordable, tasty and healthy. Through the application of Deep Tech, Singapore can overcome its resource constraints and further cement its role as a regional innovation hub in the AgriFoodTech space as it progresses on its journey towards becoming a healthier, fitter nation.

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## About SGInnovate

SGInnovate is Singapore's catalyst for opportunities in the Deep Tech Economy. We forge new pathways for tomorrow's promising talent and emerging tech startups through the translation and commercialisation of research. Our work is closely aligned with Singapore's RIE2025 strategy and focuses on emerging technologies in the areas of sustainability, healthcare & biomedical sciences, AgriFood as well as Advanced Manufacturing. We achieve this through our triple helix approach of building and growing tech talent pipelines, investing in and supporting disruptive companies, and engaging Deep Tech communities to spark collaboration between startups and corporates.

## Advancing AgriFood Innovation

SGInnovate has embarked on various initiatives and collaborations to advance the conversation around AgriFood innovation in Singapore. In addition to investing in notable startups, SGInnovate also regularly serves as a bridge between AgriFood corporates and startups by facilitating collaboration opportunities and investments to drive the development and adoption of emerging technologies in the sector.





SGInnovate also works closely with local and international ecosystem partners to develop programmes and content for the AgriFood and wider Deep Tech community covering perspectives, trends and opportunities in this space. These range from industry reports and insights papers to interviews with experts such as our The Digital Feed series, in addition to SGInnovate's larger Open Innovation initiative that looks to bridge innovation gaps through corporate-startup collaborations. Collectively, these efforts are aimed at building expertise and encouraging the exchange of knowledge within the local AgriFood tech community to develop talent within the sector for startups and corporates alike.





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