Renewfood manufacturing: Food production for a nourished, resilient nation

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Dr Kang Lan Tee, Matthew Hutchinson, Joe Price and Professor Tuck Seng Wong from the University of Sheffield explain the importance of re-imagining food production to support people and the planet

Food transcends its basic role as a human necessity, encompassing a multifaceted significance in our lives. Beyond its fundamental function of providing nutrition and sustenance, food is a profound social instrument, it not only nourishes our bodies but also nourishes our relationships and interactions. Food production is undoubtedly vital to livelihoods everywhere.

We gather around a shared meal with our family and friends, using this communal experience to foster and maintain deep interpersonal connections. In business, food is a catalyst for successful negotiations as we convene with clients or customers over a meal, forging bonds and laying the groundwork for prosperous partnerships.

When we extend an invitation to dine, it becomes a gesture of gratitude and appreciation, a heartfelt expression of our acknowledgement for the kindness we have received. Likewise, food becomes a means of reward, allowing us to acknowledge and honour the exceptional achievements of others by treating them to a well-deserved meal.

Furthermore, food is an integral part of celebrations, symbolising joy and shared experiences. Many derive pleasure from exploring the culinary world, seeking Michelin-recommended restaurants to indulge their senses. With its profound impact on our social fabric, food has surpassed its utilitarian roots, assuming a prominent role in human connection and shared experiences.

Feeding the growing population and tackling hunger

As conscientious food consumers, we must look beyond the contents of our dining table and consider the broader implications of food production. Several compelling reasons underscore the need to examine how our food is manufactured.

Firstly, with the global human population reaching 8.0 billion in mid-November 2022, projections indicate a staggering increase of nearly two billion individuals within the next three decades, ultimately reaching 9.7 billion by 2050 and potentially peaking at around 10.4 billion in the mid-2080s (United Nations).

This begs the question: is our current food production and manufacturing process equipped to sustainably support such a vast population? Secondly, despite the world producing enough food to feed everyone, the harsh reality remains that 828 million people continue to suffer from hunger.

Fourteen million children endure severe acute malnutrition. Shockingly, hunger and related causes account for 45% of child deaths globally (Action Against Hunger). Thirdly, it is crucial to recognise the substantial environmental impact associated with food production.

A striking 26% of greenhouse gas emissions stem from the food sector, while 70% of global freshwater withdrawals are allocated to agriculture (Our World in Data). Lastly, the UK's average price of food and non-alcoholic beverages has experienced the sharpest increase since 1977, as the Office for National Statistics reported.

Factors such as poor harvests and conflicts like the Ukraine war have contributed to mounting challenges to our food supply, placing immense strain on household budgets. The need for immediate action to revitalise and innovate our food production and manufacturing processes has become exceedingly apparent.

How can precision fermentation support global food needs?

Fortunately, in the face of our food crisis, we possess a formidable biotechnological solution at our disposal: precision fermentation. Fermentation itself is not a novel concept. It stands as one of humanity's oldest and most effective biotechnological practices.

Many of our beloved foods and beverages owe their existence to the transformative power of fermentation. This process has been embraced and integrated into diverse cultures worldwide. From beer and wine to bread, cheese, yoghurt, kefir, sauerkraut, kimchi, miso, and kombucha, the extensive repertoire of fermented foods exemplifies the widespread acceptance and consumption of products created through fermentation.

We have grown accustomed to enjoying foods that involve microbes in their production or have undergone microbial processing. The question is whether we are prepared to embrace food derived from precision fermentation.

Precision fermentation harnesses microbial hosts as efficient "cell factories" to manufacture targeted functional ingredients. Simply put, it involves cultivating genetically engineered microbes capable of producing specific products (product precision) within controlled conditions and using carefully selected starting materials (process precision) in large-scale bioreactors.

Fermentation, conducted with high precision, offers enhanced food traceability (i.e., clear knowledge of food origin) and bolsters food safety standards.

For example, we can employ genetically modified yeast to synthesise bio-identical milk proteins such as whey and casein. This breakthrough technique holds extraordinary potential. Conventional dairy production methods release a substantial 3.51 kg of CO_2 per litre of milk produced (Our World in Data).

Reducing greenhouse gas emissions by 97%

In contrast, precision fermentation for dairy production can reduce greenhouse gas emissions by an astounding 97% (Perfect Day)! This significant environmental advantage is just one of the many benefits offered by precision fermentation, highlighting its capacity to revolutionise food production and address the pressing challenges of sustainability and climate change.

At the University of Sheffield, we are dedicated to pushing the boundaries of precision fermentation, taking it to unprecedented heights. Rather than simply replicating what conventional agriculture can provide, such as dairy and meat proteins, we delve into the realms of nature to uncover protein-based molecules that bestow familiar flavours upon us, such as meatiness, sweetness, saltiness, and even bitter-taste masking.

Our explorations are not limited to the familiar; we actively seek proteins that offer unique sensations or challenge our taste buds, expanding the realm of culinary experiences. These protein-based molecules have potential applications in food production and can be sustainably and consistently manufactured through precision fermentation, ensuring both quality and a reliable supply.

This opens up exciting possibilities for introducing new and innovative food products to the market. It is worth emphasising that our bodies are naturally attuned to digest proteins, making them a healthier and more nutritious option compared to chemicals. Through our research, we strive to unlock the immense potential of protein molecules, revolutionising the food industry with sustainable, flavourful, and wholesome offerings.

Securing the enjoyment of food for future generations requires us to take immediate action to renew our food manufacturing practices. By embracing the power of biotechnology, we can pave the way for a sustainable and thriving food future. Our responsibility is to preserve the luxuries we enjoy for generations to come.

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