

Ingredient innovations for successful reformulation



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Introduction

Consumers are seeking healthier and delicious alternatives to their old favourites. Manufacturers can ensure their products meet such demands by reducing the amount of so-called dietary evils such as salt, sugar, and fat; by adding healthy ingredients, such as fibre and other nutrients; or even by making their products more appealing through vibrant natural colours.

In this report, we will examine the reasons behind the drive to reformulate and look at some stand-out ingredients to ensure reformulated products still taste and look good.

At **Fi Europe**, the leading ingredient trade show that brings together over 1,200 exhibitors from the food, beverage, and nutrition sectors and thousands of visitors every year, manufacturers can scout out the latest ingredients for reformulation that will help them create winning products that are healthier for both people and the planet.

Visitors to Fi Europe can also explore the latest insights, regulatory changes, challenges, and solutions around reformulation thanks to the expert sessions, panel discussions, and fireside chats held at the Future of Nutrition Summit, Fi Europe Conference, Innovation Hub, Sustainability Hub, and more.



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The HFSS backlash

Diet-related disease is a major cause of mortality globally, responsible for one in five deaths and killing more people than tobacco and high blood pressure combined.¹ More so than ever before, consumers are aware of the link between an unhealthy diet and poor holistic health, and are looking to reduce their intake of foods high in fat, sugar, and salt (HFSS).

In the UK, most consumers understand the impact that their diet has on their health (78%) and an even greater number (87%) think that eating healthily is important, according to UK government data.² FMCG Gurus data shows that for many consumers globally, the Covid-19 pandemic reiterated the importance of maintaining a balanced diet, particularly as a means of supporting immune health.³

Consumers are increasingly opting for “better for you” alternatives, which strive to offer the same taste as their old favourites, but with a reduced cost to their health.⁴ In China, just under half (45%) of consumers realise the importance of maintaining a “light diet”, centred around the reduction of oil, salt, and sugar, and have made this way of eating a habit, Mintel data shows.

Food reformulation can therefore be an important tool in allowing consumers to maintain balanced, nutritious, and sustainable diets – and for brands to stay relevant by meeting their demands.

¹ [https://www.thelancet.com/article/S0140-6736\(19\)30041-8/fulltext](https://www.thelancet.com/article/S0140-6736(19)30041-8/fulltext)

² <https://www.food.gov.uk/research/wider-consumer-interests/healthy-and-sustainable-diets-consumer-poll>

³ <https://fmcggurus.com/blog/fmcg-gurus-long-term-implications-of-covid-19/>

⁴ <https://data.mintel.com/databook/1102789/#Q6>



Reduced sugar: Finding the sweet spot

In many food and drink products, sugar is not only useful in boosting sweetness and flavour but also plays an important functional role. In baked goods, sugar contributes to taste, colour, texture, and shelf life by facilitating caramelising, bulking, protein denaturation, starch gelatinization, and swelling.⁵ In frozen products such as ice cream, sugar affects the freezing point, influencing the softness of end-products.

“The big challenge is always to reformulate a product and deliver the same taste experience,” said Steve Osborn, commercial development director at The Aurora Ceres Partnership, a food and beverage consultancy.

“In some cases, like the early salt reduction, ‘stealth’ was an effective strategy over time, as consumer taste preferences changed.

But with fat and sugar, which provide texture and structure to a product, it can be less straightforward, as these ingredients possess unique physicochemical properties that are the essence of the products, such as melting characteristics and crystallinity. Replacing this functionality is extremely difficult through reformulation and sometimes new products with new sensory profiles are [a] better option.”

Brands are experimenting with solutions to replicate sugar’s non-sweetening functionalities while preserving its all-important taste properties. These include combining sweeteners like stevia with other functional ingredients such as inulin and maltodextrins, and altering the physical properties of sugar molecules to influence how consumers perceive sweetness.

⁵ <https://insights.figlobal.com/fi-webinar-series/algorithm-powered-digital-sugar-reduction-interview>

Innovative ingredients for sugar reduction

Next-generation stevia

The stevia leaf contains more than 70 sweet-tasting molecules, including Rebaudioside A, M, and B. Reb M is a steviol glycoside present at low levels (less than 1%) in the stevia leaf, with a taste profile around 300 times sweeter than sugar. It is considered to be the best-tasting stevia molecule, without the bitter or liquorice-like aftertaste that is often associated with the first-generation stevia, Reb A.

Novel methods to scale up production of Reb M are emerging. In 2021, the European Food Safety Authority (EFSA) approved Reb M produced via a bioconversion process,⁶ while in 2022, the Joint FAO/WHO Expert Committee on Food Additives (JECFA) approved Reb M production from precision fermentation, also known as Fermented Sugarcane Reb M, which converts sugarcane into a high-purity, no-calorie sweetener.⁷

These newly approved production processes could allow manufacturers to commercialise and sustainably scale Reb M, solving stevia's taste issues and ultimately reducing the sugar content of food and drink products.

Replacing the more energy-intensive sugar with stevia sweeteners made using these novel methods can also boost the sustainability of products.

The results of a lifecycle analysis commissioned by multinational ingredient supplier Ingredion found that producing Reb M via fermentation reduced the ingredient's environmental impact by 82%, and by half when bioconversion was used.⁸

Sugar proteins

In recent years, a growing body of research has emerged around the potential of several naturally occurring sweet-tasting glycoproteins, mostly derived from West African plants, such as brazzein from the oubli plant (*Pentadiplandra brazzeana*) and thaumatin from the katemfe fruit (*Thaumatococcus daniellii*). Many of these boast profiles hundreds or thousands of times sweeter than sugar and can be effectively combined with other sweeteners, such as stevia or sucralose, to achieve similar functional properties.

However, these proteins also fall short in some areas. Occurring in tiny concentrations (often less than 1%) in the plants that produce them, sweet proteins are difficult and expensive to extract and scale commercially.⁹ The low thermal stability of some sweet-tasting proteins has also traditionally limited their applications in the food industry.¹⁰ Progress to date has been slow, with a small handful of companies operating in the space. However, precision fermentation could be a solution to overcome these obstacles.

Several companies are using precision fermentation to scale up production of brazzein, a protein which is pH- and heat-stable, contains zero calories, and is around 1,200 times sweeter than conventional sugar.¹¹

Magellan Life Sciences, a UK-headquartered firm, is producing protein sweeteners via protein expression, using prokaryotic cells and fermentation through its proprietary production platform, XSeed.¹² Oobli, formerly known as Joywell Foods, is a food tech startup using microbial fermentation to produce sweet proteins sourced from fruit. The company recently launched the first product in its B2C range: chocolate bars made with brazzein that contain 3g sugar per 32g serving – this is around 70% less sugar than competitor products, according to Oobli.¹³

⁶ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R1156&from=EN>

⁷ https://fei-online.com/codex-alimentarius-adopts-processes-of-bioconversion-fermentation-for-production-of-reb-m-into-its-guidelines/?utm_source=rss&utm_medium=rss&utm_campaign=codex-alimentarius-adopts-processes-of-bioconversion-fermentation-for-production-of-reb-m-into-its-guidelines

⁸ <https://www.ingredion.com/na/en-us/be-whats-next/sustainable-sugar-reduction-lca.html>

⁹ <https://www.ers.usda.gov/data-products/sugar-and-sweeteners-yearbook-tables.aspx>

¹⁰ <https://europepmc.org/article/med/33302109>

¹¹ <https://insights.figlobal.com/processing-technology/precision-fermentation-producing-next-generation-protein-sweeteners>

¹² <https://insights.figlobal.com/processing-technology/precision-fermentation-producing-next-generation-protein-sweeteners>

¹³ <https://www.prnewswire.com/news-releases/oobli-announces-first-ever-sweet-protein-powered-products-beginning-with-chocolate-bars-301703646.html>

Salt reduction success

Poor diets account for an estimated 11 million deaths worldwide each year, three million of which are attributable to high salt intake, according to the WHO.¹⁴ Averaging between nine and 12 g per day, most adults consume around twice the recommended maximum level of sodium intake daily, which in some cases is equivalent to just three slices of bread.

In many products, simply removing salt is not feasible. Salt serves not only as a flavour enhancer but also as a core functional ingredient, such as leavening in bread or preservation in meat. Yet research shows that for many foods, reductions of as much as 30 to 40% could be made before safety or consumer acceptance is compromised.¹⁵

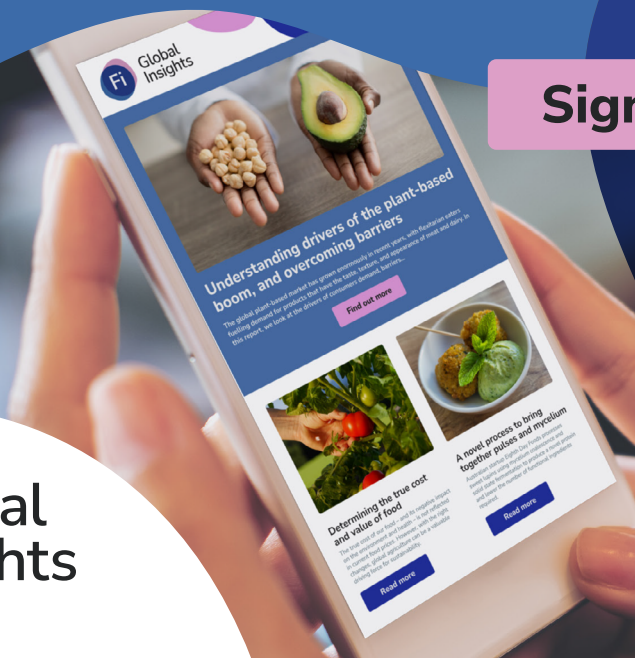
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¹⁴ <https://www.who.int/news-room/fact-sheets/detail/salt-reduction>

¹⁵ <https://www.whoccsaltreduction.org/resources/industry-and-reformulation/>

Next-generation ingredients for salt reduction

Bitter blockers

Salt replacers such as potassium chloride, calcium chloride, and acid salts offer similar taste and functionality to traditional sodium with fewer negative health impacts. The downside of such ingredients – given that taste is often the top purchase driver for food products – is their metallic and bitter aftertaste, which can often be difficult to hide.¹⁶

One solution to the bitter aftertaste of sodium chloride replacers is to combine them with flavour modifiers, such as umami extract or bitter blockers. A granted patent by Northeast Agricultural University covers a method to produce a flavour-boosting, low-sodium compound salt comprised of sodium chloride, potassium chloride, hydrolysed plant protein, yeast extract, maltodextrin, and citric acid, which claims to be effective in masking the off-flavour of the mineral.¹⁷

Bitterness-masking of potassium chloride can also be achieved by using a natural polysaccharide, kappa-carrageenan, to bind directly with potassium and reduce the amount required in food formulations, according to one case study.¹⁸

Micron-sized particles

Physical modification, such as size reduction or encapsulation of salt particles, influences the perceived saltiness of foods by affecting how salt is dissolved and tasted in the mouth. This ultimately allows manufacturers to reduce the amount of salt used, while preserving the familiar salty taste of products.

US-based company MicroSalt has developed a patented technique to create micron-sized particles that, despite being half the size of normal salt crystals, increase the perceived saltiness of food by dissolving instantly when coming into contact with the tongue.

The technique involves creating a salt-carrier mix by dissolving salt in water and combining the solution with carrier particles like food-grade additives or bulking agents. After undergoing a drying and evaporation process, the resulting micron- or submicron-sized particles can be used for dry topical applications, like popcorn or crisps.

Microencapsulation

In a study published in the Journal of Food Science and Technology, salt encapsulation was found to be effective in controlling the release of sodium ions. By using salt encapsulated in carnauba wax, the researchers were able to reduce the salt content of bread by 35% without impacting its perceived saltiness or dough parameters.¹⁹

Biotech scaleup Nucaps has developed a natural product using protein microencapsulation that controls the release of salt in the mouth. Delivering a more intense salty flavour with a sodium reduction of over 25%, the product allows manufacturers to lower the salt content of food while maintaining its nutritional and organoleptic properties.

¹⁶ https://www.efsa.europa.eu/sites/default/files/2022-09/EB97.2-food-safety-in-the-EU_report.pdf

¹⁷ <https://s3-eu-west-1.amazonaws.com/pdf-static.cipher.ai/pdf/20210908/AU2021100803A4.pdf>

¹⁸ https://www.fsai.ie/uploadedFiles/Food_Business/salt-summit-spain.pdf

¹⁹ <https://link.springer.com/article/10.1007/s13197-022-05504-2>

Ingredients for health: Added benefits and health halos

To meet the changing demand of an increasingly health-conscious consumer base, many food and beverage brands are taking steps to reformulate their products. Reformulation, however, isn't always about removing so-called dietary evils such as salt, sugar, and fat.

Recently, there has been a growing interest in increasing the fibre content of food and drink products. From precision prebiotics to upcycling fibre-packed side streams, ingredient manufacturers are using a variety of innovative techniques to boost the amount of fibre their products provide.

Most of the Western world is deficient in fibre. In the US, only 5% of people meet the Institute of Medicine's recommended daily fibre target, and in the UK an estimated 91% of the population do not eat enough fibre.²⁰

"When we talk about ingredients for digestive wellness, certainly one of the most popular and traditional ones is fibre," said MeganZEade, innovation technologist at product development consultancy, RSSL, speaking at Fi Europe 2021.

"Fibre is obviously very important for overall gut health, not only in the area of prebiotics but also in helping food move through the intestinal tract, and despite its importance – and our knowledge of its importance – still many of us are not reaching anywhere near our recommended fibre intake per day. So, this [...] remains a huge opportunity for development in innovations for digestive wellness."

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²⁰ [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(18\)31809-9/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(18)31809-9/fulltext)

Spotlight on trending fibre ingredients

Oat fibre

Oat fibre is tipped to be an on-trend ingredient for fibre fortification. The percentage of product launches containing oats as a core ingredient has soared in recent years, rising by 18% in plant-based milk drinks; 6% in plant-based, spoonable yoghurts; and 11% in plant-based ice cream and frozen yoghurt in the four years to 2022, according to Mintel.

Oat fibre is a type of soluble and insoluble fibre that has been shown to be effective in boosting the total dietary fibre (TDF) content of food and drink products.²¹ Derived from the processing of oat hulls, this fibre has a neutral taste and light colour, making it ideal for use in a wide range of applications. Added oat fibre ingredients are usually insoluble and can extend the shelf-life of products due to their ability to increase water absorption while regulating water retention, moderating the moisture of food products.



Prebiotics

Prebiotics are food for the live microorganisms living in the gut and for probiotic strains of healthy bacteria.

The International Scientific Association for Probiotics and Prebiotics defines prebiotics as "a substrate that is selectively utilised by host microorganisms conferring a health benefit." Prebiotics promote the growth of beneficial microbiota in the gut and commonly take the form of fibres.

To capitalise on the growing consumer awareness and interest in gut and digestive health and the microbiome, some brands are leveraging prebiotic fibres as wellness ingredients in better-for-you products. Despite representing less than 1% of all launches, prebiotic claims in global food and drink launches rose by 42% from 2016 to 2020, according to Mintel.

²¹ <https://www.grainmillers.com/oat-fiber-vs-oat-bran-whats-the-difference/>

Colour me happy: Ensuring sensory appeal with vibrant colours

Colour is an essential element of food formulation and plays a key role in influencing the consumer perception and acceptance of products, studies show.²² Despite seven in 10 global consumers perceiving new and experimental colours such as blue, pink, and green²³, as fun and exciting, many associate these with being unnatural, according to FMCG Gurus. This is spurring ingredient innovators to develop naturally vibrant colours.²⁴

By extracting colours from so-called superfoods such as spirulina and turmeric, manufacturers are optimising their use of natural colours in food and drink products and adding a health halo. The development of advanced processing methods such as precision fermentation is also allowing them to decrease the costs and natural resource demands of food production.

Consumers are growing increasingly concerned about the use of artificial colours in food and drink products, given their potential negative health effects. A survey conducted by FMCG Gurus in 2020 found that over half (56%) of US and UK consumers were concerned by the use of artificial colours in the food industry.²⁵ In turn, demand for natural food colourants such as annatto extract, carotenoids, and chlorophylls is growing, according to Mordor Intelligence.²⁶

Earlier this year, over 20 consumer advocacy groups in the US signed a petition from the Center for Science in the Public Interest (CSPI) calling for the Food and Drug Administration (FDA) to ban the use of FD&C Red No.3 dye in food, dietary supplements, and ingested medicines, due to its potential links to cancer and neurobehavioral problems in children.²⁷



²² <https://pubmed.ncbi.nlm.nih.gov/34038746/>

²³ <https://fmcggurus.com/blog/flavor-color-and-texture-innovative-flavors-are-sparking-consumer-interest-in-2022/>

²⁴ <https://fmcggurus.com/flavor-color-texture-free-resource/>

²⁵ <https://fmcggurus.com/concerns-around-artificial-food-colors/>

²⁶ [https://www.mordorintelligence.com/industry-reports/europe-food-colorants-market-industry#:~:text=Europe%20food%20colorant%20market%20is,period%20\(2020%20%2D%202025\).&text=Anthocyanin%20and%20betalain%20pigments%20are,demand%20over%20next%20five%20years.](https://www.mordorintelligence.com/industry-reports/europe-food-colorants-market-industry#:~:text=Europe%20food%20colorant%20market%20is,period%20(2020%20%2D%202025).&text=Anthocyanin%20and%20betalain%20pigments%20are,demand%20over%20next%20five%20years.)

²⁷ <https://www.regulations.gov/document/FDA-2023-N-0437-0001>



What are the latest novel ingredients for colour?

Volcanic microalgae

Novel sources of microalgae are also coming to the fore. Researchers at Wageningen University in the Netherlands have developed a method to grow microalgae that originate in volcanic hot springs, which could be used as a blue colourant and protein source by the food industry.²⁸ The microalgae species, *G.sulphuraria*, was found to contain significant amounts of phycocyanin, a natural blue pigment that is already in use in some products but is typically sourced from cyanobacteria or spirulina.

“Microalgae offer some key advantages compared to other microorganisms currently being studied as potential food sources. They are a natural source of essential fatty acids, and species such as *G.sulphuraria* are among the few naturally occurring sources of blue pigment,” said Iago Dominguez Teles, the project manager at Wageningen University.

Precision fermentation

Israeli startup Phytolon is using precision fermentation to produce betalain colours that could replace up to 70% of the natural and synthetic options on the market today, according to Halim Jubran, the company’s co-founder and CEO.²⁹ Using a proprietary technology and baker’s yeast that is more sustainable than synthetic colour production, the startup extracts natural pigments of beet and cactus fruits, providing a colour spectrum ranging from purple to yellow.

Last year, Phytolon announced plans to partner with US biotech company Ginkgo Bioworks to develop yeast strains with enhanced production yields, which will help to “pave the way to compete with synthetic colours in terms of cost and performance”, Jubran said.

²⁸ https://www.wur.nl/en/news-wur/show-home/microalgae-from-volcanic-hot-springs-as-a-promising-protein-source-for-the-future.htm?utm_source=webpower&utm_medium=email&utm_content=Microalgae%20from%20volcanic%20hot%20springs%20as%20a%20promising%20protein%20source%20for%20the%20future&utm_campaign=WUR%20Newsletter%2007%2F04%20EN

²⁹ <https://www.ingredientsnetwork.com/fermentationderived-betalain-food-colours-could-news116908.html>

Key takeaways

- Consumers are growing increasingly health-conscious and are seeking food and drink products that offer reduced levels of so-called dietary evils such as salt, sugar, and fat.
- Next-generation sweeteners include stevia produced via precision fermentation and enzymatic conversion, and sweet proteins such as brazzein.
- Combining salt replacers with flavour enhancers allows manufacturers to produce reduced-sodium products that do not have a bitter aftertaste, increasing the consumer acceptance of low- and no-salt products.
- Altering the physical properties of salt and sugar molecules, such as producing micron-sized or encapsulated particles, allows manufacturers to reduce their use of harmful ingredients, without affecting the taste and texture of products.
- Consumers associate artificial colours with negative health impacts and are instead opting for products containing clean label, sustainable colours derived from natural sources such as algae, fruit, and fungi.
- Interest in gut and digestive health is rising, yet most Western consumers still lead diets that are deficient in fibre. By adding oat fibre, prebiotics, and upcycled high-fibre ingredients to products, brands can help consumers meet their recommended dietary fibre needs.

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