Reformulation and ingredient innovations report, part 2:

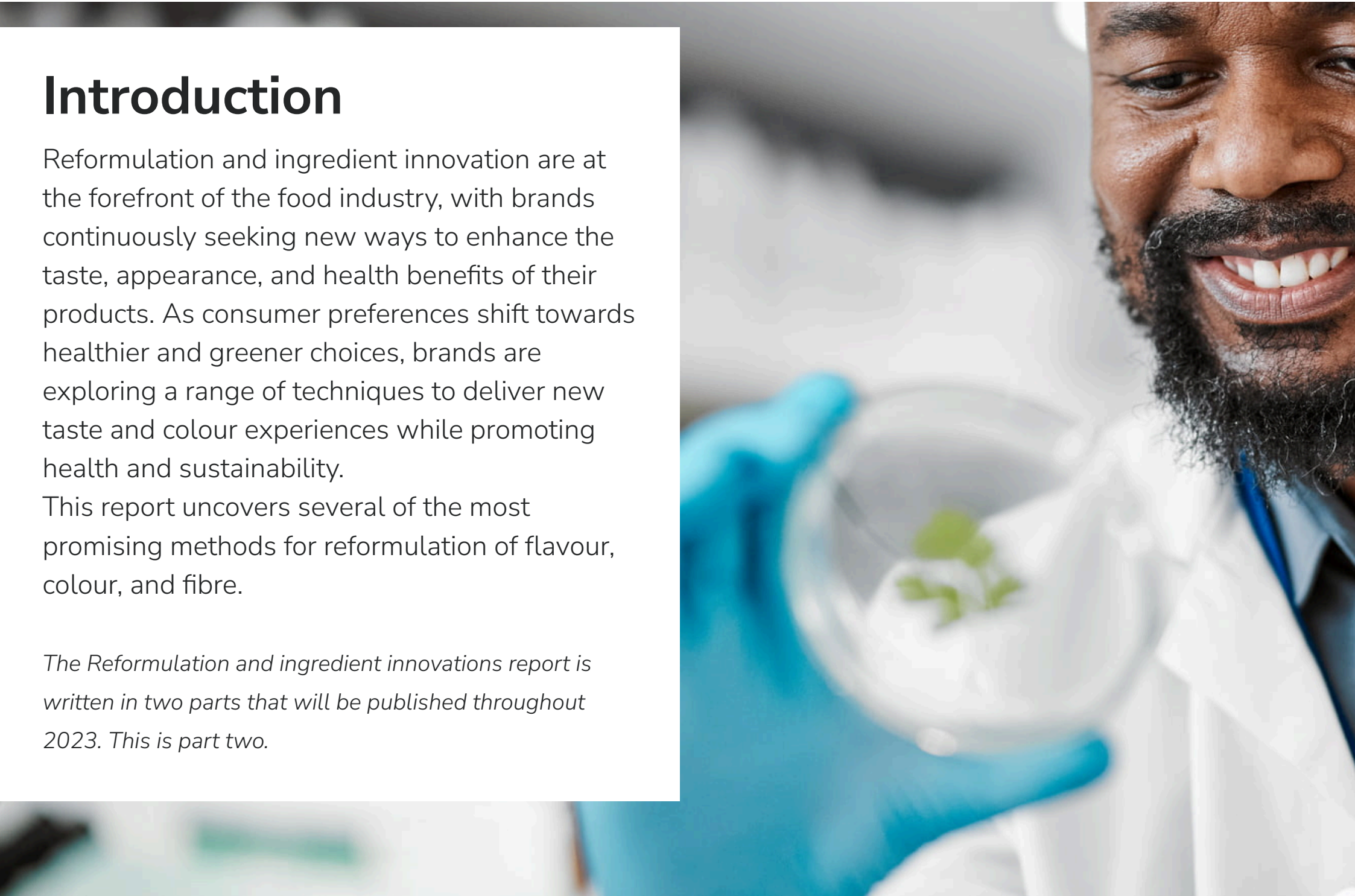
Flavour, colour, and fibre

Introduction

Reformulation and ingredient innovation are at the forefront of the food industry, with brands continuously seeking new ways to enhance the taste, appearance, and health benefits of their products. As consumer preferences shift towards healthier and greener choices, brands are exploring a range of techniques to deliver new taste and colour experiences while promoting health and sustainability.

This report uncovers several of the most promising methods for reformulation of flavour, colour, and fibre.

The Reformulation and ingredient innovations report is written in two parts that will be published throughout 2023. This is part two.



Global Insights

Boosting fibre for the health-conscious consumer

The health and wellness trend has taken the food industry by storm in recent years. In 2022, over half (58%) of European consumers actively sought to improve their eating habits, according to data from Euromonitor.[1] This trend is set to continue throughout 2023, with a recent FMCG Gurus survey predicting that, over the course of the next year, consumers will prioritise products that support their wellness needs, notably immune (66%) and digestive (56%) health.[2]

To meet the changing demand of this 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.

Capitalising on oats for consumer health and appeal

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.[3]

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.[4] 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.[5]

Of global food, drink, and supplement launches between 2018 and 2022 tracked by Mintel, less than 1% contained oat fibre, although this number is growing.[6] Most of these launches were concentrated in nutritional and meal replacement drinks; snacks, cereals, and energy bars; and cold cereals, most commonly in North America.

To deliver sought-after fibre nutrition claims, some brands are combining oat fibres with other fibres such as chicory and corn fibre. Austrian-based Yfood's Smooth Vanilla Balanced Drink is a lactose- and gluten-free, high-protein, and fibre-rich yoghurt drink that ranks as A on the Nutri-Score and contains oat and soluble corn fibre. French St Hubert's Plant-Based Chocolate Dessert is made from a blend of oat and chicory fibre and is high-fibre, free from artificial flavourings, and vegan.

As well as helping brands achieve high and added fibre claims, oat fibre ingredients are growing in popularity as clean label alternatives to chemical additives such as artificial emulsifiers in ice cream or methylcellulose in meat substitutes. Consumer awareness of oats is generally good, with 45% of US consumers agreeing that the use of oats as an ingredient would motivate them to buy a new snack bar, and half of Polish consumers viewing oats as a good source of fibre when used as a main ingredient in dairy alternatives.[7]

Cashing in on the holistic health trend via 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.[8]

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.[9] 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.[10]

As well as promoting prebiotic and digestive health benefits, prebiotic fibre ingredients can improve the nutritional profile of products by supporting sugar or fat reduction. Between 2016 and 2020, almost one in five product launches globally with a keto claim (19%), a low/no/reduced carb claim (18%), or a low/reduced sugar claim (16%) contained prebiotic ingredients.[11]

On the up: Upcycling side streams into high-fibre ingredients

Upcycling unwanted side streams from food production into fibre-rich ingredients can fulfil the consumer demand for increased fibre products that are also clean label and sustainable.

California-based startup ReGrained transforms brewers' spent grain – the by-product that remains after the beer-brewing process – into a barley-based functional flour for food manufacturers. Working in partnership with the United States Department of Agriculture (USDA), the startup developed a patented and highly efficient thermo-mechanical process for stabilising the grain.[12] The end-product is a soluble powder similar to toasted flour with a nutty, caramel-like flavour that packs a nutritional punch, containing 3.4 times more dietary fibre than wheat flour and twice as much protein as oat flour.

"*We're a food tech company and we use the technology we developed to make new, innovative ingredients through edible upcycling*," Kurzrock told Fi Global Insights.

"*Essentially, we mapped out all the food that is over-looked and under-utilised in the food system, identified how much nutritional value it had, and put it to use*."

The ingredient is also a source of prebiotic fibre, beneficial for gut health, and contains micronutrients such as iron, magnesium, manganese, zinc, and phosphorous. Tapping into the holistic health trend, the startup produces snacks including granola bars and extruded puffs, as well as selling the powder directly to manufacturers. The fact that the beer-making process uses up the natural sugars in the grain means the powder is low in sugar.

READ MORE: ReGrained's upcycled grain adds a health halo and sustainable story to products (click image)

READ MORE: Transforming citrus peel into functional ingredients (click image)

A circular citrus economy

Dutch circular-economy startup PeelPioneers upcycles citrus peel by-products from oranges and lemons left over from the European juicing industry into fibre and essential oils for food and drink products.[13] Using its proprietary technology, the company extracts valuable ingredients from the fruit peel and transforms them into functional ingredients for meat and plant-based meat analogues, plant-based dairy, bakery, and confectionery applications.

As well as being a source of fibre, PeelPioneer's citrus fibre is neutral in taste and colour and fulfils technical functions such as binding, thickening, emulsifying, and water retention. The company is also carbon negative and contributes to a circular economy by reusing water and running off green energy, it says.

Extracting protein and fibre from rapeseed oil side streams

Polish startup NapiFeryn BioTech developed a proprietary, patent-protected technology that processes rapeseed presscakes, a side-stream of rapeseed oil processing, into high-protein and high-fibre ingredients.

NapiFeryn extracts, purifies, and isolates proteins found in rapeseed presscakes to produce a fibre-protein blend that is soluble across a wide range of pHs and can act as an emulsifying, gelling, or foaming agent in food applications. Using this ingredient, the company has conceptualised a high-fibre and high-protein bar and granola, which have high stability due to the ingredient's high water and oil absorption properties, it says.[14]

Fibre deficiency suggests an untapped opportunity

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,[15] and in the UK an estimated 91% of the population do not eat enough fibre.[16]

"When we talk about ingredients for digestive wellness, certainly one of the most popular and traditional ones is fibre," said Megan Eade, 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."

Delivering flavourful food that is good for both people and planet

Consumers today are more concerned about their personal health and the health of the planet than ever before. Nevertheless, taste remains front of mind when it comes to making purchasing decisions at the supermarket.

With "taste temptation" a top trend for 2023 according to Mintel, consumers are seeking indulgent and pleasurable flavour experiences, but at a reduced health and financial cost.[17] Meanwhile, regulators are mandating brands to improve the sustainability of their business practices and products.

Quentin Reyt, taste expert and founder of flavour consultancy Your Flavourist, said: *"Consumers are increasingly turning to naturalness, less sugar, less salt, less fat, and less alcohol. However, they do not want to lose the pleasure factor!*

"Let's take the example of the premium non-alcoholic drinks market, which is literally booming. The typical request we receive from project owners for whom we develop recipes is as follows: 'Make me a non-alcoholic drink that reproduces all the sensations of alcohol, [is] low in sugar, natural and organic'."

From fermented foods to high pressure processing technology, manufacturers are finding innovative ways to satisfy consumers' craving for healthier and more sustainable products, that do not compromise on taste.

Using fermentation as a natural flavour enhancer

Despite soaring inflation across much of the globe over the past year, consumers are prioritising health and wellness when making

food purchasing decisions, according to Mintel. In Italy and Brazil, two of the hardest-hit economies in 2022, consumers say health benefits (61% and 57% respectively) and natural ingredients (53% and 54%) are more important factors than low price to indicate if food and drink is of good value.[18]

"With consumers increasingly seeking health-conscious and transparent options, companies

are turning to natural and recognisable ingredients for flavour," said Jasper Schouten, CEO and co-founder of 1-2-Taste, a global digital marketplace for food ingredients.

Fermented foods and beverages are gaining popularity given their unique and complex flavours and potential positive effects on health, including antioxidant, anti-microbial, anti-fungal, and anti-inflammatory activity.[19]

London-based startup The Coconut Collaborative uses a slow fermentation process to produce low-sugar, dairy-free yoghurts and desserts from ethically sourced coconut milk. For its yoghurt product, the startup ferments coconut milk with a mixture of live, vegan cultures (*S. thermophilus +, L. bulgaricus, Lactobacillus acidophilus,* and *Bifidobacterium lactis*) and probiotics to achieve a tangy, creamy flavour, without the need for added water, sugar, or stabilisers. The mixture is then blended with additional ingredients, such as fruit or natural flavouring, to create a variety of flavours options.

Sustainability as a key priority for flavour brands

The rise in demand for better-for-you products is mirrored by the growing global sustainability trend. Consumers view healthy foods as more environmentally friendly and better for the planet, while regulators mandate brands to increase their efforts and accountability regarding sustainability.

FMCG Gurus consumer data shows that since 2020, there has been a 13% increase in the number of consumers valuing sustainability initiatives from brands or outlets.[20]

"The flavour sector is not immune to the impact of the industry-wide push for sustainability. To meet sustainability targets and reduce environmental impact, companies are increasingly adopting sustainable solutions such as the use of natural and plant-based ingredients, reducing waste and emissions in the production process, and exploring alternative sources of energy," said Schouten from 1-2-Taste.

Foodtech startup Siiqoia Labs, for example, extracts natural flavours and bioactive compounds from botanical, fruit, and vegetable-based side streams using a heat-free process that ensure nutrients are not lost. The Belgian startup believes the answer to shifting consumer eating habits and creating a healthier and more sustainable food system lies in flavour. It sees its solution as the answer to several of the sector's greatest challenges including fragmented markets and a lack of small, seasonal, local flavours, it says.[21]

The startup's patented process consists of high-pressure processing (HPP) – a technology traditionally used in pasteurisation that uses compressed water as a pressure medium to remove bacteria, yeast, and mould – to extract, replicate, and infuse flavours from industry by-products. Unlike alternative processing methods such as thermal processing, HPP replaces the need to use heat, ultimately improving the sustainability and environmental credentials of end products.

Initiatives such as the EU Green Deal and Farm to Fork Strategy aim to fundamentally transform food systems, to make food production and consumption within Europe fair, healthy, and environmentally friendly. Shifting towards more sustainable food systems puts emphasis on natural, plant-based alternatives, and away from products high in so-called 'dietary evils' such as salt, sugar, and fat.[22]

Alexander Mohr, executive director, the European Flavour Association (EFFA), said: "*Often, the challenge on this type of reformulation is to achieve the right taste. Flavourings have a key role to play in helping brands to provide these products while maintaining a great taste. The flavour industry can therefore be a key ally in achieving the EU Green Deal objectives.*"

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Flavour suppliers, sitting in the middle of the food value chain, will likely be heavily impacted by the EU regulatory drive towards sustainability within the coming months, Mohr said. It is therefore essential that brands anticipate the changes that will be required of them by initiatives such as the Corporate Sustainability Due Diligence Directive (CSDD) and start taking steps to becoming more sustainable.

Nature’s palette: Innovating for natural, more sustainable 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.[23] Despite seven in 10 global consumers perceiving new and experimental colours such as blue, pink, and green[24], as fun and exciting, many associate these with being unnatural, according to FMCG Gurus. This is spurring ingredient innovators to develop naturally vibrant colours.[25]

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 eat with their eyes (and their social media accounts!)

It was over 2,000 years ago that first-century Roman gourmand Marcus Gavius Apicius reputedly said, "we eat first with our eyes."[26] In today's social media age where consumers' purchasing and consumption habits can be dictated by the social media they are exposed to, this statement could not be more relevant.[27]

Social media has exploded in popularity over recent years, with over 60% of the global population now regularly using one or more social media app.[28] The surge in popularity of social media sites such as Instagram, TikTok, and YouTube has forced manufacturers to reassess the importance of appearance when it comes to designing and producing food products.

A survey conducted by the International Food Information Council (IFIC) found that 64% of consumers considered the appearance of food and drink products to be an important factor when making purchasing decisions.[29] The same research found that 42% of consumers were willing to pay a premium for products that had an appealing appearance.

Consumers view artificial colours as being bad for their health

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.[30] In turn, demand for natural food colourants such as annatto extract, carotenoids, and chlorophylls is growing, according to Mordor Intelligence.[31]

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.[32]

Despite evaluations by several health agencies, including the National Toxicology Program in the US, concluding that "convincing" evidence of carcinogenicity and thyroid tumours from FD&C Red No.3 exist,[33] the colourant has been deemed safe since its joint evaluation by the FAO/WHO Expert Committee on Food Additives (JECFA) and the EU Scientific Committee for Food (SCF) in 1990.[34]

In recent years, many food brands have voluntarily opted to remove artificial colours from food and drink products sold within the EU due to negative consumer perception although this is not the case in all regions around the world. In 2016, confectionery and packaged food giant Mars announced plans to remove synthetic food colourings from its US portfolio of products, but later abandoned its pledge.[35]

Using microalgae to deliver a vibrant colour and a clean label

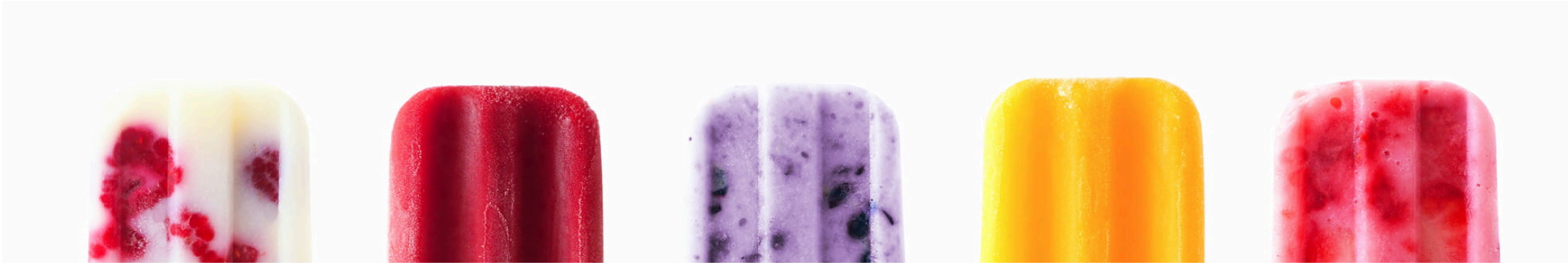
The vast majority (78%) of consumers consider clean label products to be appealing, FMCG Gurus data shows.[36] In the EU, many food producers are shifting from synthetic to natural food colouring to appeal to the clean label trend, according to the Centre for the Promotion of Imports from developing countries (CBI).[37]

One popular development in the natural colour sector is the use of plant ingredients such as turmeric, beetroot, and spirulina. Microalgae, such as spirulina with its blue-green colour, are gaining popularity as natural colorants due to their high nutritional value and vibrant colour.

Appealing to health-conscious consumers, manufacturers are using microalgae extract in products such as energy drinks, protein bars, and smoothies to achieve a clean label.

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.[38]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.



READ MORE: Fermentation-derived betalain food colours could replace 70% of natural and synthetic options (click image)

This new method of sourcing phycocyanin could offer a more sustainable alternative to existing blue colorants as microalgae can be grown in a controlled environment and requires less land and water than traditional alternatives. Some microalgae-based pigments may also have higher stability and a longer shelf life than the already commercially produced microalgae strain *Spirulina*, which can degrade over time and with exposure to light.

Precision fermentation opens the door for natural, more sustainable food colours

In keeping with the sustainability trend, US-based startup Michroma develops proprietary, gene-edited fungi strains from which it can produce high performance ingredients using precision fermentation, including food colourants. The fungi are fed on upcycled agricultural waste.

Michroma's first ingredient, Red+, delivers a clean label, uniform, bright red colour and is temperature-resistant and stable across the food pH spectrum. The ingredient's ability to withstand intensive processes such as pasteurisation and extrusion make it applicable across a wide range of applications, from cultivated meat to ice cream.

Israeli startup Phytolon is also 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.[39] 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 told Ingredients Network.

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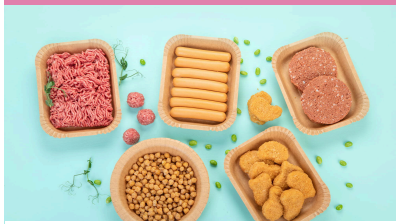

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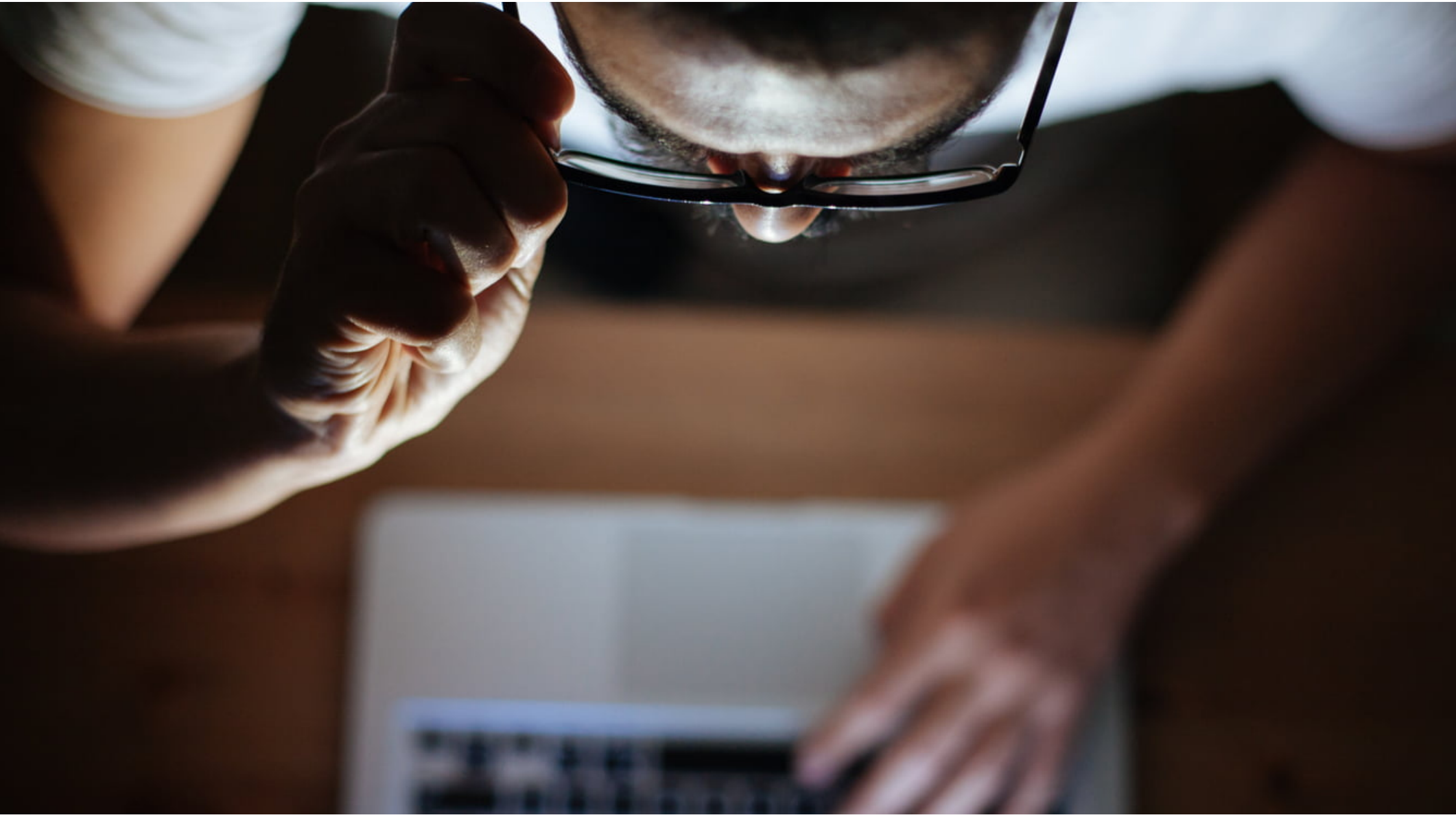
Key takeaways

- A range of techniques including precision fermentation, upcycling, and high-pressure processing allow brands to boost the consumer appeal of their products by offering new taste and colour experiences.

- Healthy indulgence continues to be a key industry trend in 2023, with consumers increasingly seeking products that are good for them and good for the planet. Flavour innovation is essential to ensure these products do not compromise on taste.

- 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 have diets that are deficient in fibre. By adding soluble and insoluble fibre and prebiotics to products, brands can help consumers meet their recommended dietary fibre needs.



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