TETRA PAK INDEX 2023

The future of health and nutrition

Consumer attitudes, trends and the potential for new food

Tetra Pak®
PROTECTS WHAT'S GOOD

Thoughts from our President and CEO

Adolfo Orive,
President & CEO,
Tetra Pak

Welcome to the 15th edition of the Tetra Pak Index, which focuses on what consumers see as the future of health and nutrition. Having experienced an unprecedented global pandemic, today's consumers are more focused on health than ever, and are more demanding of their food and beverages. At the same time, the industry is investing heavily to meet their evolving needs and capture the opportunities they present, while also addressing the pressing sustainability challenges. As a result, we are now in an exciting phase, with a number of promising technologies generating 'new food' innovations like never before.

Modern consumers are quite well-aware of the changes going on around them. They see technology as key to a healthier, more sustainable and more equitable future. But there are concerns to be navigated, with some becoming wary of innovation, desiring products that are as natural as possible.

Interest in preventive health measures and holistic wellness continues to be strong, driving appetite for healthy products and those with specific benefits, notably immunity boosters. Mental health is a major focus: three-quarters of consumers now say that it's as important as physical health – and more than four in five choose products to support it.

In general, consumers are paying far more attention to what they eat and drink – and are feeling better as a result. Sugar is the number one food concern, with consumers, regulators and industry all taking steps to reduce its consumption. Personalisation is on the rise, as brands invest heavily in tailored solutions for narrower consumer groups, particularly around age and medical conditions. There are exciting possibilities for probiotics products - also known as functional foods – that may help to reduce the risk of serious illnesses, such as cancer and Alzheimer.

Value and price are paramount, as consumers everywhere struggle with the cost-of-living crisis. Many worry that this will limit their access to healthy food, but they are determined not to give this up. There is continued high interest in organic and natural food, and almost half of consumers now strive to be flexitarian or to exclude meat altogether. While in some cases, higher price points have cooled the demand for plant-based protein alternatives, the longer-term forecasts for such products remain strong.

Climate change and other environmental issues continue to be pressing concerns and are increasingly interlinked with health. Two-thirds of consumers now say that environmental factors impact health, and even more believe that healthy products should not harm the environment. Packaging is part of the picture: sustainable products should go in sustainable packages – such as those that use renewable and/or recycled materials with a low carbon impact, are recyclable and help reduce food waste. Many believe that the food and beverage choices they make can result in a positive difference; more than half say that by changing their diet they can contribute to a better world.

In many parts of the world, people still rely on products such as milk and juices for their daily nutrition, so it is critical to optimise their value chain with innovations in sourcing, packaging, processing and distribution, which is where we have been playing an active role together with our customers and suppliers.

In addition, considering that the world will need 60% more food by 2050, we need to complement these efforts through technologies that can help explore new sources of nutrition – ranging from new plant-based sources to alternative proteins produced with biomass and precision fermentation. Both these areas are critical to contribute towards food system[1] sustainability.

For decades, we have been working towards building resilient and sustainable food value chains that improve livelihoods, reduce environmental impact, and ultimately, help provide healthy diets to the global community. This year's Index shows plenty of examples of our recent work, including how we reduce food waste and climate impact; converting low-value side streams from food production into new ingredients; alternative protein; fermentation-derived proteins; and collaborations with start-ups that are providing technological solutions to some of the issues affecting global food systems today.

All this is part of our commitment to the future - and to our long-standing purpose: "We commit to making food safe and available, everywhere. And we promise to protect what's good: food, people and the planet."

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>
> **Adolfo Orive,**
> President & CEO, Tetra Pak

1 The term 'food systems' refers to all the elements and activities related to producing and consuming food, and their effects, including economic, health, and environmental outcomes (OECD, https://www.oecd.org/food-systems, 2023)

Today's consumer

We see four key macro forces shaping the food and beverage industry of today and tomorrow: health and wellness; the cost-of-living crisis and geopolitical tensions; climate change and sustainability; and technology and innovation. In this section, we explore global consumer attitudes around these forces and their likely influence on nutrition going forward.

Research methodology
The findings in this year's Index are based on a bespoke global consumer attitudes research study; expert interviews; additional Tetra Pak research studies; and desk research. For more on research and methodology, see page 37.

HEALTH AND WELLNESS

The rise and rise of wellness

COVID-19 put health and nutrition in the spotlight. People demand food that supports their mental health and boosts their immune system

Micael Simonsson,
Director, Processing Development, Tetra Pak

Key survey findings at a glance

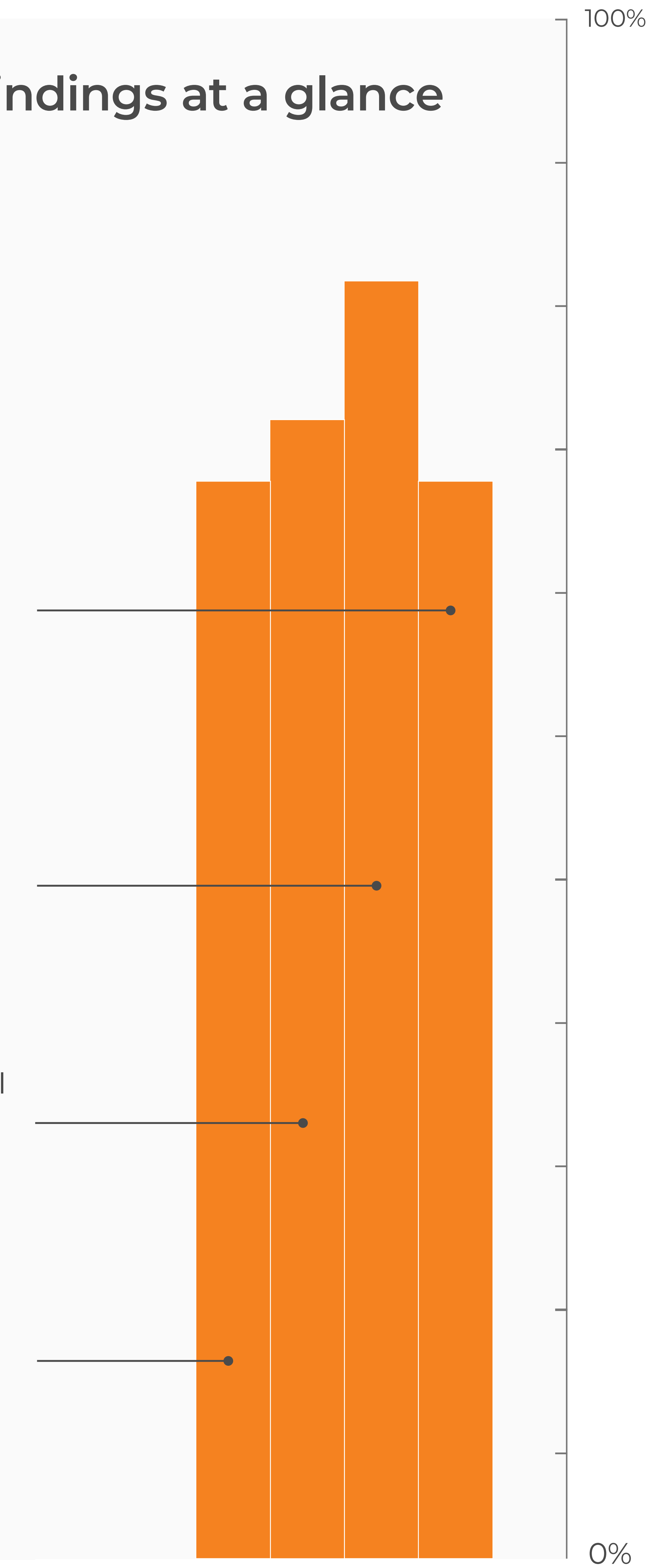
70% say that healthy food and drink makes them feel better

Reducing sugar is the #1 healthy option

83% consume products that support their mental health

74% say that mental health is as important as physical health

70% say health has become more important over the last few years



Preventive health measures remain key, and food and beverage products have a huge role

69% say they now try to be healthier to prevent future illness

74% are interested/very interested in purchasing products with specific health claims

43% would opt for products that strengthen the immune system and reduce the risk of diseases

The pandemic had a huge impact on the food and beverage industry on multiple levels. It disrupted supply chains, reduced consumer purchasing power, and changed eating and shopping habits, to name just a few. The effect on consumer attitudes and behaviours is still marked and comes through strongly in our research.

Health and wellness are more top of mind than ever. 70% say health has become more important for them and their family over the last few years – rising to 86% in China and 88% in Kenya.

Nearly three-quarters (74%) of consumers are either interested or very interested in purchasing products with specific health claims, with products that strengthen the immune system and reduce the risk of diseases topping the list at 43%. Such products are particularly in demand in Africa: they were voted #1 most desirable health product by 64% of respondents in Kenya, and 54% in South Africa. Globally, in terms of ingredients, natural and organic options are the go-to for immunity boosts.[1]

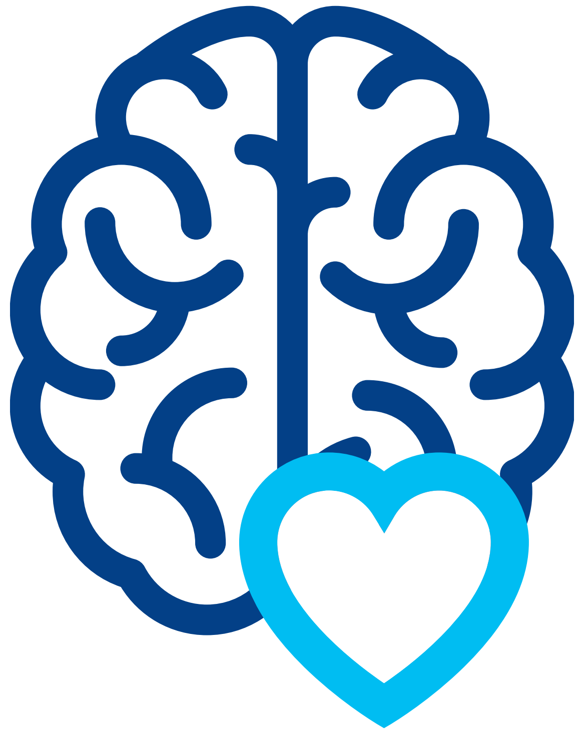
Physical and mental health go hand-in-hand

As we found in the last Index, the pandemic heightened awareness of mental health, as consumers struggled with issues such as anxiety and isolation. Today, this awareness is stronger still, as post-pandemic consumers face new stress factors, such as the rising cost of living and geopolitical instability.

↗ READ MORE

Three-quarters of consumers now agree that mental health is as important as physical wellbeing – the highest level for any statement in our general health questionnaire, and perhaps the most striking figure in our whole survey.

The connection between physical and mental wellbeing comes through very strongly in this year's research. The joint #2 most desirable health-related products are those that are good for both physical and mental wellbeing, at 39% (tied with those that manage weight). Meanwhile, other research shows that physical and mental wellbeing go hand in hand, with one impacting on the other in a variety of ways.[2]



3/4 of consumers now agree that mental health is as important as physical wellbeing

1 Trendipedia Consumer Trends 2023, Ipsos for Tetra Pak, January 2023.
2 For example, scientists in South Korea found a link between anxiety and eyesight problems, while a US study showed loneliness increased the risk of hospitalisation and death for heart failure patients. https://www.mckinsey.com/mhi/our-insights/the-secret-to-great-health-escaping-the-healthcare-matrix

The McKinsey Health Institute (MHI) believes that over the next decade humanity could add as many as 45 billion extra years of higher-quality life – roughly six years per person on average, and substantially more in some countries and populations – by adopting a more holistic view of health, including mental, social and spiritual aspects, as well as physical. https://www.mckinsey.com/mhi/our-insights/adding-years-to-life-and-life-to-years

Food and beverage boost mental wellbeing

Our survey shows that food and beverage products are perceived as critical to helping improve mental wellbeing. 83% of global respondents in our survey say they now consume products that support their mental health, and more than a quarter do this "often". The main benefits they are looking for are to feel more energised (50%), more relaxed (47%), and to destress and find comfort (39%).

Moreover, 69% of global consumers say that healthy food and drink should help them stay in control of their body and mind – again, highlighting the link between the two.

Healthy behaviour on the rise

Two-thirds (66%) of consumers say they now pay more attention to what they eat and drink – compared with 62% who said they paid more attention to the quality of their food and beverage choices in 2021. More than half (55%) now say they have improved their eating habits in the past two to three years. Reducing sugar (44%), eating more fruit (43%) and preparing homemade food (40%) are considered the most healthy options. Moreover, 70% agree that healthy food and drink make them feel better.

Consumers also say they are changing their behaviour in order to stay healthy, notably by drinking a lot of water/staying hydrated and through exercise.[1] Also on the rise are consumption of nutritional supplements (cited by 56%) and using technical devices/apps to monitor health (55%). Other research shows that moderation is another key trend, fuelling demand for no- or low-alcohol beverages, as well as low fat, sugar, calorie and salt options.[2]

Generally, our findings reflect the global explosion in interest in wellness, a market that is now estimated by McKinsey to be worth more than $1.5 trillion and growing at a rate of around 5% to 10% per year.[3] Other research is similarly bullish, forecasting a compound annual growth rate (CAGR) of 8.5% from 2022 to 2027, adding $452.93 m in value. Nearly a third (31%) of that will come from North America, which is showing the fastest growth in this sector.[4]

TREND

Replenish and repair

In these challenging times, many consumers feel a need to pause, unwind and recover. Recharging through ingredients such as CBD (cannabidiol), herbals and adaptogens, or the practice of ancient wellness rituals, can provide relief from feeling overwhelmed. Traditional medicine from China and Ayurvedic medicine from India are experiencing a resurgence in wellness practices. "Lost" ingredients, such as the Native American yaupon,[5] have been rediscovered, while involution (neijuan) is the buzzword for China's Gen Z: increasingly frustrated with the 9-9-6 (9am to 9pm, 6 days a week) work culture, they are turning to food and beverage products that lift their mood and calm stress.

TREND

Empowerment through diet

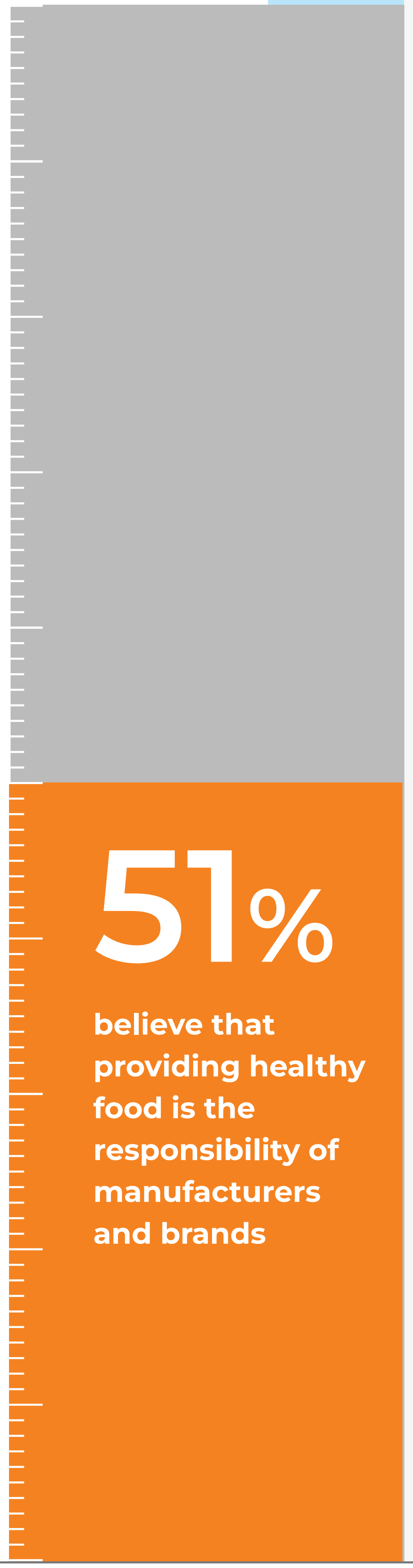
Food and beverage consumption choices are critical to create a much-needed feeling of empowerment and control in a turbulent world. Consumers are increasingly matching what they put into their bodies to their health and life goals, from recovering from illness, to sitting exams, to preparing for new life stages such as parenthood or ageing.

1 Both activities were cited by 57% of respondents, with around two-thirds (62% and 65% respectively) saying that they had increased this activity in the past two years.
2 Trendipedia Consumer Trends 2023, Ipsos for Tetra Pak, January 2023.
3 https://www.mckinsey.com/industries/consumer-packaged-goods/our-insights/feeling-good-the-future-of-the-1-5-trillion-wellness-market
4 https://www.prnewswire.com/news-releases/health-and-wellness-food-market-size-to-grow-by-usd-452-93-million-from-2022-to-2027--assessment-on-parent-market-five-forces-analysis-market-dynamics--segmentation---technavio-301678986.html
5 Yaupon is a species of holly that is native to southeastern North America. The plant was traditionally used by Native Americans to make an infusion containing caffeine, with with emetic and purgative properties.

Responsibility for healthy food (and planet) falls on brands

Consumers believe that healthy, sustainable food is key both to their own health and that of the planet – and they expect the food and beverage industry to deliver it. More than half (51%) of consumers believe that providing healthy food is the responsibility of manufacturers and brands – the number one choice, ahead of farmers/producers and government. They also look to them for guidance in this area: 72% see health and wellness as the number one issue that brands should speak out on, followed by nutrition (69%) and environmental issues (58%).[1]

Food and beverage companies have long been working to overhaul their portfolios to offer healthier choices. But they are being pushed to do more, notably by regulatory trends and pressure from shareholders, including institutional investors managing trillions of dollars in assets. "Sugar in particular is really being targeted by the industry at the moment," says Mark Rumbell, Processing Director, Business Stream Beverage, Tetra Pak (see Sugar reduction, page 34).



VIEWPOINT

Health is getting personal

The potential for personalised nutrition is a trend that comes through strongly in our expert interviews for this year's Index. "Personalised nutrition is a trend that is relatively new but it's going to be revolutionary," says Tammy Meiron, Chief Technology Officer at Fresh Start.

Increasingly, brands are offering a wide range of personalised products for every consumer. "People are cautious about their body, and select food based on their needs and lifestyle," says Micael Simonsson, Director, Processing Development, Tetra Pak.

"Global brand owners are investing billions in research and innovation, as well as collaborating with universities and institutions, as part of a long-term strategy around different target groups and special needs," says Niclas Torstensson, Global Account Processing Director, Tetra Pak. "They are creating tailored recipes for ever narrower consumer groups, based on factors such as age and medical conditions."

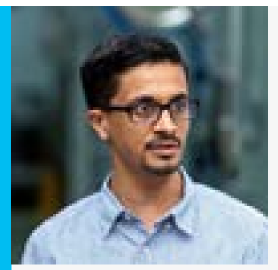
"A huge segmentation is going on in this space," says Jim Dicks, Global Account Director, Tetra Pak. "Brands are actually now helping consumers understand their own health and wellness needs. For example, by expanding needs to meet emerging lifestyle segments. These refined segments include Adult Nutrition, Weight Loss (meal replacement), Sports Nutrition, Hydration and Active Lifestyle."

"We're also working with a lot of start-ups active in the arenas adjacent to pharma food," says Micael Simonsson. "We can see that it is possible to produce anti-cancer products and the industry is in the starting phase for anti-Alzheimer's, too. They are what we call probiotics or functional foods. They will not treat you, but they will inhibit the condition and help to improve your health and wellbeing from different angles. This is a very tricky area: you can't really make these claims on the package, because you need to prove efficiency with long term studies first."

1 2022 Global Trend Study, Health Focus International

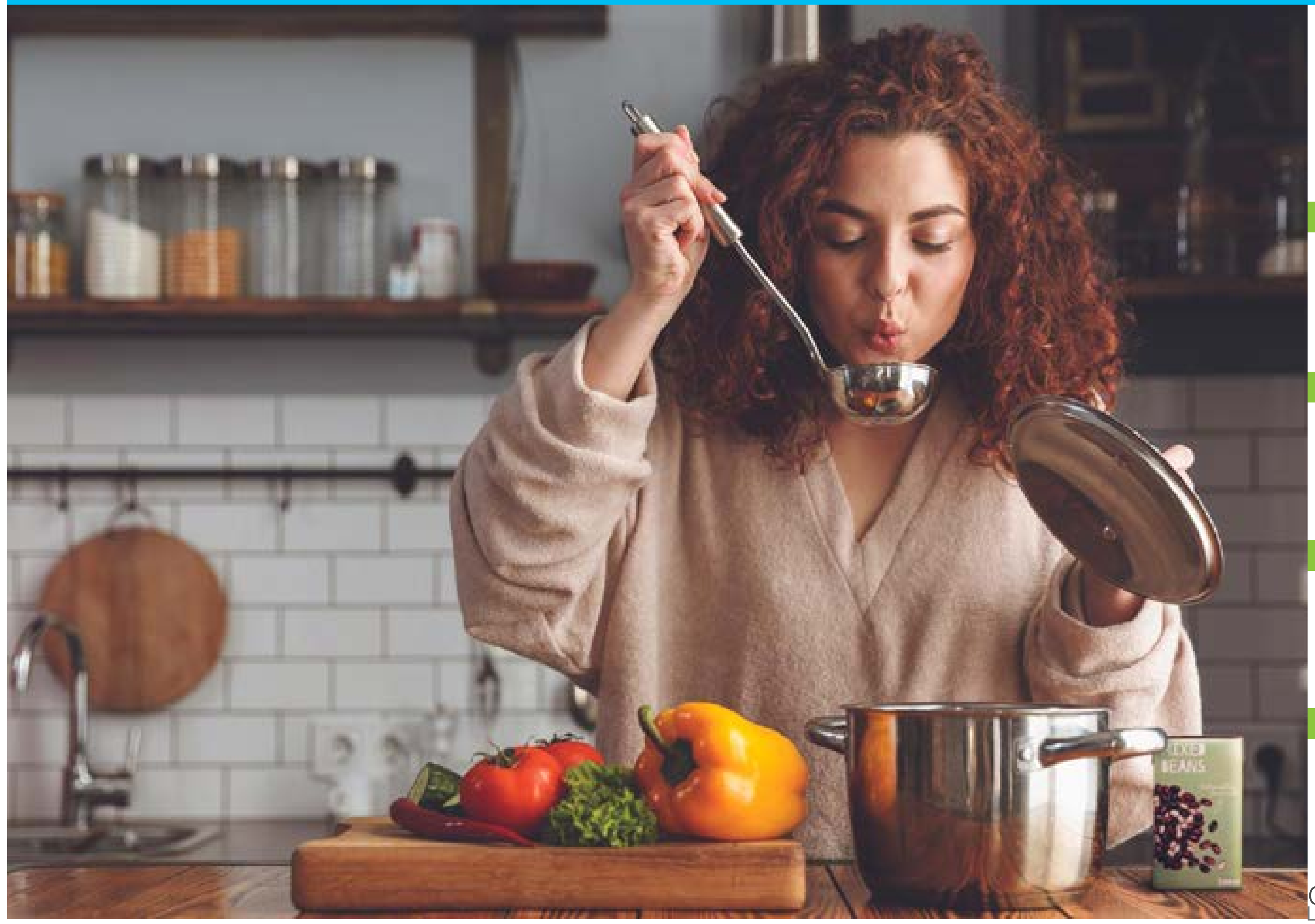
COST OF LIVING AND GEOPOLITICAL UNCERTAINTY

Getting by and trade-offs

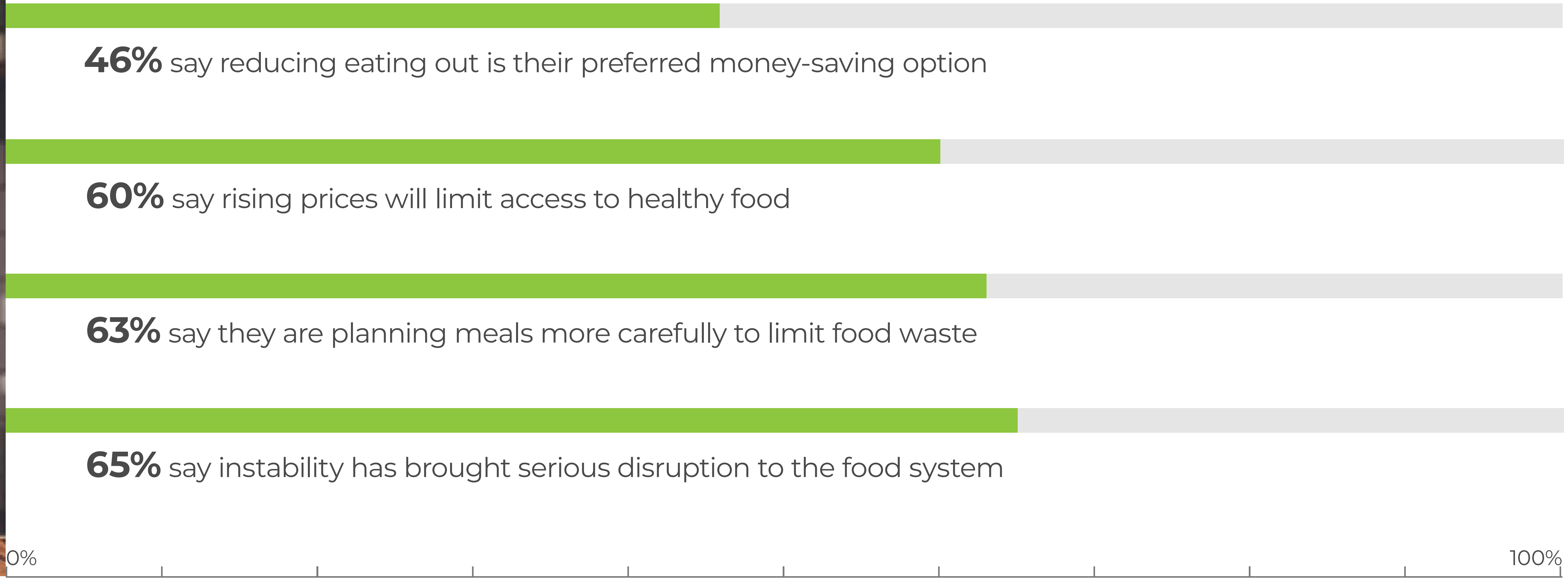


> *The longer-term forecasts for plant-based beverages market remain strong.*

Hemang Dholakia,
Centre of Excellence Manager, Plant-based, Tetra Pak



Key survey findings at a glance



Economic activity across much of the globe is experiencing a slowdown. With high inflation impacting the price of many staple goods, European and North American consumers are being put to the test by the cost-of-living crisis. Elsewhere, in APAC countries, the lingering effects of COVID-19 still weigh heavily on the recovery outlook. And general geopolitical uncertainty is impacting consumer and business confidence worldwide.

Our survey reflects this global mood. Consumers are increasingly concerned about being able to afford or access the food and drink that they want or need, as rising costs significantly impact consumption and attitudes. High prices of quality food and healthy options top the list of concerns around food and beverage products (on 42% and 40% respectively).

Nearly half of consumers struggling financially

Nearly half (49%) of global respondents say they are only just about getting by, or worse, from a financial perspective. Nevertheless, consumers seem determined to avoid cutting back on food and drink with health benefits (just 17% say they would choose to do this), or that is organic (17%) or environmentally sound (17%). All of these rate bottom of the list of preferred money-saving options, while reduce eating out and snacking rate top. Interestingly, 70% say they would sacrifice convenience if it means getting healthier products, rising to 85% in India and 82% in China – a marked shift in long-prevailing attitudes.[1]

Consumers face affordability versus health trade-offs

Despite their reluctance to cut back on healthy food, 60% say that increasing prices will have a negative impact on their access to such products – again, underscoring the perception that healthy options are seen as premium products. Even more (63%) say they are already planning meals more carefully in order to limit food waste in the household, while nearly half (47%) say they are concerned that they cannot afford all the food types that they want to buy.

There are also signs that principles of healthiness that have been widely accepted by consumers for many years are being outweighed by affordability. Concerns about excess sugar and obesity are now exceeded by worries about high prices – particularly for both quality food and healthy food.

Despite struggling financially, only

17%

would sacrifice food and drink with health benefits

1 Food Forecast: Trends, Tensions and Macro Forces in Food & Beverages, Ipsos. Based on 24,332 adults in 25 markets, interviewed August-September 2021

There is continued high interest in organic and "natural" food, while almost half of consumers strive to be "flexitarian", or to exclude meat altogether. Those that are flexitarian, pescatarian, vegetarian or vegan choose their diet because they believe it to be healthy first and foremost (56%), far ahead of being better for the environment (34%) or animal welfare (28%). But in some markets, demand for plant-based protein alternatives has cooled, particularly due to their higher prices points.

"The longer-term forecasts for the plant-based beverages market remain strong," says Hemang Dholakia, Centre of Excellence Manager, Plant-based, Tetra Pak. "But we're seeing consumers moving back to dairy from plant-based, when a litre of oat milk, for example, might cost three to four times as much. We're also seeing plant-based customers really pushing to lower the cost of production. That's key for more mature categories like dairy, but now it's happening in this relatively new category, too."

Instability and food security concerns
Political instability and conflict are also major concerns for consumers, with 65% of global respondents believing that they have brought serious disruption to the food system. Food security is a significant issue, with two in five (42%) saying they are concerned that they won't be able to access the food types they want to buy. These concerns reflect expert predictions: the World Economic Forum warns of a persistent food crisis in the next two years, saying that system failures are unavoidable, and that society can expect further food price spikes this year as the cost-of-living crisis continues.[1]

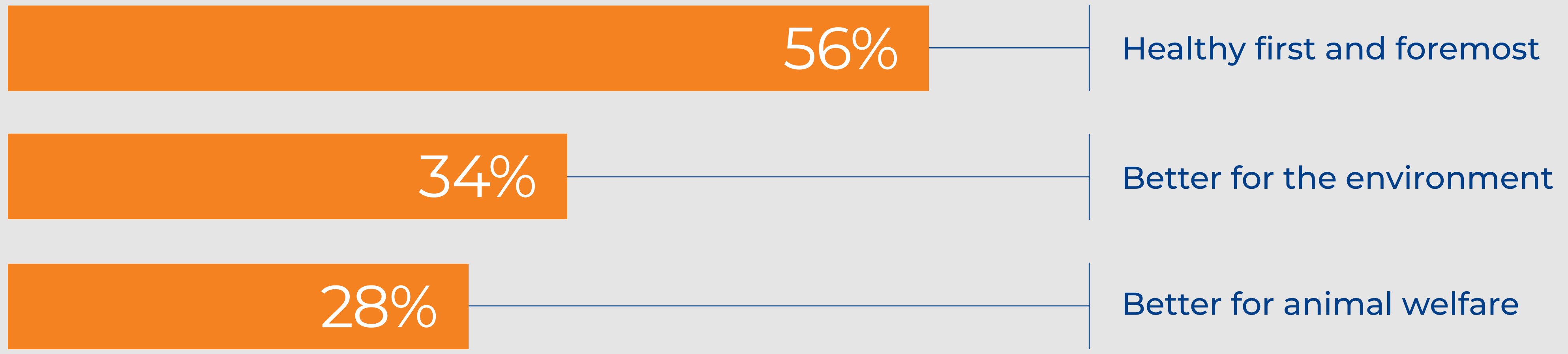
TREND

Life hacks

Global economic disruption is driving consumers to be more thoughtful in their behaviours and consumption habits. A culture of "food hacks" has emerged on social media, pushing people into creative ways of reducing waste, such as using parts of fruit and vegetables that would formerly have been discarded. TikTok influencers are sharing cooking hacks to reduce energy usage, and freezer hacks to prolong the shelf life of fresh food, while sales of energy efficient appliances, like air fryers, have tripled.

42% are concerned that they won't be able to access the food types they want to buy

Flexitarians, pescatarians, vegetarians or vegans choose their diet because they believe it to be:

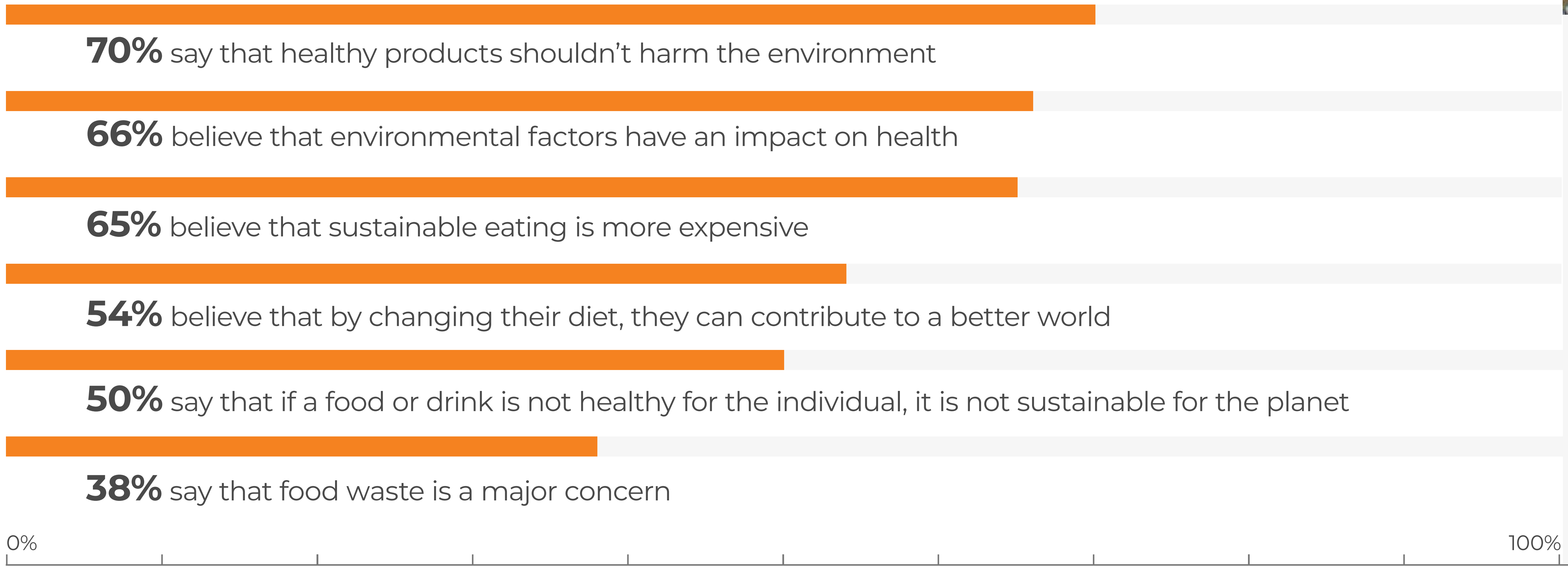


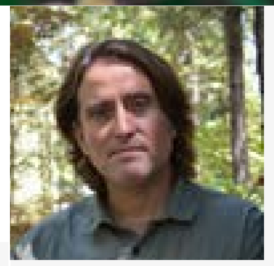
1 https://www3.weforum.org/docs/WEF_Global_Risks_Report_2023.pdf

CLIMATE CHANGE AND SUSTAINABILITY

Diet can make a better world

Key survey findings at a glance





Sustainability actually involves ecological health, social equity and justice – you're healthier if you have achieved this.

Philip Loring,
Director of Human Dimensions Science,
The Nature Conservancy

TREND

Climatarianism

Despite the cost-of-living crisis, sustainability remains top of mind for consumers with a "climatarian" mindset. They are keen to make the meaningful trade-offs that they believe will have a positive environmental impact – and food and beverage innovations, both synthetic and natural, are key. Attractive options include natural, plant-based foods and alternative proteins (see page 25). In addition to the environment, climatarians may be motived by animal welfare (a smaller, but fast-growing cohort) or health (larger, but static growth). Expect climatarianism to grow as the effects of climate change continue to spread.

As countries increasingly experience the impact of climate change first-hand, health and the environment are increasingly entwined in consumer minds – as the last several issues of Tetra Pak Index have shown. In this year's survey, two-thirds (67%) of global respondents believe that environmental issues (such as pollution, depletion of natural resources and global warming) have an impact on their health. The figure is significantly higher in Kenya and China, on 86% and 85% respectively.

Health and the environment are also bound together by the rising interest in holistic and mindful health, which emphasises the relationship between mindfulness, nature and wellbeing, both physical and mental – a relationship borne out by clinical studies.[1]

People, planet and products intertwined

This intertwining of people and planet extends to products, with consumers believing that what is good for one must be good for the other – suggesting that companies should view planetary health as an opportunity to provide the co-benefit of both health and sustainability. 70% of global respondents say that healthy products shouldn't harm the environment, while half say that if a food or drink is not healthy for the individual, it is not sustainable for the planet.

Packaging is part of the picture: the number one attribute for a package for a healthy product is recyclability. And while 65% of consumers believe sustainable eating is more expensive, nearly half (47%) would consider changing what they order from a menu if they knew it to be more sustainable.[2]

70%

say that healthy products shouldn't harm the environment

1 Sonja Sudimac et al., "How nature nurtures: Amygdala activity decreases as the result of a one-hour walk in nature," Molecular Psychiatry, 2022. Cited in https://www.mckinsey.com/mhi/our-insights/the-secret-to-greathealth-escaping-the-healthcare-matrix?cid=other-eml-dre-mipmck&hlkid=a799c2688e334dc4ab94552947b1ca3c&hctky=12080686&hdpid=575f7ace-a259-4dd9-8d1d-289ecad5f38d

2 Amplify, Trendwatching, Deliverect, 2022

Diet can make a positive difference

More generally, there is a strong belief among consumers that their food and beverage purchasing and consumption decisions can make a positive difference, with 54% believing that by changing their diet, they can contribute to a better world.

Meanwhile, food waste continues to be a major concern for consumers, cited by 38%, exceeded only by high prices – possibly because it is an issue for both environmental and economic reasons. This is leading to opportunities for upcycled food products (see page 35).

TREND

Green clarity

Consumers are looking to brands to provide transparency across the whole supply and value chain: they want to know the carbon footprint of the products they choose. Innovations in food production – such as vertical or rooftop farming, and processes that promote the reuse of ingredients, reduce waste and use less resources, such as water – may help brands boost their appeal. Transparent and effective communication of eco-credentials, including meaningful labelling, will be key too, overcoming potential consumer scepticism and accusations of green-washing.

On 22 March, 2023, the European Commission issued a proposal for a Green Claims Directive designed to protect consumers from greenwashing by making environmental product claims and labels reliable and verifiable across the EU.

The proposal follows a Commission study from 2020 which highlighted that more than half (53%) of examined environmental claims in the EU were found to be vague, misleading or unfounded and 40% were unsubstantiated. Under the new proposal, explicit environmental claims must: be based on robust scientific evidence; demonstrate a life-cycle perspective; illustrate whether the claim is accurate for the whole product or only for parts of it; and provide transparent information on carbon offsetting.

In September 2023, Parliament and Council have reached a provisional agreement on the new rules, then, when the directive comes into force, member states will have 24 months to incorporate the new rules into their law. Meanwhile, some companies are already taking their own steps to ensure responsible marketing and communications. For example, Tetra Pak is regularly updating its procedure for making environmental claims, aligning it with leading standards in the international arena. Driven by general principles (clarity, relevance, accuracy and substantiation), environmental claims must be fact-based and follow authorities' guidelines, as well as international best practices and local codes of conduct.

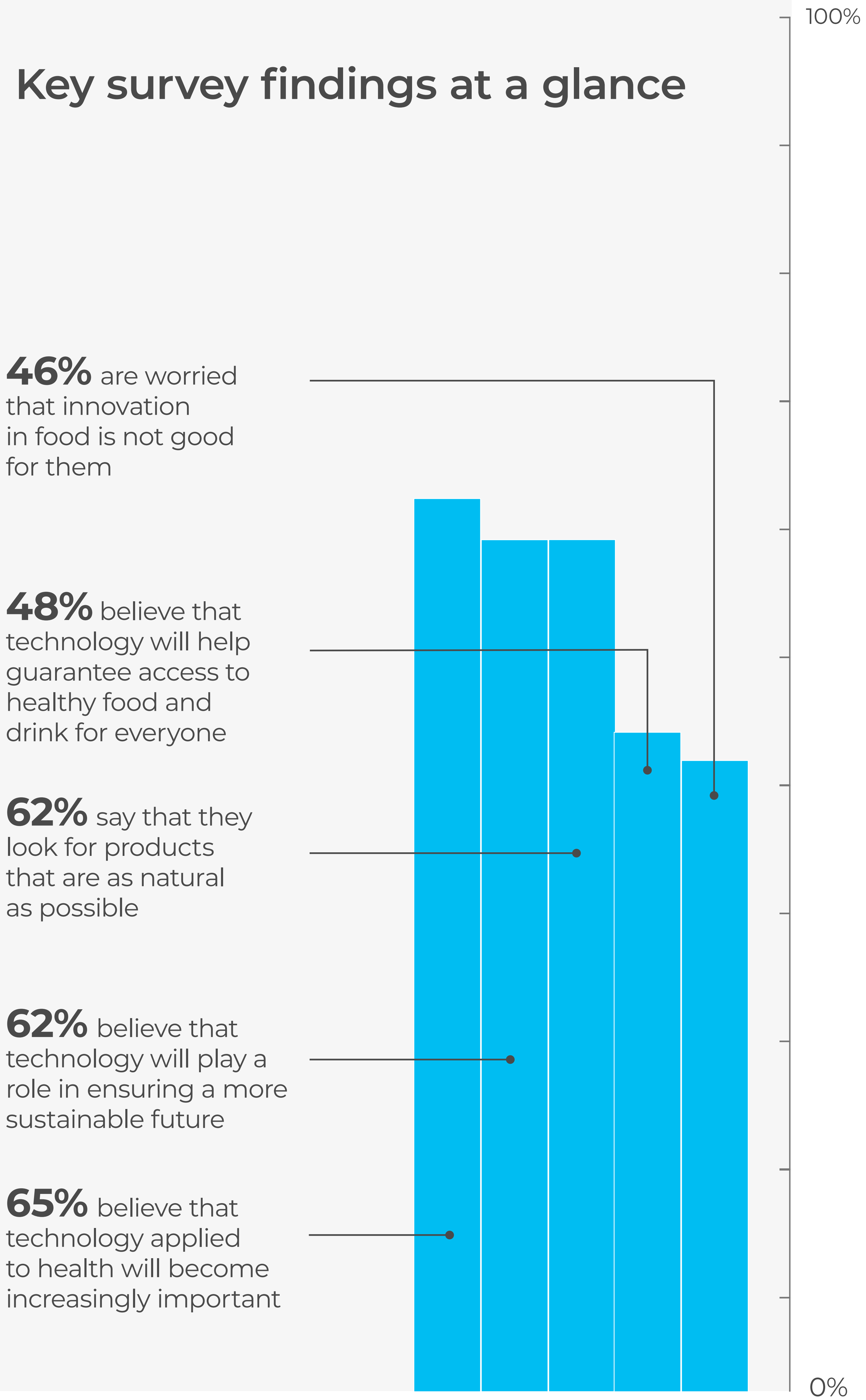
TECHNOLOGY AND INNOVATION

Digital and analogue tensions

The one-size-fits-all approach of the traditional food system is going to change – and this change will be data-driven. Based on data, you see things that you absolutely cannot feel in your body – and you can use this to make better-informed food decisions. We're all different machines and we need to treat ourselves as such.

Johan Jörgensen,
Founder, Sweden Foodtech

Key survey findings at a glance



Consumers believe that technology has a major role to play in both health and sustainability going forward. 65% of global consumers agree that technology applied to health will become increasingly important, and 62% believe that it will play a role in ensuring a more sustainable future. Nearly half (48%) think that technology will help guarantee access to healthy food and drink for everyone. Younger men are more positive about technology, as are those with higher income and education.

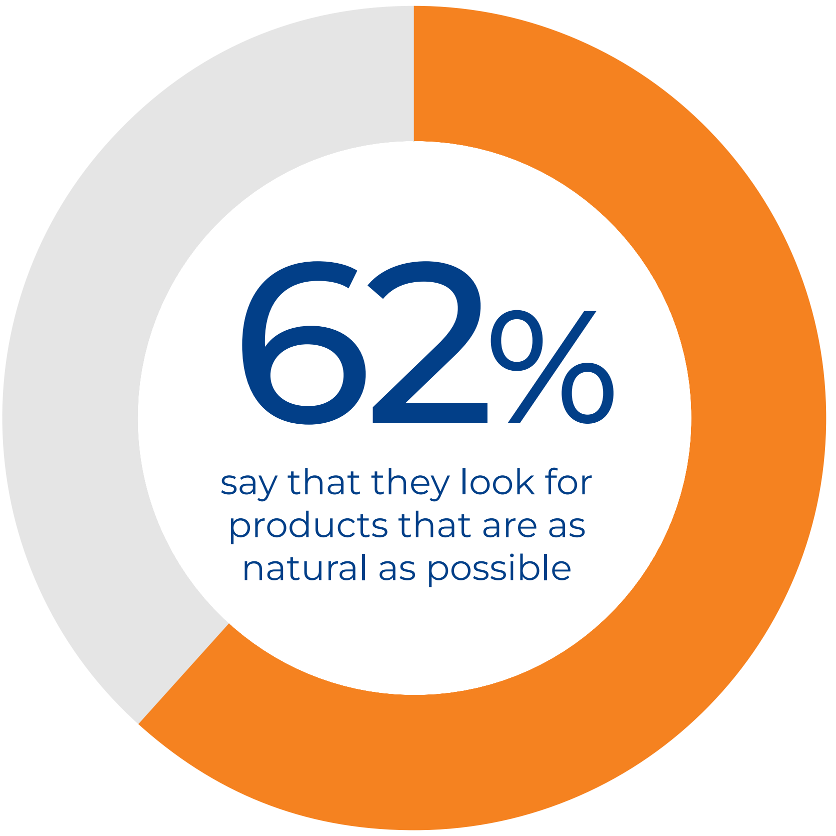
Consumers are already using technology to improve their health and nutrition choices, such as through nutrition and diet apps that help users record and analyse their eating patterns. According to recent figures, global revenue in this segment is projected to rise to US$8.29 billion by 2028, up from US$4.79 billion in 2023 – a CAGR of 11.59%.[1] The leading region for revenue generation is India, forecast to be $1.28 billion in 2023.

Going forward, data will play an even more crucial role. Data-driven personalised nutrition will give consumers exactly what they need, when they need it, to achieve their life goals and get the most out of the food they have. "The one-size-fits-all approach of the traditional food system is going to change – and this change will be data-driven," says Johan Jörgensen, founder of Sweden Foodtech. "Based on data, you see things that you absolutely cannot feel in your body – and you can use this to make better-informed food decisions. We're all different machines and we need to treat ourselves as such."

Caution around "too much" innovation

However, there is some scepticism around new approaches, too. Nearly half (46%) of consumers say they are seeing too much innovation in food and they are worried it is not good for them. Natural is still the ideal for many. 69% think that fresh, unprocessed food is the best way to get safe and healthy nutrition, while 62% say that they look for products that are as natural as possible. This contrast between embracing technology and preferring a more natural, "analogue" approach is apparent in the trend for authentic connections (see boxout).

This is going to be increasingly important going forward, argues Philip Loring, Director of Human Dimensions Science, The Nature Conservancy. "When it comes to future innovations, we need to ask: is this a solution that is further distancing us from our environments – or reconnecting us? I think the solutions that are going to stick are the ones that remove some of the steps, strengthening the connection with the ecosystems we're eating from."



I think the future innovations that are going to stick are the ones that strengthen the connection with the ecosystems we're eating from.

Philip Loring,
Director of Human Dimensions Science,
The Nature Conservancy

TREND

Authentic connections

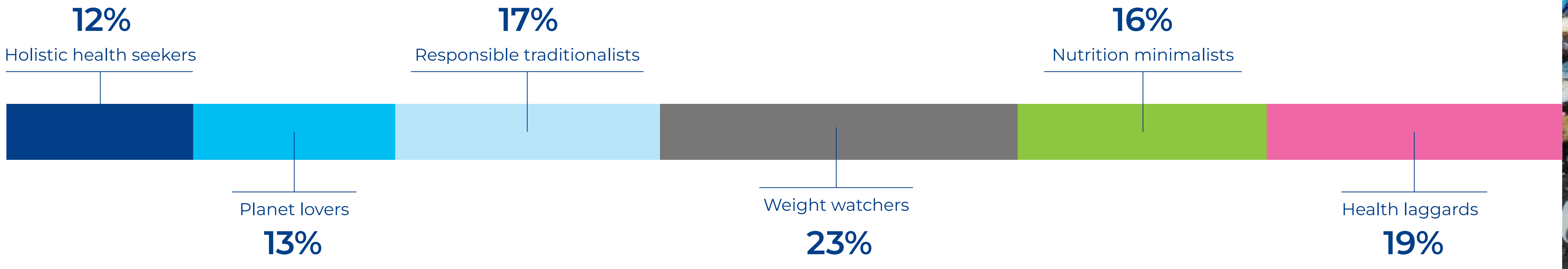
Technology has the potential to transform the way people connect, removing all kinds of barriers. But post-COVID Zoom fatigue, and the relentless use of filters, is resulting in a craving for authenticity – for people to be able to present their true selves.

Consumers are increasingly looking for genuine connections, particularly with their communities. They value transparency, provenance and the story behind their food. They seek ingredients that evoke feelings of nostalgia for a past they might remember as being more straightforward. They also seek genuine recipes for global cuisines using authentic ingredients. At the same time, they want to see their local communities strengthened and made more resilient, which is driving a parallel trend for buying local and choosing domestic brands, along with taking pride in heritage and local cuisine.

1 https://www.statista.com/outlook/dmo/digital-health/digital-fitness-well-being/health-wellness-coaching/nutrition-apps/worldwide?currency=usd

A new consumer segmentation

While we have identified a number of global trends from this year's research, there is clearly no such thing as a "typical" consumer or a "one-size-fits-all" product approach. To get a better understanding of how different consumers think about health and nutrition, both today and in the future, we have used our survey data to build a consumer segmentation. Based solely on health and nutrition factors, we have identified six types of consumer, each with their own attitudes and product needs.



Holistic health seekers

- Most engaged segment across health and environment.
- Interested in health benefits in foods/drinks, superfoods and mental health products.
- Younger segment (around 70% under 44).
- Big in China.
- Strong financial situation.

12%

Planet lovers

- Concerned about climate change and taking action to address this issue, they strongly believe that environmental issues impact on health.
- Flexitarian/vegetarian/vegans over-represented.
- Particularly strong in India and Germany.
- More than half (57%) are living comfortably or 'doing all right'.

13%

Responsible traditionalists

- Very concerned about food waste and over-packaging, they avoid sugar and additives, and make home-cooked food.
- Older segment: nearly half (47%) are between 45 and 65.
- Over-represented in Western countries.

17%

Weight watchers

- With weight control playing as the main motivation/health focus, they are very cautious about sugar, fat and obesity.
- Over-represented in US, UK and Brazil – and slightly among women (54%).
- Strong concern about high price of quality food, with more than half (53%) only just about getting by or finding it quite or very difficult.

23%

Nutrition minimalists

- Concerned about security of food supply. Healthy food is natural food, e.g. fruit and vegetables.
- Over-represented in Africa.
- Financial situation under pressure and concerned about cost of both healthy and quality options.

16%

Health laggards

- The least engaged segment when it comes to health.
- Take care of the basics, but little interest or activity beyond that.
- Over-represented in South Korea, Germany and India.

19%

Tomorrow's opportunities

In this section, we explore the innovation ecosystems developing new foods, and analyse three key areas: alternative proteins; sugar reduction; and food made with low-value side streams, that otherwise would have been wasted. In each case, we tested innovation concepts with a panel of consumers across ten countries, while also drawing on insights from our expert interviews and additional Tetra Pak research.

The importance of new food

Category[3]	Invested capital 2022	Total invested capital 2013–2022	10-year avg growth 2013–2022
Total alternative protein	$2.9b	$14.2b	107%
Cultivated	$896m	$2.8b	196%
Fermentation	$842m	$3.7b	190%
Plant-based	$1.2b	$7.7b	99%

New food is becoming one of the most dynamic investment sectors in the world today. As discussed, the sector is being shaped by the four macro drivers explored in the previous chapter. But by far the most pressing of these is climate change, which goes hand in hand with food security.

The world has long been tasked with the need to feed a growing population that is forecast to reach nearly 10 billion by 2050. To do that, we need to fill a gap of 7,400 trillion calories, or 56% more crop calories than were produced in 2010, according to the World Resources Institute.[1] At the same time, food systems account for one-third of greenhouse gas emissions, and one-third of food is lost or wasted instead of consumed.

Today's food systems are wasteful and unsustainable, and therefore optimising our current food sourcing, production, and processing is a key imperative. Considerable effort is going into developing more efficient processes for dairy production, agricultural yield, and improvements in food transportation and food waste reduction. However, we cannot significantly increase our share of arable farmland.

Therefore, supplementing these innovations with new food sources that are less dependent on agriculture offers an exciting additional avenue for feeding everyone efficiently. These new food sources may be impressive, but they also come with several challenges in terms of technology, scalability, widespread accessibility, and consumer acceptance. The opportunity is phenomenal, but not without significant effort.

Consequently, the lion's share of new food investment is going into the development of alternative proteins and meat analogues that can be produced more efficiently than conventional methods, thereby significantly reducing emissions. Indeed, investing in the alternative protein segment has the highest CO_2 equivalent (CO_2e) savings per dollar of invested capital of any sector, according to BCG.[2]

> *If we remain on track for an 11% share for alternative proteins by 2035, we will see a reduction of 0.85 gigatons of CO_2e worldwide by 2030 – equal to decarbonising 95% of the aviation industry.*
>
> **Benjamin Morach et al,**
> Boston Consulting Group

For a long time, the alternative protein space was dominated by plant-based solutions. However, there is an increasing focus on fermentation-derived and cultivated products. In this section, we investigate the latest developments in these areas, and test the core concepts with consumers, to help us understand which are likely to be the most accepted solutions going forward. We also explore and test the latest sugar reduction concepts – an area that remains the most in demand by consumers, according to this year's survey.

Innovation in food ingredients and processing is a fast-moving space, but our research shows that consumers are increasingly aware of (and communicating about) the latest developments, particularly those with health and sustainability benefits.

1 https://research.wri.org/wrr-food
2 https://www.bcg.com/publications/2022/combating-climate-crisis-with-alternative-protein. The Untapped Climate Opportunity in Alternative Proteins by Benjamin Morach, Malte Clausen, Jürgen Rogg, Michael Brigl, Ulrik Schulze, Nico Dehnert, Markus Hepp, Veronique Yang, Torsten Kurth, Elfrun von Koeller, Jens Burchardt, Björn Witte, Przemek Obloj, Sedef Koktenturk, Friederike Grosse-Holz, and Olivia Stolt-Nielsen Meinl
3 https://gfi.org/investment/

VIEWPOINT

Innovation

Tammy Meiron is Chief Technology Officer at Fresh Start, a leading food technology incubator that's part of the emerging agri-food cluster in northern Israel. The company works with a portfolio of start-ups to provide technological solutions to some of the challenges facing the global food systems. It is collaborating with Tetra Pak, providing opportunities for direct engagement with its portfolio of start-ups. Here she gives her view on new food technology development today.

"We want to eat healthy food. We need to be able to feed a growing population. And we're facing a climate crisis. We're the first generation to know about this and the last that can do anything about it. So industry is now facing an accelerated demand to find new resources and new technologies. It's a race.

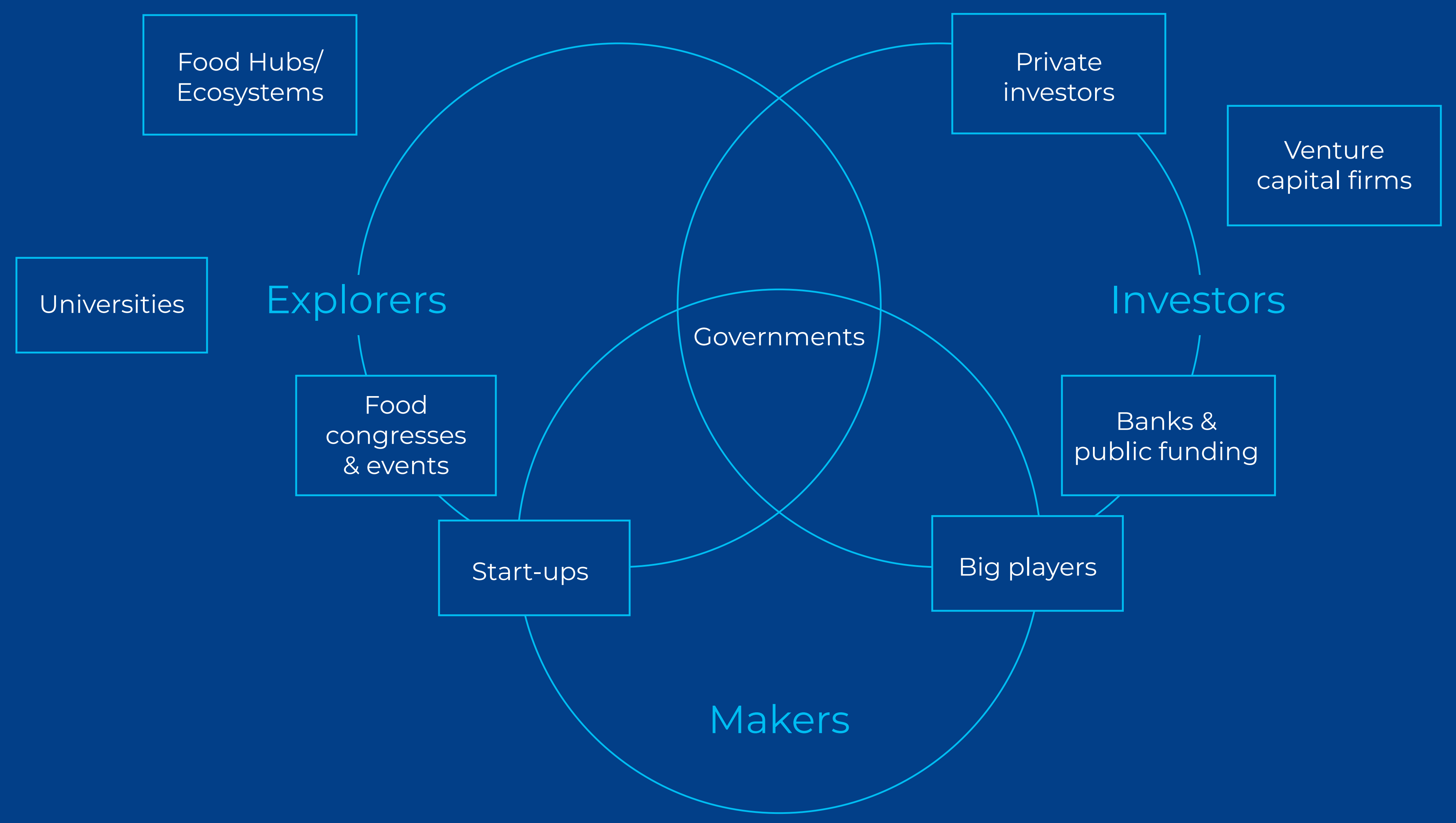
"People want more transparent labelling. They don't want to find words that they don't understand. They want less processed foods with a minimal ingredients list. Plant-based alternatives often have very long ingredients lists, because they have to be tasty as well as nutritious and healthy. They are trying to create an experience that's close to the original, which means using stabilisers, thickening agents and so on. Some of these products aren't that healthy right now – but they will be in the future.

"We are in the transformation phase. Most products that I see on the market today don't have the nutritional value of the original product. But the next generation of ingredients – produced by precision fermentation, molecular farming, algae, mushrooms and so on – will bring us to the stage where these alternatives are tasty, nutritious and healthy, too.

"The early adopters of these new food products will be the younger generation. They are more open-minded to new and unexpected ideas. They also excite them, not least due to alignment with ethical and environmental issues, such as animal welfare."

Did you know?

Tel-Aviv-Jerusalem is now in the global top five agtech and new food ecosystems, along with Silicon Valley, New York City, London, and Denver-Boulder.



This diagram shows how innovation ecosytems interconnect, with investment and collaboration across multiple players.

VIEWPOINT

The regulatory agenda

Many governments are now looking at updating their national dietary guidelines to include sustainability, as Katie Carson, Corporate Affairs Director, Food & Climate Policy, Tetra Pak, explains. "It's no longer just about healthy diets," she says. "It's about healthy, sustainable diets."

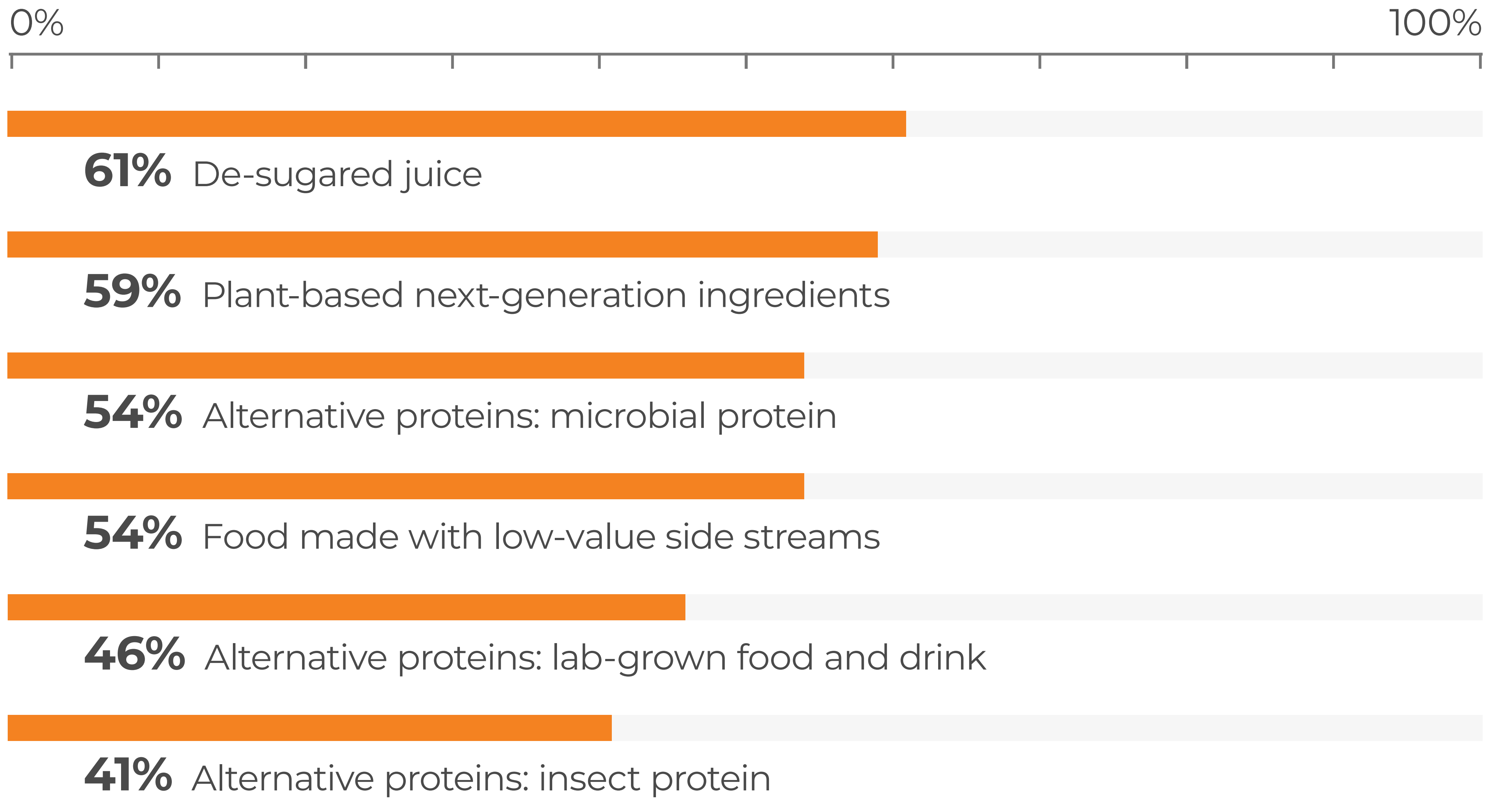
But this is not a straightforward task. "Today, there is no set criteria to determine what is a sustainable food product and given that food and diets are very local, this is highly complex." There are certain policies that governments can adopt to encourage healthy diets, including nutrition labelling, rules on marketing communications, as well as initiatives to incentivise the reformulation of food products, for instance. Front-of-pack nutrition labelling to help consumers make healthier choices has been high on the policy agenda for some time with, arguably, Latin America setting the pace. "Latin America is very advanced when it comes to nutrition labelling, with many countries putting warning labels on the front of food and beverage products that are high in fat, sugar and salt."

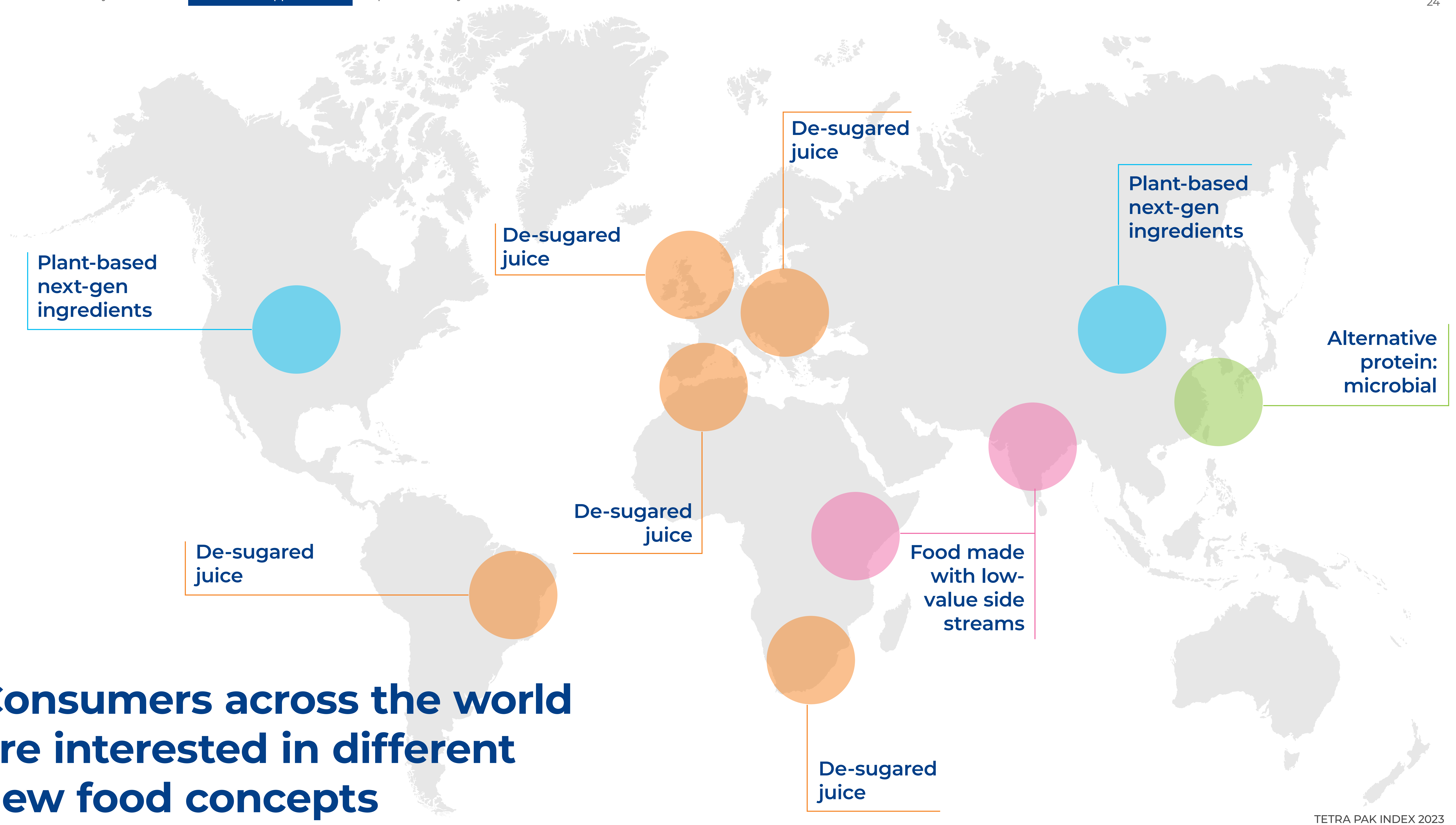
And initiatives to integrate sustainability more broadly into food policies are gaining traction, notably the EU's ambitious Farm to Fork Strategy, which aims to accelerate the transition to a more sustainable and resilient food system through regulations and initiatives across the food supply chain.

New food concepts tested

To better understand consumer acceptance, we ran a number of new food concepts past a panel of consumers across ten countries. We analyse the findings in greater detail on the following pages, but here are the results for the key concepts related to the food innovation areas explored in this Index, ranked in order of consumer consideration.

The below figures show the percentage of all consumers surveyed who would consider trying these products in the future, ranked in order of popularity. In general, the strongest attributes in most of the innovation categories are around their health and sustainability benefits.





Consumers across the world are interested in different new food concepts

Innovation explored and tested

Today's food systems are mostly reliant on animal-based protein sources. The term "alternative proteins" means alternatives to these sources. Finding alternative sources to proteins that fulfil key nutritional and functional roles in food and beverage production is a major area of research and development within the food and beverage industry.

There are many different potential sources for alternative proteins, but innovation in this area can generally be organised into four main categories:

- Plant-based
- Fermentation-based
- Cultivated meat
- Insect proteins

Plant-based next-generation ingredients

Plant-based proteins are the most well-established of the alternative protein categories. Ingredients such as soy and oat have become commonplace on supermarket shelves across the world. However, as processing technologies and ingredient access evolves, a new generation of plant-based proteins is beginning to develop.

Investment in plant-based innovation may have started to slow, but the global market for plant-based ingredients continues to grow at pace, particularly plant-based proteins. These are forecast to post 7.3% CAGR over the next five years, growing from $12.2 billion in 2022 to $17.4 billion in 2027.[1]

There are challenges, however, at least in the short term. As we have already seen, relatively high prices during the cost-of-living crisis are problematic for many consumers. Moreover, consumers are increasingly scrutinising the health, nutritional and environmental credentials of some plant-based products. This is driving manufacturers to develop next-generation ingredients that deliver on all counts, notably sustainability. For example, "Climate-hero ingredients" were picked by forecasting agency WGSN as one of their "top food and drink trends for 2023 and beyond".[2]

1 MarketsandMarkets: Plant-based protein market size, share 2022-2027 (2022)
2 "Climate-hero ingredients like fava beans, teff, lupin beans, algae, fonio, moringa and bambara nuts will make their way into more packaged goods around the world, as issues associated with monoculture crops and biodiversity loss become more widely known. These underutilised ingredients are either drought-resistant or can grow abundantly, restoring environments and boosting biodiversity. They are also all nutritious – often more so than their conventional counterparts." https://www.wgsn.com/fd/p/article/63985805995aec17a4769879?lang=en?utm_source=newsletter&utm_medium=email&utm_campaign=pspct&_gl=1*scvl31*_ga*MTE2NTE4MjcxNy4xNjczNDI4NzM1*_ga_3N1Q1PKH1F*MTY3MzQyODczNC4xLjEuMTY3MzQyODc0MC4wLjAuMA

To better understand the main applications and opportunities in this category, we undertook a thorough Plant-Based Ingredients Market Assessment, including web listening to assess consumer viewpoints.[1] We found that high-protein ingredients, notably soya, currently dominate, although due to factors such as environmental impact and allergy issues, usage is decreasing. Likely replacements include pea, chickpea and oat, while canola, fava beans, mung beans and other proteins from cereals, traditional grains, seeds and potatoes are emerging in high-protein applications. Extraction of bioactives from herbs, spices and traditional medicinal plants is also on the rise.

Talking popularity, and calculated according to a cumulative score of six parameters (acceptance, flavour and texture, nutritional aspect, price, scalability and total social media hits) potato, buckwheat grain and hemp are cited amongst the most interesting plant-based ingredients by consumers, in this order.

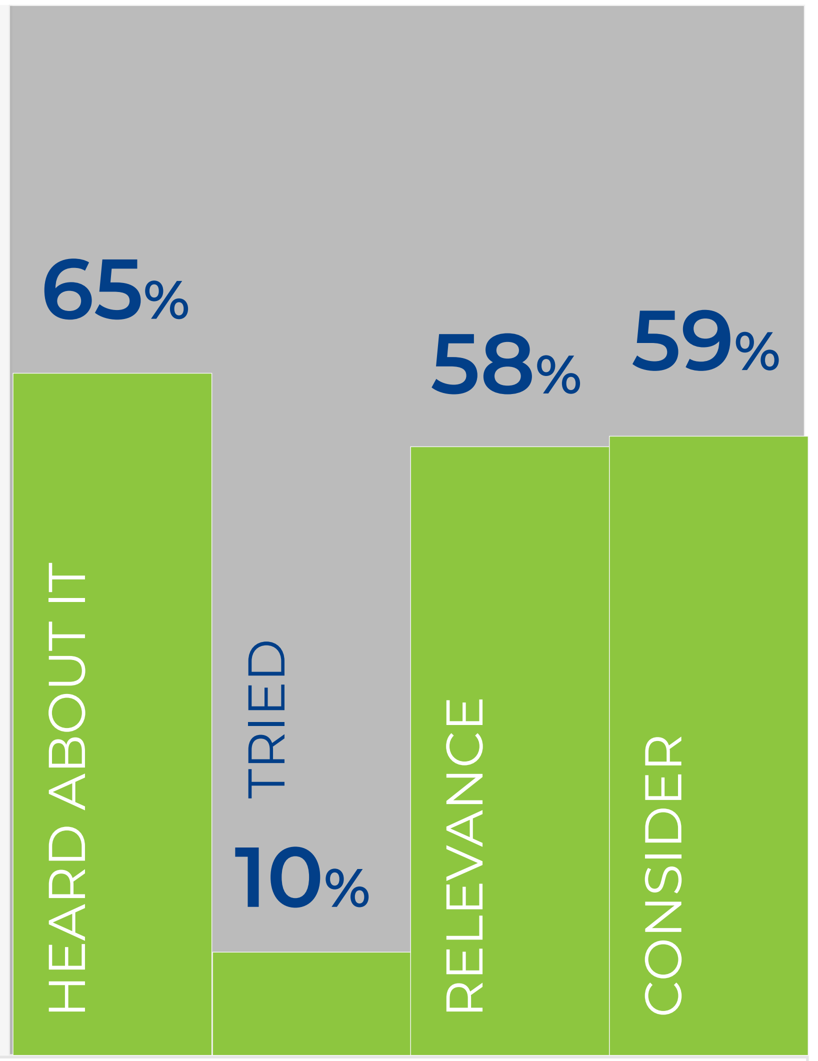
Consumers are very active on social media around this topic, with high levels of engagement on emerging ingredients such as mushrooms, hemp, algae and lupin. There is high acceptance for beverages with well-known ingredients such as potato, buckwheat, lentils and grains, while sorghum and chestnut applications are appreciated for their texture and flavour. Traditional grains such as buckwheat, millet and spelt also have a positive image and their use in functional and health drinks is growing accordingly. Seeds such as pumpkin and hemp are also increasingly being explored in the beverage segment and are expected to grow in the next five years.

CONSUMER CONCEPT TEST

Plant-based next-generation ingredients[2]

Consumers see plant-based products as healthy and good for the planet, as well as being natural, nutritious and good for animal welfare. They rate particularly highly for awareness and interest in China and India, again possibly because these are countries with a strong plant-based tradition. "Plant-based next-generation ingredients" is in the top three of preferred concepts for all types in our consumer segmentation, and is the #1 choice for Planet lovers, Weight watchers (ahead of de-sugared juice, perhaps surprisingly) and Nutrition minimalists.

In addition to our concept test, our global listening study highlighted the new plant-based ingredients that consumers consider the most interesting.



HEALTHY	48%	12%	UNHEALTHY
NUTRITIOUS	45%	11%	NOT NUTRITIOUS
DELICIOUS	33%	15%	DISGUSTING
GOOD FOR ANIMAL WELFARE	45%	11%	BAD FOR ANIMAL WELFARE
GOOD FOR THE PLANET	48%	11%	BAD FOR THE PLANET
USED BY MANY PEOPLE	29%	19%	USED BY FEW PEOPLE
AFFORDABLE	29%	20%	EXPENSIVE
I FEEL CURIOUS TO TRY	45%	15%	I FEEL SCARED TO TRY
NATURAL	46%	14%	ARTIFICIAL
BELIEVABLE	43%	12%	NOT BELIEVABLE
I TRUST IT	38%	14%	I DO NOT TRUST IT

1 Plant Based Ingredients Market Assessment (October 2022), a Future Bridge report for Tetra Pak.
2 Concept presented to respondents: "Plant-based beverages can be made with different ingredients from those commonly seen today, so not only soy, almond, rice, but for example potatoes, peas, hemp, sorghum, pumpkin, etc. This creates the possibility to use more local ingredients, while exploring new taste and nutritional profiles." In the graph, we indicated the countries that are over-indexing via the respective flags.

A good food system is good for you. It's good for the planet. And it absolutely tastes good as well. Any type of change that we try to implement must be fuelled by taste.

Johan Jörgensen,
Founder, Sweden Foodtech

Alternative proteins: Fermentation-derived
Microbial fermentation processes have been used in food production for thousands of years. It is a key process in products ranging from bread and beer to cheese and yoghurt, and much more.

More recently, a new category of processes based on fermentation have begun being used in food production. In particular, there are two main types of process that have become the focus of recent investments and developments:

- Biomass fermentation, in which microorganisms are "grown" and "harvested" to be used as ingredients in food production.
- Precision fermentation, in which microorganisms are utilised as a "factory" to produce proteins, fats, vitamins or other compounds that can serve as functional ingredients in food production.

Fermentation is generating considerable interest as a consumer-friendly, energy- and water-efficient alternative to animal-based food production. Investment has increased exponentially, with much of the growth taking place in the last few years, closing the gap with plant-based innovation in the process. In the ten years up to 2022, total capital investments reached nearly $3.7 billion. Almost 70% of this ($2.54 billion) came in 2021 and 2022 alone. For contrast, we can compare this to the start of the period, where total global investments added up to just $6 million.[1]

Much of the recent growth in innovation investment has been spurred on by interest from venture capital, complemented by similar growth in public funding. The US has recently provided support at the federal level in the form of research financing, and individual states have also supported the industry via tax credits and similar incentives. There has been public investment in Europe and Asia as well.

The commercialisation of new fermentation-derived food has made huge leaps in just a few short years – but challenges still lie ahead. Further development in scalability is still needed to achieve parity with conventional proteins in terms of taste (flavour and smell), texture (look and mouthfeel), nutritional characteristics and cost. Once parity is achieved, experts anticipate that we will be able to prepare up to 90% of the world's most popular foods, with no sacrifices in terms of cost or overall eating experience.[2]

$3.7 billion

In the ten years up to 2022, total capital investment in fermentation reached nearly $3.7 billion, with almost 70%[3] of this coming in 2021 and 2022 alone.

1 https://gfi.org/investment/
2 Food for Thought: The Protein Transformation, Boston Consulting Group, blue horizon, 2021 https://www.bcg.com/publications/2021/the-benefits-of-plant-based-meats
3 https://gfi.org/investment/

Biomass fermentation

Also known as single-cell production, this fermentation technique focuses on the rapid reproduction of microorganisms to produce the food product. Essentially, the microorganism is the ingredient. As these ingredients are never derived from animals, they are considered vegan.

Biomass fermentation is the dominant technology in the fermentation space today. This process is increasingly used in the development of alternative foods and ingredients that can replicate characteristics of conventional, animal-based food products. A common example is the fermentation of protein-rich microfungi, which are frequently found in vegetarian and vegan meat substitutes as they can provide a texture and mouthfeel similar to traditional meat and fish products.

In many cases, the microbial biomass can double its size in a matter of hours, enabling highly efficient food production in a short span of time. According to some analyses, the efficiency of inputs to outputs can be as high as 40%. By contrast, when raising cattle for beef, only 4% of the nourishment given to the cow remains in the final meat product.

Moreover, biomass fermentation requires no arable land and is not dependent on seasons, allowing continuous production in any part of the world at any time of the year. The feedstocks used to nourish the microorganisms can often be sourced from existing waste, and new uses can be found for the broth after fermentation.

Biomass fermentation can also be used to produce "hybrid" new food products, in which fermentation-derived ingredients are combined with plant-based, cultivated meat or animal-based ingredients. The desired result is typically to better reproduce the flavour, textural or nutritional profiles of particular animal-based food products by combining different ingredient sources that mimic specific characteristics. The production method is also very efficient, producing consumer products for a much lower caloric input than animal proteins.

Precision fermentation

While biomass fermentation is essentially about farming microbes, precision fermentation is about utilising microorganisms as miniature "cell factories" that produce target nutrients or ingredients. It's these nutrients that are then harvested, rather than the microbes themselves. Precision fermentation products are typically used as ingredients in hybrid new food products.

The target ingredients in question can be proteins, fats or sugars found in traditional, animal-based ingredients, which impart certain taste, textural or nutritional characteristics. Precision fermentation makes it possible to produce vital ingredients – without any need for live animals.

With precision fermentation, it's also possible to isolate the dairy proteins that give cheeses their unique properties. These fermentation-derived proteins can then be mixed with plant-based and other ingredients to produce animal-free products that offer consumers the right tastes, textures and dietary characteristics. Cheese is just one example, but the same principle can be applied to a huge number of desirable proteins.

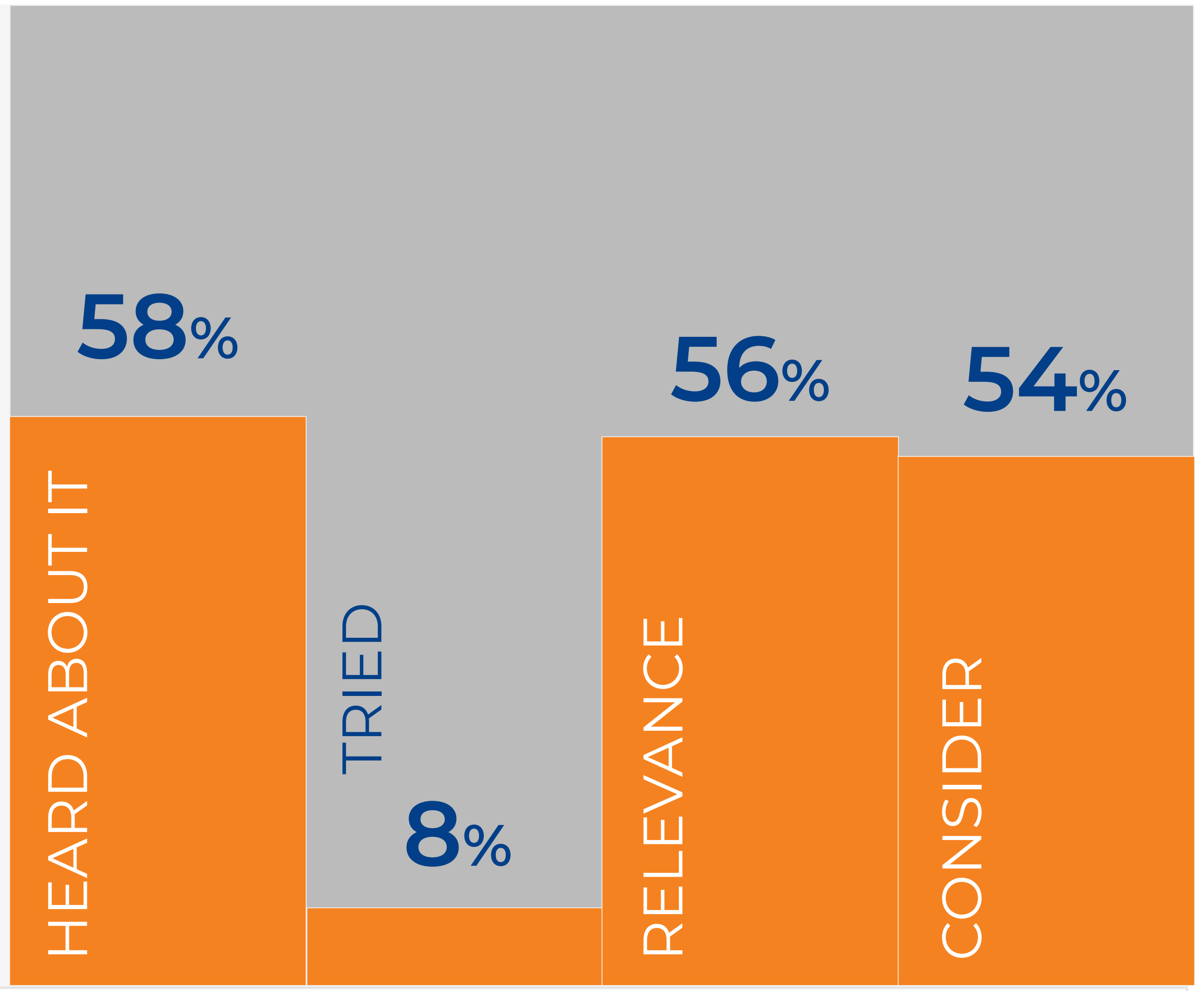
Precision fermentation is already a commonplace process within the pharmaceuticals industry, and it has heritage applications in food too – for example, it is a common method for harvesting rennet, a key ingredient in cheese production. It is only recently that this process has been adapted for the purpose of producing a wide range of food ingredients. This new set of applications requires more industrial scale production and faces similar scalability challenges to other fermentation-derived protein technologies.

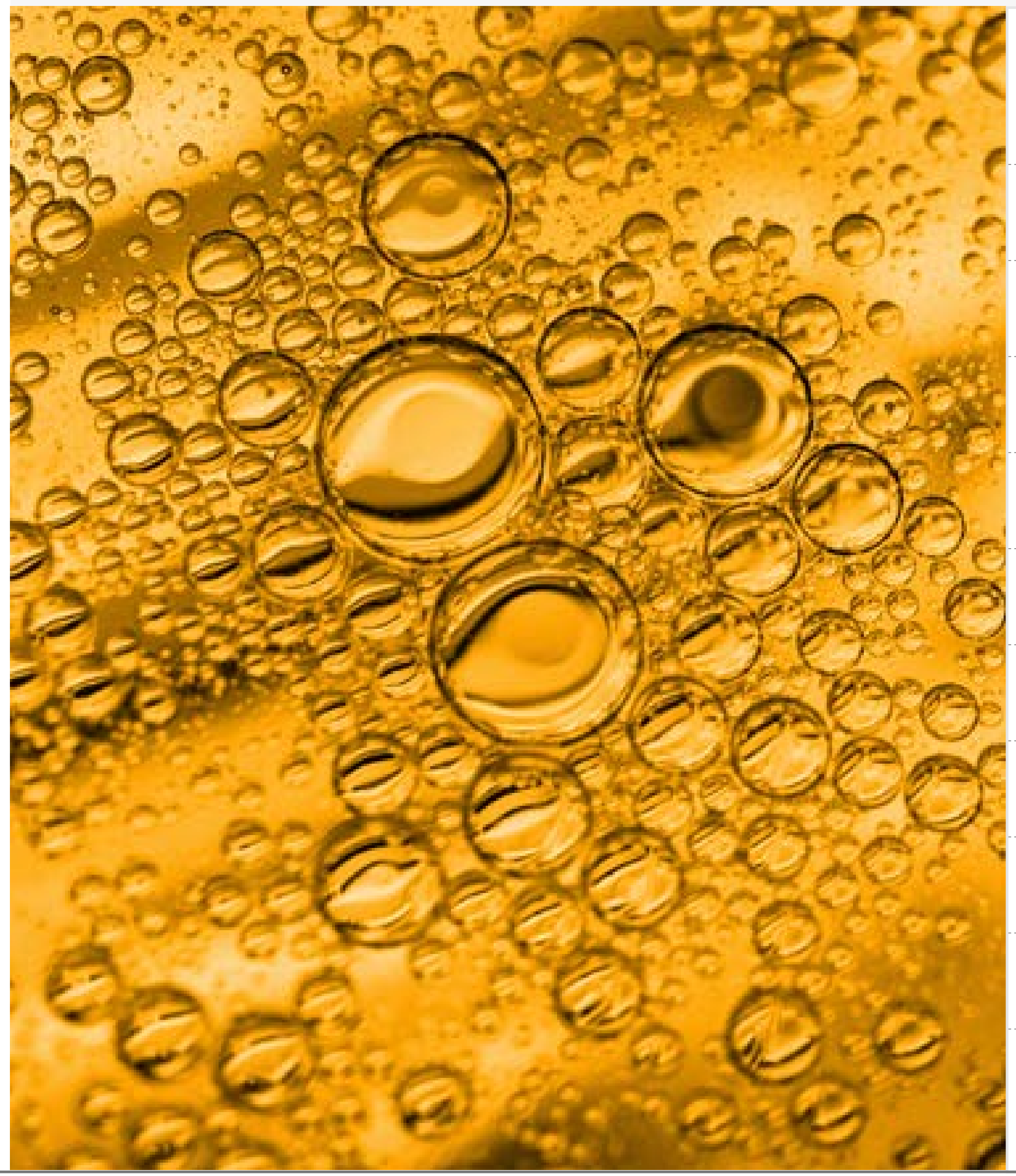
Precision fermentation is capable of producing many different ingredients, without the involvement of animals. Hence, precision fermentation products are often labelled "animal-free". However, as animal products may be the final product, not all precision fermentation products are considered vegan.

CONSUMER CONCEPT TEST

Alternative proteins: Microbial protein[1]

Consumers see microbial protein as good for both animal welfare and the planet to an almost equal degree (47% and 46% respectively). It is also seen as healthy and nutritious and, interestingly, natural. Awareness is relatively low, but it rates well for relevance, and over half of consumers say they would consider trying it in future – rising to 73% in China – placing it in the top half of concepts tested. In terms of our segmentation, microbial protein appeals to Holistic health seekers, Planet lovers and Health laggards – it is the #3 choice for all three.





HEALTHY	43%	12%	UNHEALTHY
NUTRITIOUS	41%	12%	NOT NUTRITIOUS
DELICIOUS	29%	17%	DISGUSTING
GOOD FOR ANIMAL WELFARE	47%	11%	BAD FOR ANIMAL WELFARE
GOOD FOR THE PLANET	46%	11%	BAD FOR THE PLANET
USED BY MANY PEOPLE	26%	23%	USED BY FEW PEOPLE
AFFORDABLE	28%	22%	EXPENSIVE
I FEEL CURIOUS TO TRY	38%	17%	I FEEL SCARED TO TRY
NATURAL	41%	16%	ARTIFICIAL
BELIEVABLE	39%	13%	NOT BELIEVABLE
I TRUST IT	36%	16%	I DO NOT TRUST IT

1 Concept presented to respondents: "Proteins can come from alternative sources, for example microbes, mushrooms or algae. Given the easy availability of microbial proteins and the possibility to utilise bulk production, food can be guaranteed for everyone in a more sustainable way, while ensuring good quality and high protein content." In the graph, we indicated the countries that are over-indexing via the respective flags.

Alternative proteins: Cultivated meat
Cultivated meat goes by many names, included cell-based, cultured and lab-grown meat. A UN Food and Agriculture Organization (FAO)/World Health Organization guide to the topic devotes nine pages to discussion of the terms alone. It's indicative of just how young and fast-moving this technology is, with no time yet for a consensus to emerge.

Meat cultivation is a similar process to precision fermentation, but microorganisms are not involved. Instead, the meat is produced by cultivating animal cells directly by growing stem cells. As such, the end result is not an analogue of an animal-based ingredient – it is an animal-based ingredient. This could reduce the need for livestock farming and mitigate the impact of rising demand for food on the agricultural system.[1]

Initial studies in labs began in the early 2000s, and by 2013, the first lab-grown beef burger was unveiled by Dutch researchers at a London press conference. In December 2020, a cultivated chicken product was approved in Singapore, the world leader for regulation in this area. In June 2023, the US Department of Agriculture gave its first two approvals to companies wishing to sell cultivated meat products in US supermarkets, paving the way for the first major commercial release of cultivated meat products.[2]

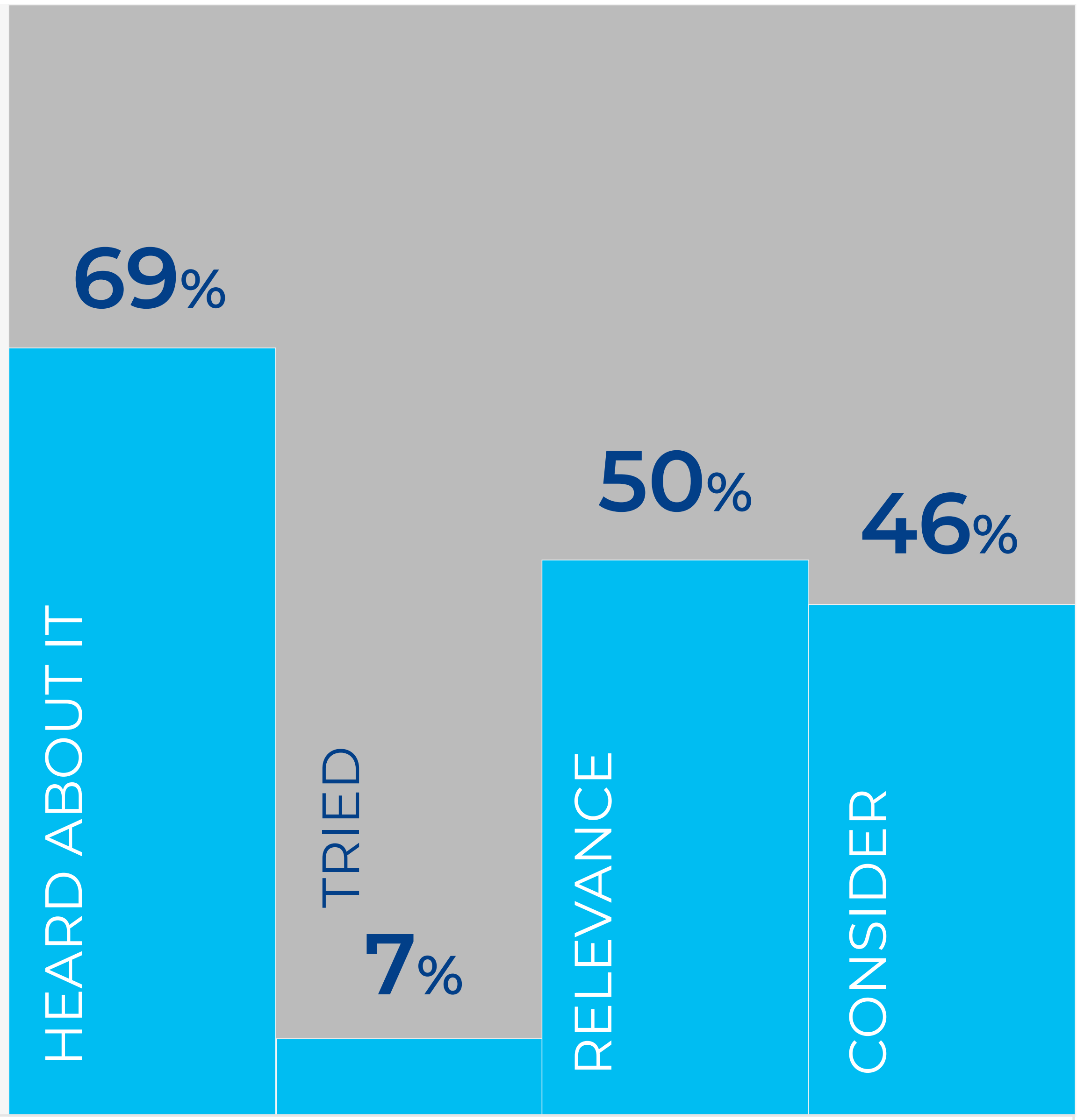
As demand for plant-based meat has cooled, the cultivated alternative has been gaining attention as "it is 'real' meat – minus the animals", made from actual animal cells that have been cultivated, multiplied and formed into products. Today, there are 150 or so start-ups developing various cell-based food products around the world.

Plenty of challenges lie ahead, including scaling up, lowering costs and gaining regulatory approval. Managing consumer attitudes may also be key. In our concept testing, lab-grown food was considered good for animal welfare and the planet, and also health. But there were negative opinions too: more than a third (34%) considered it artificial, and almost a quarter said they did not trust it (24%) or were even scared to try it (23%). Meanwhile, investment in the technology continues to grow, rising from $340 million in 2021 to $396 million in 2022.[3]

CONSUMER CONCEPT TEST

Alternative proteins: Cultivated meat[4]

This concept is rated highly by consumers for being good for animal welfare and good for the planet. However, it is seen as expensive and, particularly, artificial, cited by around a third (34%) of respondents – one of the highest figures of all concepts tested in our research. It also scores low on trust, reflecting our survey's findings that many consumers prefer natural products, and the tensions around technology and innovation in food.



HEALTHY	31%	19%	UNHEALTHY
NUTRITIOUS	32%	17%	NOT NUTRITIOUS
DELICIOUS	27%	19%	DISGUSTING
GOOD FOR ANIMAL WELFARE	47%	15%	BAD FOR ANIMAL WELFARE
GOOD FOR THE PLANET	43%	15%	BAD FOR THE PLANET
USED BY MANY PEOPLE	24%	29%	USED BY FEW PEOPLE
AFFORDABLE	25%	27%	EXPENSIVE
I FEEL CURIOUS TO TRY	35%	23%	I FEEL SCARED TO TRY
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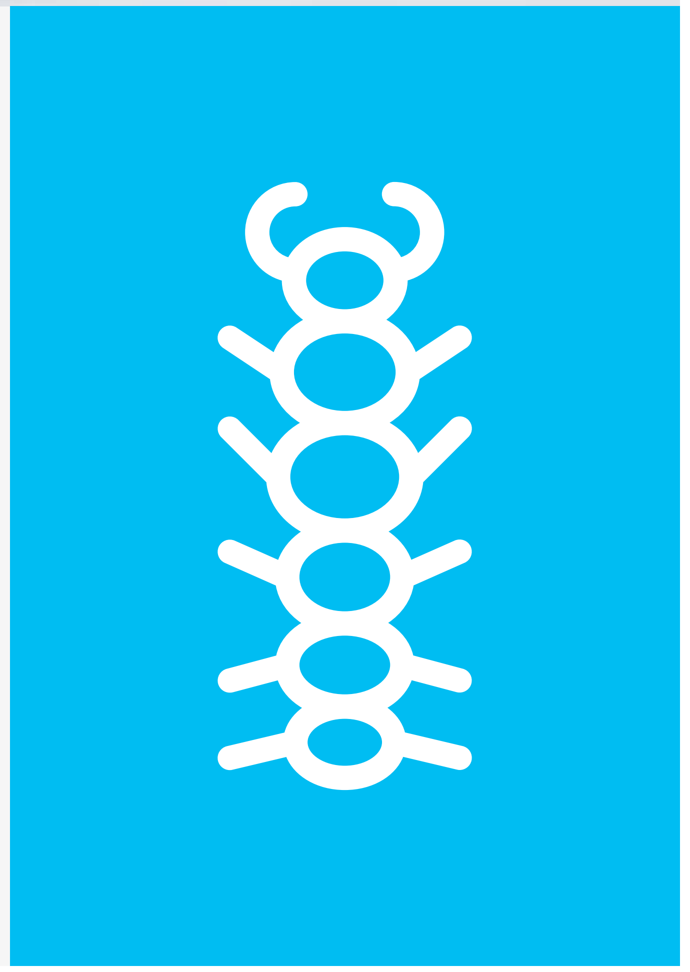
BELIEVABLE	34%	19%	NOT BELIEVABLE
I TRUST IT	28%	24%	I DO NOT TRUST IT

1 https://gfi.org/science/the-science-of-cultivated-meat/
2 https://www.reuters.com/business/retail-consumer/upside-foods-good-meat-receive-final-usda-approval-sell-cultivated-meat-2023-06-21/
3 FAIRR – Venture Investments, 2022

4 We have used "Cultivated meat" here to be consistent with the terminology used throughout this report. The concept presented to respondents was titled "Lab-grown food and drink" and described as follows: "Food & drink products (such as milk or meat) are made in a controlled environment, via the fermentation of microorganisms. This food production is more sustainable as it guarantees animal welfare and it limits the use of natural resources."

2 billion people

in 80 countries eat insects



Insect protein is like sushi. That took 20 years to take off, and now it's on everybody's plate. Insect consumption will be faster than that. I would say we will reach more or less mass take-up in ten years in the Western world.

Nils Österstöm,
CEO, Tebrito

Alternative proteins: insect protein
An important human food source for millennia, insects are now generating global interest for their potential to help alleviate world hunger and climate change. They are rich in nutrients and protein, easy to cultivate, resource efficient and with a low carbon footprint: production of one gram of beef protein requires 254 sq m of farmland, while one gram of insect protein requires only 18 sq m.[1]

In recent years, the global insect-based protein market has experienced a major spike, with applications including animal feed, pet food and pharmaceuticals, as well as food and beverages. The UN FAO has endorsed edible insects and encouraged their adoption in the diets of people all around the world. Today, they are eaten by two billion people in approximately 80 countries, including some parts of Europe, with four insects now approved by the EU for human consumption.[2]

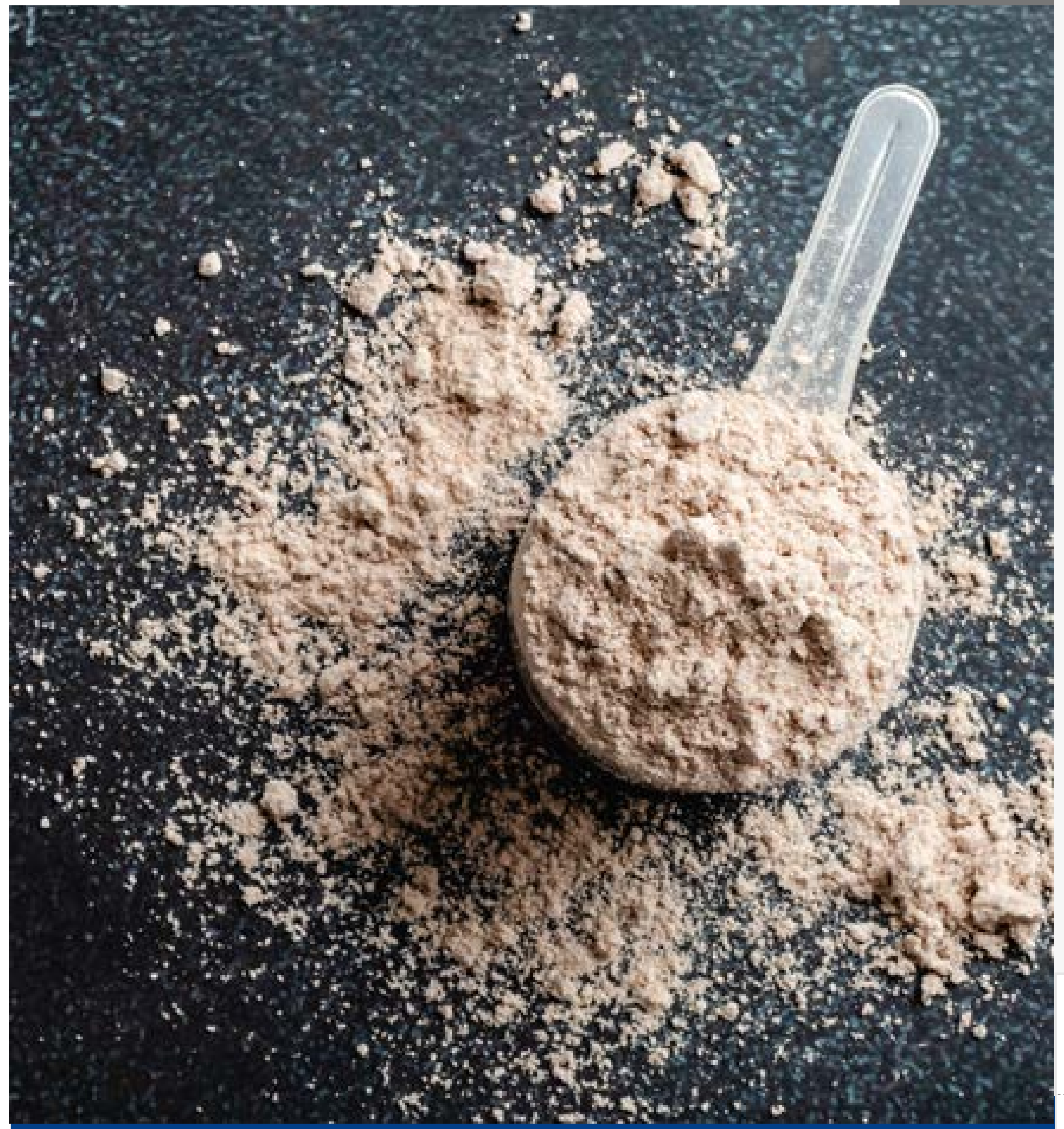
"The eating properties of insect protein are good," says Nils Österstöm, CEO of Tebrito, a company focused on rearing insects for food and feed. "It goes very nicely into the meat matrix – it's ideal for the kind of 50/50 meat blend you find in ready-to-eat meals like sausages and burgers." Tebrito is currently working with Tetra Pak to explore the potential of insect protein-based products, such as fortified oat milk.

↗ READ MORE

1 https://www.statista.com/topics/4806/edible-insects/#editorsPicks
2 https://food.ec.europa.eu/safety/novel-food/authorisations/approval-insect-novel-food_en

Around 2,000 species of insect are eaten worldwide. Black soldier fly, crickets and mealworms are all good alternatives for enhancing nutritional properties like high protein content and amino acid profile in alternative food products. But while some 7.5 billion tonnes of insects are already produced for consumption in 20,000 cricket farms in Thailand alone, global uptake of insect-based protein will remain relatively small until companies can scale up production – and global consumers can overcome their aversion to eating insects. This feeling is particularly strong in the Western world: in our concept test, 45% of respondents in the US believe the idea is disgusting, for example.

Regulation is also a potential issue – many countries currently do not have specific regulations on insect protein, and various regulatory bodies are conducting studies and research to help provide consumers with appropriate guidelines regarding the use of insect proteins.[1]



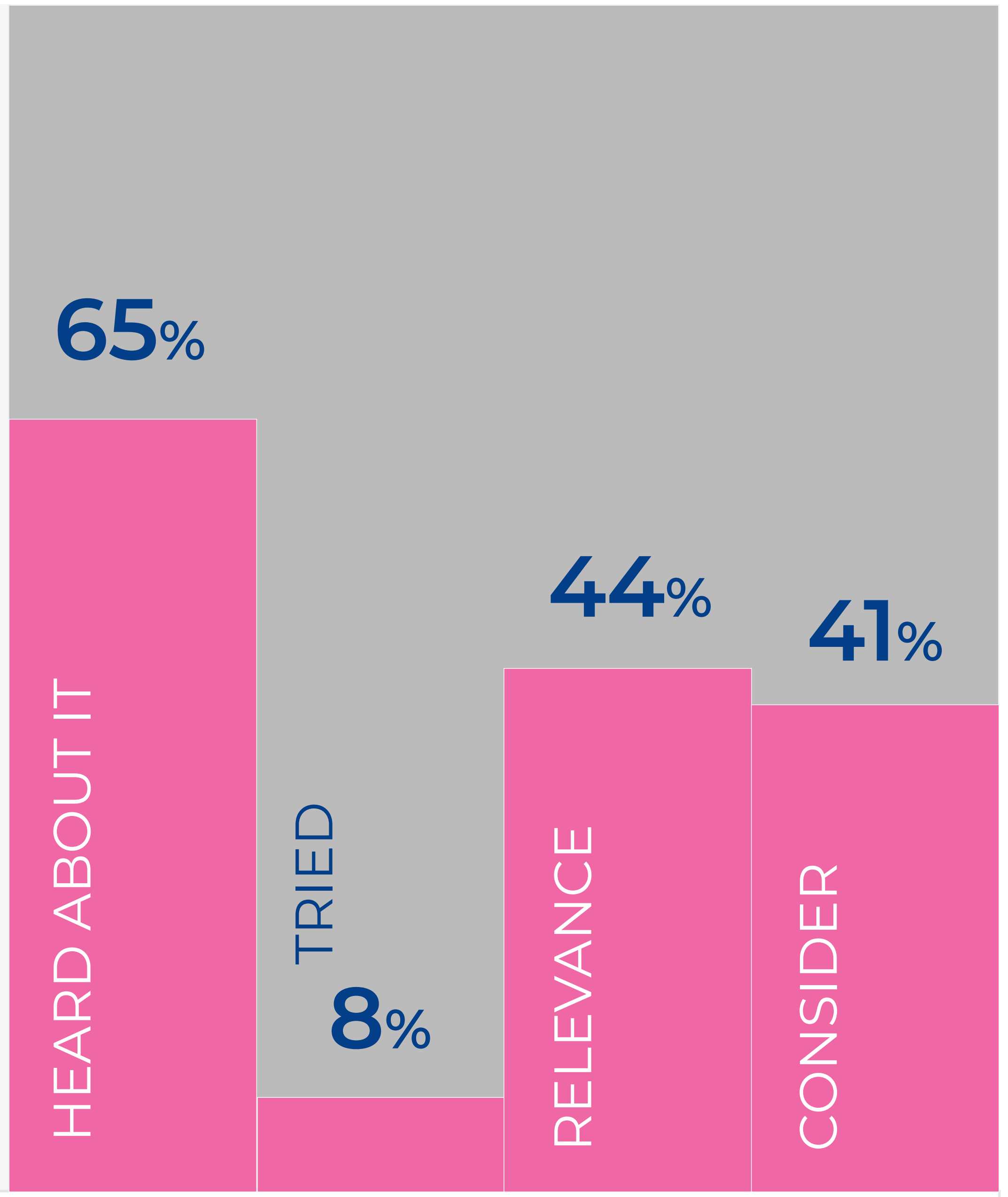
45%

in the US think eating insect protein is disgusting

CONSUMER CONCEPT TEST

Insect protein[2]

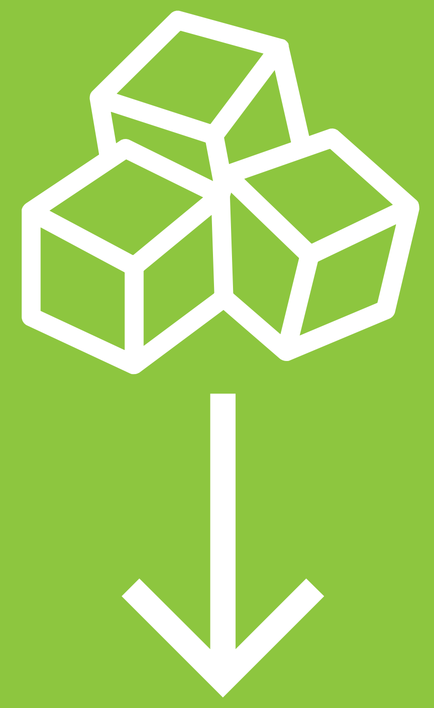
Consumers believe insect proteins are natural and good for the planet, but there are strong negative views too, with around three in ten consumers thinking the concept is disgusting – and the same amount saying they would be scared to try it. Again, there are regional differences, with greater awareness and interest in Asia, where insect consumption is more established. In China, notably, more than half (54%) of respondents say they are curious to try it. It is conspicuously absent in the top three choices of all our consumer types.



HEALTHY	37%	15%	UNHEALTHY
NUTRITIOUS	39%	16%	NOT NUTRITIOUS
DELICIOUS	25%	29%	DISGUSTING
GOOD FOR ANIMAL WELFARE	37%	17%	BAD FOR ANIMAL WELFARE
GOOD FOR THE PLANET	41%	15%	BAD FOR THE PLANET
USED BY MANY PEOPLE	23%	32%	USED BY FEW PEOPLE
AFFORDABLE	31%	19%	EXPENSIVE
I FEEL CURIOUS TO TRY	31%	30%	I FEEL SCARED TO TRY
NATURAL	42%	16%	ARTIFICIAL
BELIEVABLE	36%	20%	NOT BELIEVABLE
I TRUST IT	30%	25%	I DO NOT TRUST IT

1 https://www.feedandadditive.com/archive/Issue23_December2022/74/

2 Concept presented to respondents: "Proteins can come from alternative sources, for example insects. Through this method, food can be guaranteed for everyone in a more sustainable way: insect farming and processing produces significantly lower greenhouse gas emissions than traditional livestock, while ensuring high nutritional content." In the graph, we indicated the countries that are over-indexing via the respective flags.



Sugar consumption is the main worry for

53%

We're witnessing an evolution in food and nutrition. Twenty years ago, the mindset was around fat-free. Now we've moved to a sugar-free era. Consumers want healthier products with less or no sugar – but they still must taste good! Consumers don't want to compromise.

Peter Andersson,
CEO, Yelte

Sugar reduction

Beyond alternative proteins, there are significant advances being made in other areas of food and beverage production. One of these processes is using fermentation to reduce the sugar content in juices.

Consumer concerns around sugar come through strongly both in this year's survey, and in other Tetra Pak research. Indeed, sugar is now the main worry relating to consumption of food and beverage products, cited by more than half of respondents (53%) – even exceeding concern for fat/cholesterol (cited by 44%).[1]

Consequently, around four in ten (42%) consumers are trying to reduce their daily sugar intake, with 27% believing they are consuming more than recommended standards. This is perceived to be 9-10 teaspoons/day (significantly higher than the actual figure, which is 6-9 teaspoons/day). Quitting isn't easy, however, with over one-third (36%) citing likeability and impulse/cravings as the joint main reason for consumption.[2] Such concerns – along with government regulation, taxation and education initiatives to address conditions including obesity, type 2 diabetes and high blood pressure – are driving the reduced sugar market to grow at pace. It is expected to double in less than a decade, from $50 billion in 2021 to $100 billion in 2030.[3]

Manufacturers are increasingly investing in new sugar substitutes and exploring ways to reformulate sugar levels without changing the product profile. One approach co-developed by Tetra Pak uses fermentation to convert the sugars in juice to alcohol, much as in wine-making.

"All the sugar is removed during fermentation," says Maria Norlin, Processing Director, Business Stream Dairy, Tetra Pak. "Then the yeast is removed in the clarifier, which stops the fermentation process. We do this very gently to secure the product's quality and avoid sensory impact." Finally, the alcohol is removed using a dealcoholisation unit. The new technology can reduce sugar levels down to zero while maintaining the nutritional value of the juice, along with its pulp, aroma concentration and acidity. No additional ingredients or stabilisers are required.

It's important to note that there is a clear say/do gap around this topic. Beverages that are considered too high in sugar (carbonated soft drinks, sports and energy drinks, fruit juice drinks and nectars) are the most worrying to consumers, yet these continue to be highly popular. 100% pure fruit juice is perceived as having the most acceptable sugar level (cited by 44%) and is rated the least worrying beverage (less than plant-based drinks). The most impactful claims for beverages are "Low/no added sugar" and "No artificial sweeteners", followed by "Natural".

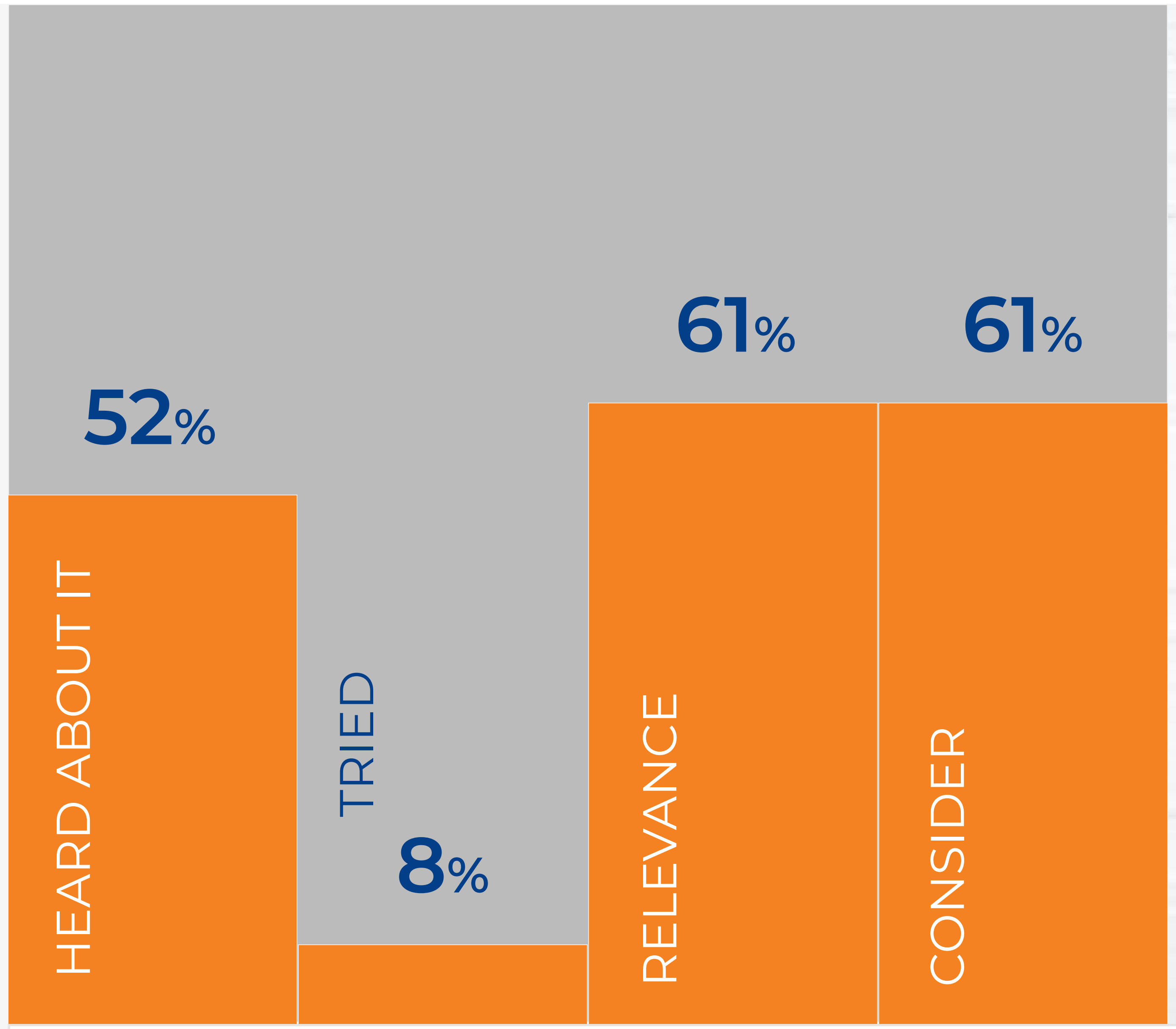
1 Sugar, sugar substitutes & de-sugared concept: Understanding consumers' perceptions, attitudes and behaviours, September 2022. Ipsos research for Tetra Pak.
2 Sugar, sugar substitutes & de-sugared concept: Understanding consumers' perceptions, attitudes and behaviours, September 2022. Ipsos research for Tetra Pak.
3 From $50.2 billion in 2021 to $99.79 billion in 2030, a CAGR of 8.9%. Grand View Research: Reduced Sugar Food and Beverages Market Size report, 2030, 2022

CONSUMER CONCEPT TEST

De-sugared juice[1]

De-sugared products are considered good for the body, being seen as healthy, nutritious and natural, making consumers curious to try them. However, they are seen as expensive by some. The concept is already well known and generates strong interest in India and China, perhaps because these are countries with a tradition of fermented food and beverage products. De-sugared juice is in the top three of preferred concepts for all types in our consumer segmentation, and is the #1 choice for Holistic health seekers, Responsible traditionalists and Health laggards.

We also tested the same concept in a separate study.[2] Nearly a third (31%) of consumers in this study said they would be very willing or willing to pay more for de-sugared juice. Two in five sugar-lapsed users would consider returning to such drinks, the key reason for lapsing being the perception of high sugar.



HEALTHY	48%	13%	UNHEALTHY
NUTRITIOUS	42%	14%	NOT NUTRITIOUS
DELICIOUS	33%	14%	DISGUSTING
GOOD FOR ANIMAL WELFARE	37%	11%	BAD FOR ANIMAL WELFARE
GOOD FOR THE PLANET	37%	13%	BAD FOR THE PLANET
USED BY MANY PEOPLE	28%	20%	USED BY FEW PEOPLE
AFFORDABLE	26%	24%	EXPENSIVE
I FEEL CURIOUS TO TRY	46%	15%	I FEEL SCARED TO TRY
NATURAL	39%	18%	ARTIFICIAL
BELIEVABLE	42%	13%	NOT BELIEVABLE
I TRUST IT	38%	15%	I DO NOT TRUST IT

1 Concept presented to respondents: "Through fermentation it is possible to remove or reduce the natural sugar content in juice coming from fruits. This creates a healthier juice while retaining its nutritional value and maintaining a similar taste profile." In the graph, we indicated the countries that are over-indexing via the respective flags.
2 Sugar, sugar substitutes & de-sugared concept: Understanding consumers' perceptions, attitudes and behaviours, September 2022. Ipsos research for Tetra Pak.

Food made with low-value side streams
One-third of food is lost or wasted,[1] and there is growing investment in technologies that aim to reduce this by creating food products by recovering and reusing currently wasted low-value side streams. This trend is on the rise, fuelled by growing global concern around food waste and the drive to develop a circular economy.

A great example is Brewers' Spent Grain (BSG), a side stream from the brewing industry. Every year, 40 million tonnes of BSG, rich in fibre and protein, ends as animal feed or in landfill due to its rapid spoilage and the lack of processing solutions and application know-how that can enable its effective usage in the food industry.

Tetra Pak has developed a highly efficient patented sterilisation process that allows BSG to be heat treated for longer preservation, allowing it to be used as an ingredient for further food applications such as plant-based milk or bread. The solution is now being used in a number of projects with customers worldwide to make use of BSG.

Another example is acid whey, which is a by-product of cheese production; over 22 billion litres are produced every year. It has a great deal of nutritional value, which is, at present, rarely utilised. That's because

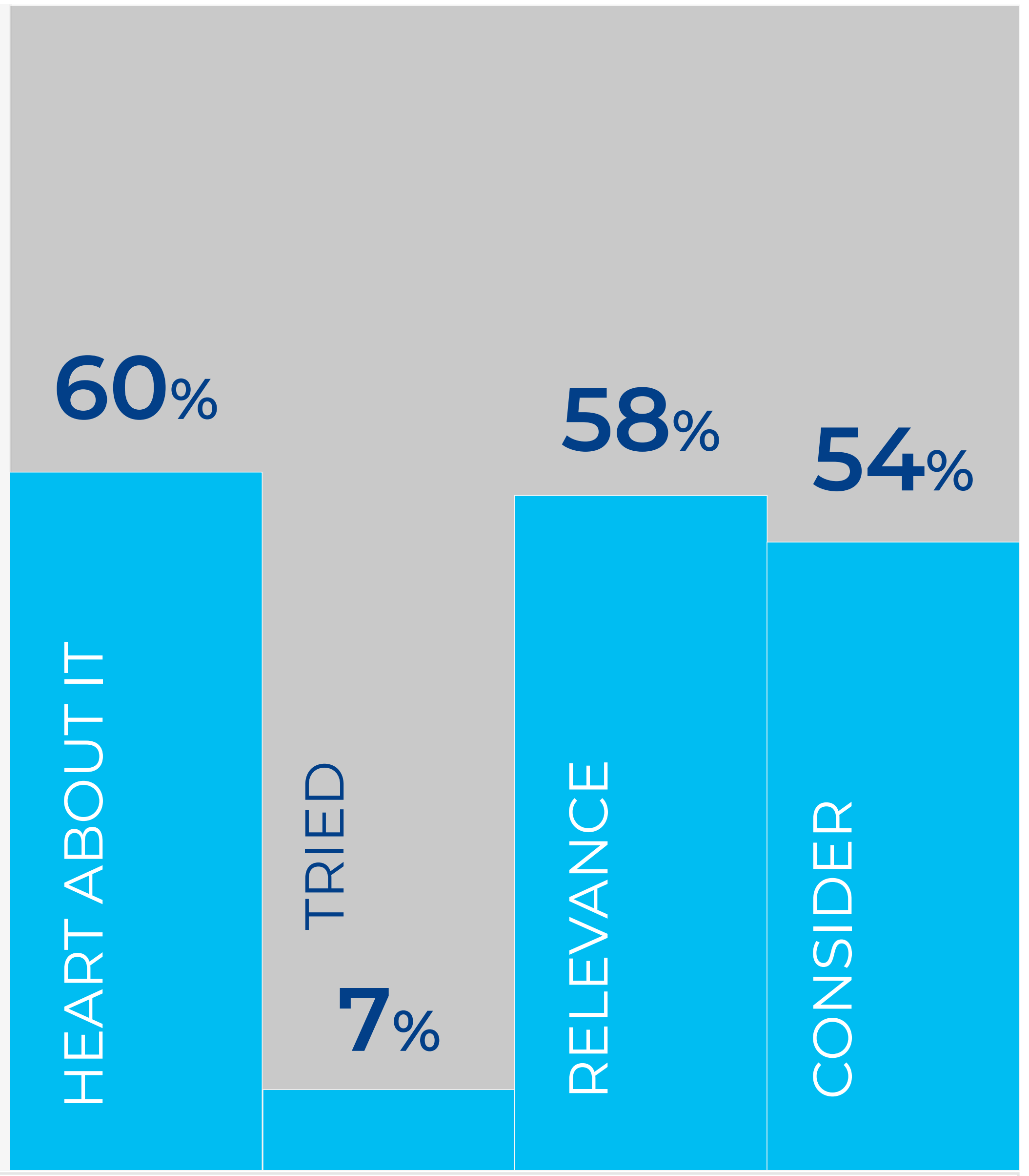
transforming acid whey into an ingredient or supplement requires large amounts of energy. Tetra Pak is now working with EnginZyme, which has developed a smart enzyme system that has the potential to address this. By using an enzyme rather than a catalyst, the conversion of acid whey can be done with significantly less energy input.

This type of repurposing low-value side streams, that would be wasted otherwise, is going to be more important going forward, as new processing techniques become more mainstream, says Tammy Meiron, Chief Technology Officer at Fresh Start. "If we are producing new products via fermentation and cell culture, for example, we're going to have a lot of streams coming out of those production lines. So we need to consider how to recycle, upcycle or reduce waste from those streams."

CONSUMER CONCEPT TEST

Food made with low-value side streams[2]

Of all concepts tested, this has the highest rating for good for the planet (on 52%), and it scores highly for animal welfare too (44%). Negative perceptions are low across the board, with "used by few people" the only one to exceed 20% (on 22%). This concept is particularly appealing in India, with 78% of respondents saying that they would consider trying such products.



HEALTHY	38%	13%	UNHEALTHY
NUTRITIOUS	35%	13%	NOT NUTRITIOUS
DELICIOUS	29%	15%	DISGUSTING
GOOD FOR ANIMAL WELFARE	44%	11%	BAD FOR ANIMAL WELFARE
GOOD FOR THE PLANET	52%	12%	BAD FOR THE PLANET
USED BY MANY PEOPLE	26%	22%	USED BY FEW PEOPLE
AFFORDABLE	34%	16%	EXPENSIVE
I FEEL CURIOUS TO TRY	39%	16%	I FEEL SCARED TO TRY
NATURAL	42%	15%	ARTIFICIAL
BELIEVABLE	39%	13%	NOT BELIEVABLE
I TRUST IT	34%	16%	I DO NOT TRUST IT

1 https://www.wfp.org/foodwaste
2 Concept presented to respondents: "By utilising and improving production processes, low-value side streams could be retained and used as raw materials for production of food or beverages (for example, using the peel of oranges to produce a natural oil concentrate). In this way food waste can be reduced, while feeding more people." In the graph, we indicated the countries that are over-indexing via the respective flags.

Top ten takeaways

1 Health is more important than ever...

70% of consumers say that health has become more important to them over the past few years. Two-thirds now pay more attention to what they eat and drink. 70% say they feel better as a result.

2 ... particularly mental health

Nearly three-quarters of consumers now think mental health is as important as physical health. More than four in five (83%) choose food and beverage products that support it.

3 Health and environment go hand in hand

70% say that healthy products shouldn't harm the environment. Half (50%) say that if a food or drink is not healthy for the individual, it is not sustainable for the planet.

4 Despite cost worries, consumers won't compromise on health

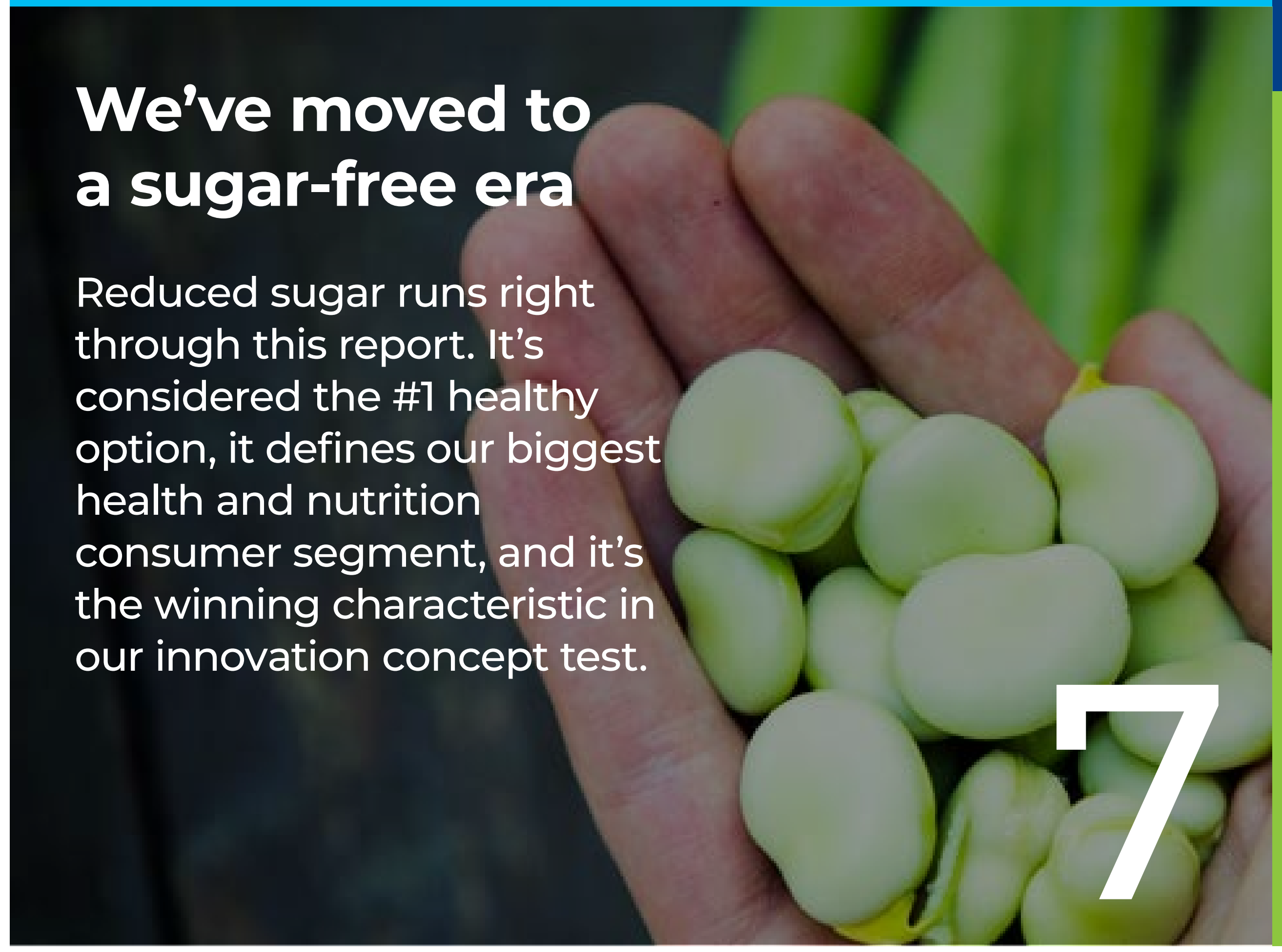
60% fear that rising prices will limit access to healthy food. But only 17% would sacrifice food and drink with health benefits to save money. 70% would even sacrifice convenience if it means getting healthier products.

5 Diet can change the world

More than half (54%) say that by changing their diet, they can contribute to a better world.

6 There are tensions around technology and innovation

Nearly two-thirds believe that tech will be increasingly important to health (65%), and that it will play a role in ensuring a more sustainable future (62%). But nearly half (48%) think there is too much innovation in food and worry that it's not good for them.



7 We've moved to a sugar-free era

Reduced sugar runs right through this report. It's considered the #1 healthy option, it defines our biggest health and nutrition consumer segment, and it's the winning characteristic in our innovation concept test.

8 Personalised nutrition is going to be revolutionary

A huge segmentation is going on. Brands are creating tailored recipes for ever narrower groups, based on factors such as age and medical conditions.

9 Food systems sustainability requires multidimensional thinking

Feeding a growing population is a complex challenge. We need to find ways to not only improve our current food production methods, but also invest in technology and infrastructure to harness the potential of new food sources. Both these areas are critical to future food security.

10 Change must be fuelled by taste

Whatever the health, nutrition or sustainability benefits of a product, consumers won't compromise on taste. Cost parity will also be key for new foods, which some forecasts suggest could be seen as soon as 2025.

Research and methodology

The findings in this Index are based on the following:
Annual global research on consumer attitudes: A bespoke survey for this year's Index conducted in partnership with Ipsos, comprising 5000 online interviews during October-November 2022 across the following 10 countries: Brazil, China, Germany, India, Kenya, South Africa, South Korea, Spain, UK and USA. This is the default research throughout this report; if no attribution is given to a reference, either directly in the text or in an endnote, this is the research being referred to.

We have also interviewed **Tetra Pak and third-party experts in the field of health and nutrition,** who provided comments on societal, industry and regulatory trends and helped complement the global consumer research on consumer attitudes.

Here is our panel:
Tetra Pak experts: Erik Börjesson, Centre of Excellence Manager, Prepared Food; Katie Carson, Corporate Affairs Director, Food & Climate Policy; Andrea Cena, Global Account Director; Hemang Dholakia, Centre of Excellence Manager, Plant-based; Jim Dicks, Global Account Director; Maria Norlin, Processing Director, Business Stream Dairy; Mark Rumbell, Processing Director, Business Stream Beverage; Niclas Torstensson, Global Account Processing Director; Micael Simonsson, Director, Processing Development

External experts: Peter Andersson, CEO, Yelte; Nils Österstöm, CEO Tebrito; Philip Loring, Director of Human Dimensions Science, The Nature Conservancy; Johan Jörgensen, Founder, Sweden Foodtech; Dr. Tammy Meiron, Chief Technology Officer, Fresh Start

Desk research: A thorough review of existing data and reports.

Trendipedia Consumer Trends 2023: Annual trends report, produced by Ipsos for Tetra Pak and published in January 2023. The data is derived from proprietary Ipsos sources, including Ipsos Global Trends (December 2022) and What Worries the World (January 2023), as well as numerous other sources based on secondary research.

Plant-based Ingredients Market Assessment: Future Bridge report for Tetra Pak, providing an overview of plant-based ingredients and published in October 2022. The report includes market insights, a competitive assessment, and web listening to capture main applications and opportunities for plant-based offerings. A multi-dimensional approach has been used in the different modules: Web-based and consumer social listening to see what trends are emerging online; Primary research, mainly by interviewing industry experts and Company executives; Secondary research through web-based searches, patents, and technical literature.

Sugar, Sugar Substitutes & De-sugared Concept: Understanding Consumers' Perceptions, Attitudes & Behaviours. Ipsos research for Tetra Pak, published in September 2022. Based on 7000 online interviews with consumers across seven markets: Brazil, Japan, France, Poland, Sweden, Turkey and USA. The sample was representative for age and region population in the respective countries. The target was sugary drink users, including both frequent and lapsed.