

Kerry Tastesense™

The right taste for healthier beverages



Executive Summary

Today's consumers want to live a life healthier for themselves, and the planet. Often, this begins by choosing healthier food and beverages with reduced sugar and healthier credentials, challenging manufacturers to respond to demands without sacrificing the tastes consumers have come to love. The COVID-19 pandemic has accelerated this shift in consumer behaviour, with evidence that co-morbidities such as obesity and diabetes can lead to more severe COVID-19 outcomes.

The beverages industry has taken major actions to answer to these growing consumer expectations as shown in the following pages:



Reducing the sugar content of beverages, with a 44% increase in low/reduced sugar products in beverages since 2015. (Mintel 2019)



Developing a number of new nutritional beverages that are expected to have a **steady growth of 2.9%** in value from 2019 to 2022. (Innova 2020)



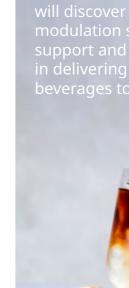
Expanding the range of dairy alternative beverages, offering drinks that are perceived as healthier by 71% of consumers and are better for the planet due to the avoidance of the outsize carbon emissions associated with animal products.



Creating low or no alcohol alternatives to alcoholic beverages without switching to soft drinks. Indeed, in the last 5 years, the world has discovered new beverages such as hard seltzers in the US and the low/no alcohol spirits increasingly available in Europe.

Nevertheless, product developers know that the creation of these delicious drinks does not come without taste challenges. This is why we reached out to our beverages application team to capture their recommendations on delivering healthier beverages without compromising taste.

What emerges from reading their tips and tricks is that there is no one-size-fits-all solution.
Rather, it is their holistic application of Kerry
Tastesense™ technologies that delivers delicious drinks with natural flavours to rebalance the sweetness of the product, mask undesirable offnotes, and bring back the syrupy, mouthcoating, creamy sensation expected by consumers using our mouthfeel solutions.



Contents

Executive Summary	1
The rise of	
healthy beverages	3
Delivering healthy	
beverages without	
compromising on taste	9
Kerry Taste solutions	
to develop flavoursome,	
healthy beverages	15
Conclusion	17



The rise of healthy beverages

Today's modern consumers are more informed than ever before. From the comfort of their own homes, they now have instant clickpad access to a myriad of information. As a result, increasing numbers of consumers are demanding tastier, healthier, more convenient and more sustainable beverages. The beverage industry has undergone a remarkable evolution in recent years to take initiative and respond to these accelerating public expectations.

Along with calling for beverage manufacturers to meet or exceed a range of stringent new standards, consumers are demanding that beverages retain the tastes they have come to love. The rising insistence on natural products with clean labels presents a rigorous challenge to producers given that the quest to

simultaneously fulfil the growing list of demands often quickly comes face-to-face with the biggest impediments to success: taste and mouthfeel issues. In short, those changes that improve the nutritional value of a product, such as reduced sugar, alternative proteins, or such added actives as vitamins, mineral, or fortifications, can end up delivering compromised taste and/or mouthfeel following formulation changes. This reality is further complicated by the fact that sustainability in manufacturing practices has become a key demand of a growing number of consumers (according to Innova (2020), up from 65% in 2018 to 87% in 2019).

The pages that follow detail the results of an investigation into the evolution of the beverage market. At the same time, Kerry's applications team offer recommendations about the best ways to formulate healthier beverages while retaining appealing taste and mouthfeel, and, ultimately, foster customer brand loyalty.

The sugar revolution

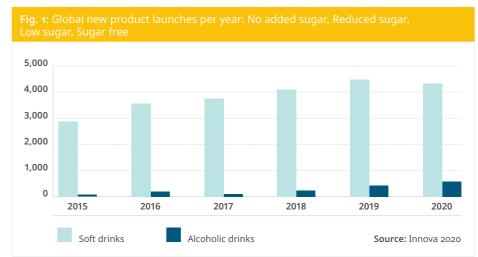
One of the most noticeable industry changes in developing healthier beverages has been the push to reduce sugar content.

Indeed, consumer's willingness and desire to curtail their sugar intake continues to heavily influence the industry as a whole, with sweetened-beverage taxation policies precipitating a hasty change in direction for manufacturers across the globe.

In the US, taxing soft drinks as a health strategy remains limited to a few cities and districts. However, in striking contrast, Mexican markets have been employing such tax disincentives since as early as 2014; now, the heat is rising even further in Mexico as it implements an updated labelling mandate (effective October 2020) that uses prominent black octagons to show excess sugar content. Likewise, Brazil has passed a law giving companies 24 months to implement labelling changes that point out high sugar levels with conspicuous magnifying glass graphics.

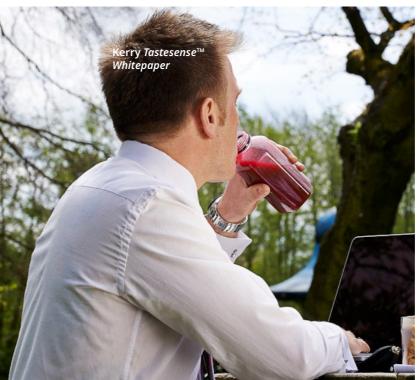
Moving forward, other LATAM countries are poised to implement similar policies. Overall, more than 35 countries worldwide have now implemented 'sugar taxes', with new initiatives, such as in Poland, entering the scene on a regular basis. Taxation specifics, however, show wide variations between countries in terms of both cost and content levels that trigger the tax. For example, while in some countries only beverages with 5g or more of sugar per 100ml are taxed, other jurisdictions have applied the duties to products with as little as 1g of sugar per 100ml. This puts even more pressure on the beverage industry, in particular the soft drink segment.

Below (Fig. 1) is a representation of the evolution of products featuring claims of 'no added sugar', 'reduced sugar', 'low sugar', and 'sugar free', according to WW (2020 year: January–November).











Many consumers claim they struggle to find nutritional beverages with an appealing taste.

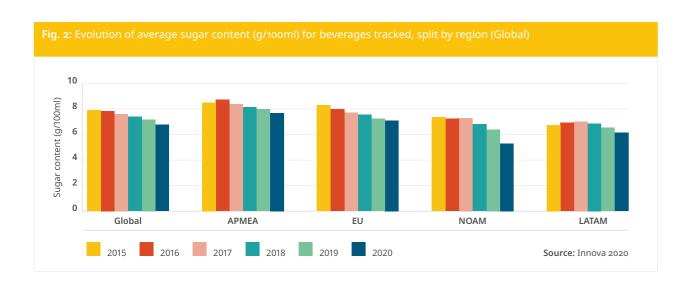
Similarly, as the next chart (Fig. 2) illustrates, average sugar content has been decreasing gradually across all regions over time for beverages as a collective category (Innova 2020).

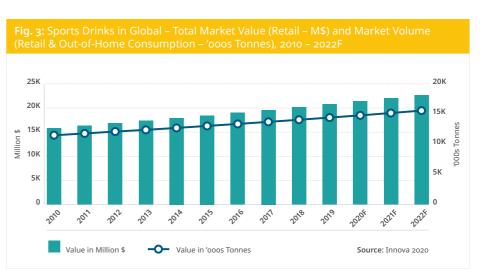
Low sugar content is one of the main beverage purchase drivers across all categories. Consumers the world over cite health concerns as the main motivator for decreasing their carbonated beverage consumption, with 30% cutting back; of note, 55% of this cohort cites their view of carbonates as "unhealthy" as their motivating reason (Innova 2020).

The nutritional beverage evolution

The nutritional beverage market has seen steady growth, as illustrated in the graph below (Fig. 3). Today, nutritional drinks are a key and growing preference for those making health-related lifestyle adjustments.

While these nutritional beverages are often rich in proteins or minerals that can improve physical performance and provide an energy boost, many consumers claim they struggle to find such products with an appealing taste. Moreover, with many novel protein sources now being utilised, taste challenges are emerging for producers struggling to maintain traditional (e.g., chocolate, vanilla, etc.) flavour appeal.







The right taste for healthier beverages | © Kerry

The right taste for healthier beverages | © Kerry

The boom in alternative dairy beverages

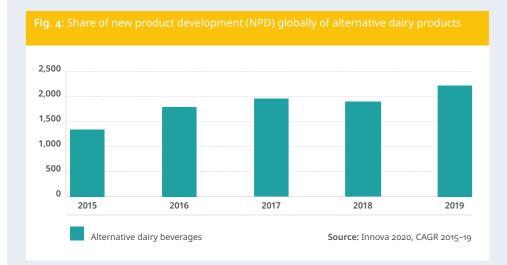
As consumers become more aware of the outsize carbon footprint attached to animal products, many have taken to moving away from dairy in an effort to reduce their own environmental impact.

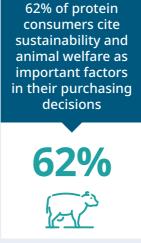


Additionally, plant protein beverages are perceived as healthier: 71% of consumers view plant protein as "healthy", compared to 42% who view animal-derived protein in the same way (Kerry Proprietary research—US n=1800, 2018). More than one-half of protein users now report "dairy-free" as their most important consideration when purchasing protein products (Kerry Proprietary research—US n=1800, 2018). This escalating trend has led plant-based claims in beverages to enjoy an impressive growth of 55%+ (Innova 2020, CAGR 2015–19).

The share of new product development (NPD) globally of alternative dairy products also grew steadily between 2015 and 2019, as shown in the chart below (Fig. 4).

Besides personal health, a remarkable 62% of protein consumers cite sustainability and animal welfare as important factors in their purchasing decisions. This is adding to the attractiveness of plant-based protein options, many of which have strong sustainability stories and can claim a lower carbon footprint than their animal-derived equivalents (Kerry proprietary research—US n=1800, 2018).





The new normal: moderation in alcohol consumption

While consumers are searching for lower-alcohol beverages, many are not ready to make the switch to soft drinks. Rather, what they desire is a similar sensory experience in term of taste, smell, and mouthfeel to alcoholbased equivalents.

Overwhelmingly, health is the main reason cited by consumers for decreasing their alcohol intake, with the trend leading global NPD of alcohol-free drinks to rise steeply between 2018 and 2019 by 32% and record a GAGR of 26% over the period 2015–19; this is versus 4% and 14%, respectively, for the overall alcoholic beverage category (Innova 2020).

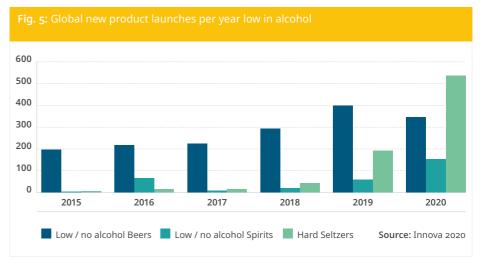
In the graph below (Fig. 5), market growth in low-/no-alcohol beverages is unmistakable (Innova, January–November 2020). Beer markets have led the way in the category, with several brands now firmly rooted. Recently, we have also seen a growing number of companies and new entrants targeting the low-/no-alcohol spirit market since the launch of Seedlip in the UK with the segment now expanding in Europe and the rest of the world. Hard seltzers,

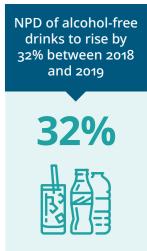
on the other hand, were introduced in the US in 2013, and are now beginning to spread worldwide (primarily in the UK and Australasia).

No-/low-alcohol content and bold flavours are key factors powering the growth exhibited in this chart. Furthermore, given their 'healthy halo' reputation, botanicals have enjoyed swift emergence for use in such beverages to improve taste, giving them a starring role in the pursuit of wellness. According to Innova, global consumers are choosing no-/low-alcohol beverages for a range of reasons: taste (24.8% of consumers), health (13.2%), and relaxation properties (18.2%).

However, all of these healthier beverages come with formulation challenges in the maintenance of customer-preferred flavour. In the next few pages, we investigate those challenges and provide ideas on how best to approach various hurdles.







Delivering healthy beverages without compromising on taste

Reducing the sugar level in refreshing beverages

Sweeteners and Challenges

There are several approved sweetener systems that can be used to support sugar reduction or removal (i.e., zero sugar/no added sugar products). The key sweeteners used globally are sucralose, aspartame, acesulfame K, stevia, and, to a smaller degree, sodium cyclamate. Manufacturers in the Unites States are also using erythritol. Each sweetener brings its own challenges, generally in the form of either off-notes or a negative perception amongst consumers.

Stevia, for example, which delivers sweetness from a natural source, is becoming more prevalent in the 'refreshing beverage' market. However, it must contend with off-notes and sweetness sensation issues not present in sugary beverages, such as the prevalence of bitter and liquorice off-notes and the delayed onset of sweetness perception versus sugar, along with unappealing mouthfeel. These main problems occur when stevia is used alone, i.e., without other sources of 'calorific' sweetener.



Several approved sweetener systems can be used to support sugar reduction.

Sugar reduction challenges

There are several key challenges that need to be considered when reducing sugar:

- Poor mouthfeel: the extent of this problem depends on the degree of sugar reduction
- Lack of sweetness sensation: upfront and general sweetness profile can be negatively affected
- Lack of flavour: sugar drives flavour delivery, with its removal therefore sometimes producing unsatisfactory results
- Increased perception of acidity: since sugar balances out acid perception, reducing its content can change the equilibrium of a final product

Application techniques to support sugar removal or reduction

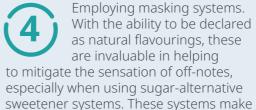
Using a combination of techniques, it is possible to employ certain application 'tricks' when reducing or removing sugar in order to support a holistic approach to taste. With the inclusion of sweeteners or functional materials, product perception can be greatly improved. Possible options include:

Using natural flavour systems to change the perception of a product through cleaner labels. These systems can modulate sugar to deliver a sensation of higher sweetness while delivering improved mouthfeel. Using these systems, a product with up to 30% (3°Brix) reduction in sugar can be achieved. A sugar reduction of up to 50% (5°Brix) can be achieved when combined with sweeteners. Final outcomes depend, of course, on the specific product type and the starting sugar content

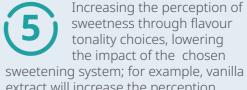


Reducing acidity to balance out and improve perceived sweetness when implementing a sugar-reduction programme

Partial replacement of citric acid in a formulation with malic or lactic acid. Citric acid has an intense but short-lived acid perception, whereas both lactic and malic acid deliver a longer, lingering acid perception that can overlay unwanted off-notes derived from sweeteners or other functional ingredients



especially when using sugar-alternative sweetener systems. These systems make use of flavour technologies that create a very targeted and complex sensory signal, triggering a lower perception of off-notes.



extract will increase the perception of sweetness. Additionally, vanilla also imparts some masking properties; lime is another such example

The goal, as always, is to deliver greattasting, innovative products that drive customer preference, extend brand loyalty, and foster repeat purchasing.

"Tastesense™ Sweet and Mouthfeel modulators combine to tackle the multiple challenges faced in delivering a sugar-reduced beverage equal in quality to the fullsugar version."

LESLIE CHANRD&A SCIENTIST BEVERAGE NA

"Products developed with Tastesense™
Sweet should be left standing for
24 hours as the beverage will
become more balanced, meaning
that while having the same brix
level, the sweetness sensation will
be higher."

KELVIN ABRAHAM NPD MANAGER, BEVERAGES, SUB SAHARAN AFRICA



Developing tasty nutritional beverages

Nutritional beverage challenges

This beverage category comes with a range of taste challenges that are mostly dependent on the various ingredients within the formulation, the most common being protein used for enrichment purposes. Depending of their source materials, extraction processes, and degree of hydrolysis, these ingredients can present distinct bitterness, astringency, chalkiness, and metallic aftertastes, to name a few. Dairy proteins considered superior due to their amino acid profiles—predominate in this market, being the most accepted in terms of both taste and texture. However, with manufacturers increasingly seeking to offer dairy-free options, more plant-based alternatives are being launched with even more pronounced challenges that must be surmounted.

For instance, depending on the plant origin, issues can include strong green, beany, oily, and/ or vegetal off-notes. Furthermore, pronounced texture impacts—e.g., powderiness and grittiness—can be present and affect flavour release or harm taste perception. For nutritional reasons, a few more complete clinical and nutritional beverages are now utilising different sources of fat—ingredients with the potential to present animalic, marine, and rancid notes depending on the origin and concentration. The list of possible complications doesn't end here: adding vitamins, minerals, and other substances such as caffeine can also accentuate bitter, metallic, and chalky sensations, and the high-intensity sweeteners often used in nutritional beverages to reduce the calories derived from sugar have a range of taste consequences—e.g., metallic, astringent, and with strong lingering aftertastes—that can have a marked impact on a product's final taste profile.

Application techniques to address the above challenges:

Taste optimisation of such challenging products must be completed in steps:

First, precise ingredient selection is critical to reducing undesirable taste and texture characteristics in base recipes. For example, depending on the format, the process, and desired parameter of the beverages, different sources of protein will be required. In addition, stabilisers must be chosen carefully in order to address the occurrence of any powdery sensations and particle suspension (when required). These texture systems can further assist in bringing more 'roundness' in terms of mouthfeel, thereby improving flavour delivery. Finally, high-intensity sweeteners can be rebalanced with the use of modulation flavours so as to reduce any lingering or metallic aftertastes

After finalising the base formulation, the remaining off-notes and undesirable tastes must be removed to foster the most neutral taste achievable. To do this, carefully researched masking flavours can be of great help. These are created as a result of a strict selection of active molecules that target the beverage components responsible for the identified taste challenge and, once applied, easily reduce metallic notes and astringency. Sweetness modulators can also help in attaining taste neutrality courtesy of their ability to rebalance bitterness and enhance the 'roundness' of the flavour profile. Finally, in the case of plant-based beverages, vegan dairy flavours and their characteristic components can be useful in masking vegetal notes. The association of all of these technologies can help in formulating an optimally neutral nutritional beverage

The final step in beverage formulation is to select the most appropriate characterising flavour(s). Indeed, choosing tonalities that correspond to the profile of the neutral base will finish harmonising the final result. Tropical fruits are an excellent example as they can be highly useful in addressing any sulfuric notes in a base, while red fruit profiles may be better on astringent bases. Brown notes such as coffee could complement a slightly bitter beverage

Overcoming the taste challenges of dairy alternatives

Challenges and formulation of dairy alternatives

Alternative dairy beverages represent a growing market that is not without its own thorny taste challenges. Similar to nutritional beverages, the main issues spring from the selected plant source; while cereals tend to deliver 'cardboardy', rancid, and toasted notes, legumes will more often be characterised by their green, beany, and metallic flavours. Since they have a direct impact on the peptides, the extraction method and processes are crucial in optimising the taste profile and ameliorating perceived bitterness. Secondly, similar to nutritional beverage products, flavour selection and synergy can aid in addressing remaining off-notes, while flavour modulators and dairy inclusion are pivotal to the neutralisation of any vegetal off-tastes in the base. Ultimately, the final profile of a beverage will depend on the chosen scheme; for example, to reinforce an oat taste, some biscuit or cereal flavours could be selected, either alone or in association with fruit or brown notes.



Extraction method and processes are crucial in optimising the taste profile.

"Tastesense™ Masking directly attacks the bitterness and off-notes that occur when formulating a dairyalternative solution."

LESLIE CHAN RD&A SCIENTIST BEVERAGE NA



Developing pleasing low-alcohol hard seltzers

Hard seltzer formulation challenges

Starting from launch in 2013 to reach \$2 billion in annual sales, hard seltzers are highly popular and their growth does not appear to be slackening.

Hard seltzers are alcohol-infused waters of between 4% and 5% ABV. They contain little (<5g per litre) to no sugar or sweeteners. All hard seltzers have one marketing strategy in common: every product-no matter the ABV, single pack size (can or bottle), or sugar content-clearly states a calorie <99 kCal/serving on the label.

With a low sugar level and extremely low pH (typically 3.0–3.4), these products are highly acidic. This negative trait is exacerbated by the 'spirit burn' that accompanies such acidity. Additionally, hard seltzers, being heavily charged with water, have little to no body.

From launch in 2013 hard seltzers have reached \$2 billion in annual sales

\$2 billion



Application techniques to address the challenges in this emerging category:

First and foremost, there is a need to enhance and rebalance the taste and sweetness of the product using a natural flavouring system

Taste solutions are critical in hard seltzers to attain a better balance of the liquid such that it works with both the acidity and the alcohol. The boosted sweetness perception lifts the flavour and carries it across the palate as a fuller flavour tonality. Hard seltzers that are not formulated to address these challenges typically present as hollow, flat, and incomplete

For hard seltzers, sugar reduction and mouthfeel solutions will often be complementary, providing additional mouth coating/texture upon ingestion. These technologies are generally used at between 0.1% and 0.4%, with a dosage of 0.1% enough to give perceived mouthfeel of about 30g of sugar equivalence. In combination with sugar reduction solutions, a fruit flavour can be lifted such that it will be perceived favourably on the tongue. Use of the optimum combination of modulators results in a finished beverage that is far less hollow or flat



Reducing alcohol in beers

The pitfalls of low-alcohol beers

One of the most formidable challenges in the production of low-/no-alcohol beverages is the lack of the syrupy, mouthcoating sensation that alcohol delivers. Innovation has become crucial as consumers, not ready to turn to products that more closely resemble soft drinks, continue to seek better equivalent-to-alcohol beverages. In this longer-term view around market needs, enterprising solutions are required to meet and exceed challenges. Also emerging in the retail landscape is an increase in flavoured beers and ciders with organic certification.

Application techniques to address mouthfeel challenge in no-/low-alcohol beers:

Solutions to modulate the sweetness sensation are used extensively across the brewing industry, sometimes at remarkably low levels. They are also employed to enhance mouthfeel and reduce astringency in zero-alcohol beers. The dosage in such applications tends to be between 0.01% and 0.02%, modifying the sweetness sensation to enhance the overall flavour

Mouthfeel solutions are likewise used to improve the body of zero-alcohol base liquids. A combination of sugar reduction and mouthfeel taste solutions yield the best results



Flavour-masking technologies are sometimes needed to hide off-notes due either to poorquality alcohol or malt bases, and, when used in conjunction with mouthfeel solutions, deliver excellent results

In the organic beer market, "organically suitable" sweetness modulation systems are worth investigating. When added to a beer or cider recipe matrix, these can provide both improved flavour tonality and a boost in perceived sweetness

"Tastesense™ is a natural flavour solution that modifies the sweetness and flavour profile, providing for great taste in sugar-reduced beverages, enabling consumers to enjoy the pleasing taste and mouthfeel delivered by sugar, yet without the negative labelling impact.

- Tastesense™ restores sweetness and mouthfeel sensations in alcohol applications and can be fortuitously identified as "Natural Flavours".
- 2 Tastesense™ enables sugar reduction and aligns with the "better for you" and calorie-reduction product claims.
- Tastesense[™] is a natural solution that utilises proprietary taste modulation technologies to address the flavour, aroma, and aftertaste challenges of alcoholic beverages "

CHIKA EZEANI BREWMASTER NA

Kerry Taste solutions to develop flavoursome, healthy beverages

At Kerry, our application teams are highly qualified to help deliver tasty and healthier beverages, responding optimistically to the possibilities new consumer demands create.

We can be counted on to provide highperforming flavour solutions specially designed to tackle the challenges that come from adapting formulations to address consumer's health goals, and adding market-leading value at every turn. Working together with our customers, we create opportunity to outpace the market, shaping initiative into excellence.

Indeed, Kerry's abundant expertise in selecting natural ingredients based on functionality, e.g., sweetness, mouthfeel, and masking, combined with our innovative scientific approach which links sensory inputs with research into volatile and non-volatile taste components, underpinned by a proven ability to scale up natural processes, allows us to deliver great natural taste solutions with cleaner labels.

We are a transformative partner in creating great taste for better nutrition.

20
29
21
45

LATAM



"With consumers increasingly wary of their sugar intake, Kerry's Tastesense™ portfolio is an excellent aid in sugar reduction, delivering on sweetness, masking, and mouthfeel challenges in ways that enhance the overall taste experience. Tastesense™ solutions increase sweetness sensation, add mouthfeel, and mask off-notes from high-intensity sweeteners, protein aftertastes, and generally optimising overall product attributes."

RENATA IBARRA SR. RDA DIRECTOR, BEVERAGE NA

Kerry's portfolio also incorporates a variety of extracts and flavours, as well as nutritional and functional products, that ensure the very best beverages for your customers.

	Tastesense™ Sweet	Tastesense™ Masking	Tastesense™ Mouthfeel
DESCRIPTION	A range of taste solutions that improve the taste of reduced- or low-sugar products. This technology could also provide other benefits in beverages (long lasting, better mouthfeel, increased juiciness, etc)	A range of taste solutions that foster consumer acceptance when fortification, sweeteners, or plantbased ingredients have been added	A range of taste solutions that improve the mouthfeel of low- fat, low-sugar, low- alcohol, or plant- based products
RANGE	 A traditional selection of liquid and powder solutions allowing for a sugar reduction of up to 30% (3°Brix) while maintaining a natural flavouring declaration A range allowing for sugar reduction up to 50% (5°Brix) when combined with stevia with the following declaration: Natural Flavouring, Steviol glycosides; (E960) A range free from stevia derived materials. These are suitable for use when there is a preference for non-stevia-derived modulators A new portfolio of 'Natural X flavouring' options that deliver sweetness and a well-characterised tonality profile especially designed for the upcoming European organic regulation. 	 Taste solutions that mask the undesirable off-notes of sweeteners such as stevia, sucralose, acesulfame K, etc. Taste solutions that mask the notes linked to the use of plant proteins such as pea, soy, whey, etc. 	 Body and syrupy mouthfeel solutions for sugar reduction Body and syrupy mouthfeel solutions for low-/no-alcohol beverages Body, mouthcoating, mouthfeel solutions for plant protein Fatty, creamy mouthfeel solutions for reduced-fat products
FORMAT	Liquid and powder	Liquid and powder	Liquid and powder

The right taste for healthier beverages | © Kerry

About Kerry Taste & Nutrition

Kerry, the Taste & Nutrition company, offers solutions that nourish lives all over the world. From humble beginnings as an Irish dairy co-operative, Kerry has grown into a large international food industry leader, with offices in 32 countries, 151 manufacturing facilities and more than 26,000 employees globally, including over 1,000 food scientists. We bring to the table our strong food heritage, coupled with over 40 years of experience, global insights, and market knowledge, culinary, and applications expertise, as well as a range of unique solutions that anticipate and address our customer's needs.

For more information visit Kerry.com

151 manufacturing facilities

26,000+ employees

1,000+ food scientists

KERRY

